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# Default Risk under Different Colours of Noise

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## Abstract

In this study we theoretically simulate default risk scenarios under various economic noises. We find that firms default more quickly with stronger economic shocks but simultaneously expose higher default probabilities during their deterioration, offering traders better visibility. When the macroeconomic environment exhibits positive autocorrelation, the volatility of assets' value increases with corporate creditworthiness, and vice versa. While positive autocorrelation forces liquidation more swiftly even for firms with higher risk tolerance, counter-cyclical economic movements reduce default risk for firms with greater sustainability. When a series of economic noises exhibits higher autocorrelation, although average default probabilities decline, firms tend to default more rapidly, making it tougher for traders to predict corporate failure.

**Keywords:** Colours of noise, Autocorrelation, Time series, Default risk, Merton Model

## 1. Introduction

It is debated by researchers whether a positively autocorrelated time-series of macroeconomic shocks damages corporate default risk more or less than a random sequence of economic noises. On the one hand, positive autocorrelation increases the probability of a series of contracting market conditions, implying increasing default risk. On the other hand, for any limited time period, the likelihood of at least one extreme harmful event is reduced compared with a chain of completely random noises, suggesting decreasing default risk. One should expect that positive autocorrelation increases default risk, since a firm may survive a single bad economic event but not a series of subsequent downturn conditions. However, positive time-series autocorrelation prevents a single major economic catastrophe and therefore decreases default odds. Furthermore, it is not entirely obvious how a negatively autocorrelated string of macroeconomic noises affects the creditworthiness of a firm, whether it contributes to or rather injures corporate survivability. A negative autocorrelation tends to compensate a destructive economic shock with a later constructive noise, thus reducing default risk. In contrast, it also minimizes the chances for successive favorable conditions and thus enhances default likelihoods. Moreover, it is still ambiguous whether a short memory autocorrelated time-series of economic noises hurts default likelihoods more or less than a longer memory process. These are the underlying riddles guiding our current study.

The financial literature has devoted considerable effort to exploring various issues concerning noise trading. Black (1986) describes noise as a phenomenon contrasted with information, but further explains that investors sometimes trade on noise, rather than fundamentals, as if it were information. Trueman (1988) provides a theory explaining why investors would rationally choose to engage in noise trading. De Long, Shleifer, Summers, and Waldman (1989, 1990, and 1991) investigate how stock prices respond to irrational noise trading, what the risks, expected gains and losses are from noise trading, and how noise traders can optimize their portfolio allocation and thus dominate the market. Palomino (1996) demonstrates how in imperfectly competitive markets with risk-averse investors, noise traders can expect higher incomes than rational investors. Bhushan, Brown, and Mello (1997) examine different noise-trading models and their consequential assets' prices. Dow and Gorton (1997) present a model for noise trading with delegated portfolio management, where managers cannot always identify profitable trading opportunities. Kelly (1997) discusses whether noise traders influence stock prices. Brown (1999) shows that unusual levels of sentiment among noise traders are correlated with excessive volatility of closed-end investment funds. Greene and Smart (1999) investigate whether noise traders provide further liquidity to the capital markets. Gemmill and Thomas (2002) show that noise-trader sentiment often leads to fluctuations in the discounted prices of

closed-end funds, and Huguen and McDonald (2005) examine who the noise traders are and find no evidence for a systematic mispricing by these investors.

However, prior studies have given secondary attention to the types of noise affecting traders and in particular the colours of noise that could impact not only fixed-income investors but also shareholders. In this article we examine various colours of time-series economic noise and their long-lasting influence on default risk through theoretical computer simulations. Identifying the long-term implications of different colours of noise on corporate default risk can assist noise traders, momentum traders, and contrarians to achieve better performance in debt and equity related investments. These traders must assess and act upon the unique circumstances underlying the volatility of the market. Arnott (2005) quotes Benjamin Graham as saying that “in the short run the market is a voting machine, but in the long run it is a weighing machine.”(Note 1) A single economic noise often has a negligible effect on the long-term default risk of a firm, yet a time-series of autocorrelated noises could substantially affect this matter.

We examine five different colours of noise: (1) a white noise, which represents a random macroeconomic shock, (2) a red noise, which denotes a positive autocorrelation in a sequence of shocks, (3) a pink noise, which depicts a combination of whitened and reddened noises, (4) a blue noise, which illustrates a negative autocorrelation in a string of economic shocks, and (5) a black noise, which classifies a longer term dependency and thus an extended but reduced shock over a wider time frame than the red noise, for instance. Noise traders often follow white noises, different levels of momentum traders are associated with the pink noise, the red noise, and the black noise spectra, and contrarians believe in the blue noise type of investment strategy.

We are motivated to investigate this topic to assist noise traders, momentum players, and contrarians to recognize the long-term impact of various macroeconomic shocks on default likelihoods. This link conveys further implications on yield spreads of outstanding debt issuances, as well as on expected equity returns. In essence, we explore how corporate creditworthiness fluctuates over time through different types of simulated macroeconomic shocks and whether a single random shock damages a firm’s survivability more or less than a series of reduced noises. Furthermore, the Monte Carlo simulations hereafter allow us to conduct different intra-colour as well as cross-colour comparisons.

Our main findings confirm that in the presence of strong macroeconomic shocks, as opposed to a more stable economy, firms tend to default more quickly, but at the same time these firms also reveal higher default probabilities on the way to liquidation. Paradoxically, traders enjoy better predictive capabilities under these extreme conditions. In addition, we find that when a macroeconomic environment exhibits positive (negative) time-series autocorrelation, the expected variance of assets’ value increases (decreases) with corporate creditworthiness. We further realize that while positive autocorrelation intensifies already existing trends and therefore forces liquidation more quickly even for firms with greater risk tolerance, counter-cyclical economic movements tend to reduce default risk for firms with higher sustainability. We also detect that when a series of economic noises exhibits a higher autocorrelation although average default probabilities decline, firms tend to default more quickly, thus making it more difficult for traders to predict corporate failure. Moreover, a longer memory series with reduced autocorrelation increases default likelihoods but simultaneously allows firms to survive over a longer period of time, as opposed to a shorter memory series having higher autocorrelation.

In the following sections we first present a brief theoretical background on the Merton (1974) model for assessing corporate default risk. We then describe five time-series colours of noise – the white, the red, the pink, the blue, and the black noises – along with their potential impact on default risk. Next, we construct five different computer simulations to measure the long-term influence of each colour of noise on corporate survival. Finally, we discuss the findings and their economic significance.

## 2. The Merton Model

Merton (1974) presents a model in which a firm’s equity can be considered as a European call option on the firm’s assets. The model can be simplified by assuming that the firm has one zero-coupon bond outstanding, which matures at time  $T$ . Because the model considers only one debt time to maturity, academicians and practitioners often employ the Macaulay duration to combine various debt components into a single maturity. The Merton model defines the following variables:  $V_0$  as the market value of the firm’s assets today,  $V_T$  as the stochastic market value of the firm’s assets at time  $T$ ,  $E_0$  as the value of the firm’s equity today,  $E_T$  as the value of the firm’s equity at time  $T$ ,  $D$  as the deterministic total amount of debt due to be repaid at time  $T$ ,  $\sigma_V$  as the volatility of assets’ return,  $\sigma_E$  as the volatility of the firm’s equity, and  $r_f$  as the risk-free interest rate.

If  $V_T < D$ , the firm cannot service its debt and defaults at time  $T$ , and then the value of the equity becomes zero. However, if  $V_T > D$ , the firm pays back its outstanding debt at time  $T$ , and its equity value becomes  $V_T - D$ . Thus, the value of the firm’s equity at time  $T$  can be written as

$$E_T = \text{Max}\{V_T - D, 0\} \quad (1)$$

The firm's equity is therefore a European call option on the market value of assets, with the total amount of debt due to be repaid at time  $T$  as the exercise price. The Black-Scholes (1973) model solves the value of the firm's equity today as follows:

$$E_0 = V_0 \Phi(d_1) - De^{-r_f T} \Phi(d_2) \quad (2)$$

where

$$d_1 = \frac{\ln(V_0/D) + (r_f + \sigma_V^2/2)T}{\sigma_V \sqrt{T}}; d_2 = \frac{\ln(V_0/D) + (r_f - \sigma_V^2/2)T}{\sigma_V \sqrt{T}} = d_1 - \sigma_V \sqrt{T}$$

The Black-Scholes options model considers  $\Phi(d_2)$  as the probability for an option to be exercised, where  $\Phi(\cdot)$  is the cumulative distribution function (CDF) of the Normal distribution. In the Merton (1974) model context,  $\Phi(d_2)$  is the risk-neutral probability that the firm does not default, so  $1 - \Phi(d_2) = \Phi(-d_2)$  is the likelihood that the firm defaults on the debt. An increase in  $\sigma_V$  causes a decrease in  $d_2$ . As  $(-d_2)$  increases, the risk-neutral probability for the firm to default on the debt  $\Phi(-d_2)$  increases as well. We later examine these relations with respect to the volatility of assets' return as derived by different time-series colours of noise.

In the standard Merton model  $V_t$  and  $\sigma_V$  are not directly observable but can be postulated. Jones, Mason, and Rosenfeld (1984) find the probability for a public company to default on the debt  $\Phi(-d_2)$  by solving two equations with two unknowns. The first equation is the interpretation of the Black-Scholes formula for the value of a firm's equity as in equation (2), and the second necessary equation compares the diffusion coefficients from the equity value dynamic and the one from the Itô's lemma for equity movements:

$$\sigma_E E_t = \frac{\partial E_t}{\partial V_t} \sigma_V V_t = \Phi(d_1) \sigma_V V_t. \quad (3)$$

Hull, Nelken, and White (2004) present a different approach to estimate the volatility of assets' return  $\sigma_V$  by using the implied volatility from existing options on the firm's traded stocks. In practice, however, Moody's avoids solving these simultaneous equations, since the model linking equity and asset volatility holds only instantaneously. Crosbie and Bohn (2003), and Bharath and Shumway (2004) discuss an alternative and preferable method to calculate  $V_t$  and  $\sigma_V$  through sequential iterations.

Numerous studies including Ronn and Verma (1986), Kealhofer (2003), and Vassalou and Xing (2004) have adopted the Merton model to assess corporate default risk. We therefore utilize here the Merton model to measure default risk.

### 3. The Colours of Noise

A stochastic process such as the one describing the market value of corporate assets can be affected by different "colours" of noise, analogous to the colours of a light spectrum. For instance, white noise, like the white light, consists of an even mixture of variation over all frequencies with no memory of past events. This is an entirely stationary dynamic. One can simulate a white noise by adding a normally distributed random variable to the mean value of the parameter in question for each time step, hence to command a zero autocorrelation within the time-series dimension. In the traditional Merton model only changes in market value of assets are subject to stochastic influence; therefore, we examine the behavior of the following AR(1) time-series vibrations:

$$\Delta V_t = \alpha \Delta V_{t-1} + \beta \varepsilon_{t-1} \quad (4)$$

where

$$\alpha = 0 \quad \text{and} \quad \varepsilon_t \sim N(0,1)$$

$$\text{so} \quad \Delta V_t = \beta \varepsilon_{t-1}$$

where  $\beta$  denotes a constant parameter scaling the variance of time series,  $\varepsilon$  is a random effect drawn from the standard Normal distribution, and  $\alpha$  is a constant autocorrelation parameter, but in this case it takes no role in the process.

Similar to the red light, a red noise portrays a mixture with a higher proportion of low-frequency thus long-term ingredients. A red noise often describes a dependency on the most recent events. Because of its relations to the Brownian motion, the red noise is also called a brown noise. To simulate a red noise one can compute the parameter in question at every time interval as a combination of the lagged corresponding value and a random variable with

zero mean. To assure that the most recent history continues to dominate this time-series of noises, one must select a positive though smaller-than-one constant autocorrelation parameter. In this context, a rising  $\alpha$  denotes a stronger dependency on the most recent events, for example right after a clear bubble burst. This setting triggers the following momentum effect on fluctuations in the market value of assets:

$$\Delta V_t = \alpha \Delta V_{t-1} + \beta \varepsilon_{t-1} \quad (5)$$

where

$$1 > \alpha > 0 \text{ and } \varepsilon_t \sim N(0,1)$$

Between these two extremes, the white and the red noises, lies a whole family of pink noises, which depict more or less reddened frequency spectra. The pink noise generally represents common influences of both historical events and stationary tendencies. It is therefore considered to be a quasi-stationary process, as its variance grows slowly, at a pace proportional to time. One can simulate this class of noises through a wavering autocorrelation parameter within the time-series regression, which can preferably allocate higher weight to the white or the red noises, as follows:

$$\Delta V_t = \alpha_{t-1} \Delta V_{t-1} + \beta \varepsilon_{t-1} \quad (6)$$

where

$$1 \geq \alpha_t \geq 0 \text{ and } \varepsilon_t \sim N(0,1)$$

and we assign an arbitrary function

$$\alpha_t = \left| \sin \left( \frac{\pi}{1 + \text{mod}(t/36)} \right) \right|$$

The autocorrelation parameter  $\alpha_t \in [0,1]$  is no longer fixed, but it varies with time within its quasi-stationary domain. For that purpose we appoint the absolute value of the trigonometric function sine with respect to the ratio between  $\pi$  and one plus the remainder (using the modulo function) of a fraction of the time. Consequently, the autocorrelation cycles repeat themselves once every 36 months. This way, we generate repeated downward sloping convex waves for the autocorrelation function with a greater emphasis on the spectrum of colours from white to light red.

A blue noise often expresses a process with similar properties to that of the red noise, yet with a negative rather than a positive constant autocorrelation parameter. In reality, negatively autocorrelated noise has great importance, when describing for example the mean reversion phenomenon, the investment strategy of contrarians, or common cyclical economic movements. In the Merton model context we conduct the following experiment:

$$\Delta V_t = \alpha \Delta V_{t-1} + \beta \varepsilon_{t-1} \quad (7)$$

where

$$-1 < \alpha < 0 \text{ and } \varepsilon_t \sim N(0,1)$$

A black noise portrays a more persistent dynamic with heavy dependency upon its distant past. Because of that, Bak and Chen (1991) explain that a black noise process could govern various economic catastrophes, and due to its black spectra, if such a major disaster occurs, it could stretch and cluster over a long period of time. We thus utilize the next time-series regression with reliance on three prior changes and thus four preceding assets' values:

$$\Delta V_t = \alpha_1 \Delta V_{t-1} + \alpha_2 \Delta V_{t-2} + \alpha_3 \Delta V_{t-3} + \beta \varepsilon_{t-1} \quad (8)$$

where

$$1 > \alpha_i > 0 \quad \forall i \in \{1, 2, 3\} \text{ and } \varepsilon_t \sim N(0,1)$$

We would like to further examine how assets' volatility varies across the different noise processes. Chatfield (2004, Chapter 3) shows that the theoretical variance of a stationary time-series of infinite length is:

$$\sigma^2 = \beta^2 / (1 - \alpha^2) \quad (9)$$

In addition, Heino, Ripa, and Kaitala (2000) develop the expected variance of an autocorrelated sample of length  $T$ , assuming that  $T$  is large enough that initial provisions convey no impact as:

$$E[s^2] = \frac{\beta^2}{(1 - \alpha^2)(T - 1)} \left[ T - \frac{(1 + \alpha)^2}{1 - \alpha^2} + \frac{2\alpha(1 - \alpha^T)}{T(1 - \alpha)^2} \right] \quad (10)$$



For a stochastic process with a white noise, the expected sample variance does not depend on the sample length, and in this case  $E[s^2] = \sigma^2 = \beta^2$ . If the dynamic exhibits positively (negatively) constant autocorrelated noise, as in the red (blue) spectra analysis, its variance is lower (higher) the shorter the sample. Unfortunately there are no analytical derivations for the variance of the pink or the black noises. In the latter simulations we contrast the theoretical and the expected variances of assets' value during default processes across and within the three relevant noise colours: the white, the red, and the blue.

#### 4. Monte Carlo Simulations

For purpose of robustness and to examine intra-colour and cross-colour behavior, we construct five independent simulations, one for each colour of noise: the white, the red, the pink, the blue, and the black. Every simulator executes 27 different experiments, each one over 60,000 monthly simulated observations. All the simulations derive the risk-neutral default probabilities from the traditional Merton (1974) model, with the following origin values:  $D = \$100$ ,  $V_0 = \{\$100, \$150, \text{ or } \$200\}$  to proxy different initial corporate creditworthiness,  $T = 5$  years,  $r_f = 5\%$ , and  $\sigma_V = 0.1$  for the first 12 monthly iterations.<sup>2</sup> We then compute the annual volatility of assets' return directly from changes in  $V$  after the first year by multiplying a moving window standard deviation of historical assets' returns  $\ln(V_t/V_{t-1})$  by the square root of 12.<sup>3</sup> We draw a new random number from the standard Normal distribution in every time interval for  $\varepsilon$ , and appoint  $\beta = \{10\%, 20\%, \text{ or } 30\%\}$  of  $V_0$  in all the simulations as a meaningful variance scaling constant. We further set  $\alpha = 0$  in the white noise test,  $\alpha = 0.6$  in the red noise test, and  $\alpha = -0.6$  in the blue noise test. We also denote  $\alpha_1 = 0.3$ ,  $\alpha_2 = 0.2$ , and  $\alpha_3 = 0.1$  in the black noise analysis. The reader should notice that we select these particular quantities to represent a realistic scenario with gradually decreasing autocorrelation coefficients, and at the same time we preserve comparable tests by inducing  $\alpha_1 + \alpha_2 + \alpha_3 = 0.6$  as in the red noise experiment. Within the pink noise simulation we denote a representative function for  $\alpha$  as described in equation (6), where we keep tracking the time  $t$ .

We let each of the five simulations run over 60,000 monthly iterations or 5,000 collective years of simulated data. In every iteration we compute  $V_t = V_{t-1} + \Delta V$ , where the changes  $\Delta V$  can be positive, negative, or zero. We set three default thresholds based on the maximum default probability  $\text{Max}\{\Phi(-d_2)\} \leq \{0.90, 0.95, \text{ or } 0.99\}$  to represent different levels of corporate risk tolerance.<sup>4</sup> Given the other model parameters, these three default thresholds cover a fairly wide range of ratios between the stochastic market value of assets and the fixed face value of debt.

Furthermore, to prevent any single firm from becoming disproportionately large through a continuous enhancement of assets' value, and by that to consume too many iterations of the simulation, we limit the growth of all firms to three times the initial market value of assets, thus the growth limit =  $\{\$300, \$450, \text{ or } \$600\}$ , which varies between three to six times the face value of the debt. These proportions denote very secure firms, with exceptionally low chances to default. To authenticate our findings, in the robustness checks we use other growth limits as well.

Whenever either a default occurs, hence if  $\Phi(-d_2)$  exceeds the selected default threshold, or when assets' value touches its upper growth limit, the simulation continues with a new firm having the same initial arbitrary values as with its predecessor. Because of the misbalance between the distances assets' value is allowed to shift, either towards the upper limit (200% up) or to the lower boundary (near 100% down), we expect a relatively high percentage of defaults out of the simulated scenarios. We confirm this presumption when we cap the growth of assets' value at a lower level; thus we place similar constraints on assets' value to rise or decline not more than 100%, and we obtain a more balanced proportion of defaults. Due to the repetitive nature of the robustness tests we do not report them here, but we further utilize different quantities for the remaining time until maturity  $T$ , the risk free rate  $r_f$ , as well as for the face value of debt  $D$ . All of the results remain consistent with the ones drawn from our main settings.

#### 5. Results and Conclusions

In this section we report the key findings of the intra-colour and the cross-colour analyses. We further discuss some important economic conclusions, but we first start with the intra-colour investigations. Within each colour of noise we hold everything else constant, except for the growth limit, which is set to be proportional to  $V_0$ , and alternate three variables: the variance scaling parameter  $\beta$ , the initial market value of assets  $V_0$ , and the default threshold  $\text{Max}\{\Phi(-d_2)\}$ . Each time, we record how three things vary: the average number of years to default (after mapping monthly observations to annual records), the mean default probability, and the two measures of volatility  $\sigma^2$  and  $E[s^2]$ . We summarize the results of these simulations in **Tables 1 – 5**.

Throughout all of the tests we find consistent relations between the time-series variance scaling variable  $\beta$  and the credit simulated parameters. When  $\beta$  rises the average number of years to default declines, the mean default probability increases, and both volatility measures intensify. These findings suggest that in a more volatile environment firms tend to default more quickly. At the same time, as opposed to a more stable economy, with the presence of strong macroeconomic shocks, which might be either constructive or destructive, firms portray a higher default risk along the way to liquidation. Therefore we can conclude that although default risk rises with the intensity of economic noises, so does the predictive power of traders aiming to forecast defaults.

We also detect coherent results with respect to changes in the original market value of assets. In all of the experiments, when  $V_0$  grows, the average number of years to default increases, and the mean default probability decreases as expected. However, the volatility measures exhibit interesting patterns. While the theoretical time-series variance of infinite length  $\sigma^2$  remains fixed throughout the white, the red, and the blue noise simulations, the expected variance of length  $T$  remains constant in the white noise test, rises at the red noise simulation, but declines within the blue noise recreation.

The reason for that lies within the structure of the formula of  $E[s^2]$  given in (10) and in particular the ratio of elements depending on  $T$ . This ratio is smaller than one at the red noise test but bigger than one in the blue noise simulation. Both ratios converge to one when  $T$  climbs, and therefore the expected variance of a time-series sample with an average length  $T$  increases with red and decreases with blue spectra noises. We therefore conclude that when a macroeconomic environment exhibits positive (negative) time-series autocorrelation, the expected variance of assets' value increases (decreases) with the creditworthiness of a firm, which is captured here by the distance between the floating market value of assets and the fixed face value of the debt.

When the default threshold  $Max\{\Phi(-d_2)\}$  rises from 90% to 95% and then to 99%, we generally observe a rise in the average number of years to default as expected, yet this effect is less pronounced within the red and the black noise simulations. These two colours of noise tend to intensify already existing trends and therefore force liquidation more quickly even for firms with greater risk tolerance. Furthermore, we detect a tendency of increased mean default probability, but merely minor fluctuations at the blue noise test. Therefore, counter-cyclical economic movements tend to ease default risk for firms with higher sustainability. Although we find no changes in  $\sigma^2$  when the default threshold varies, we identify a steady  $E[s^2]$  within the white noise test, no clear trend with negligible vibrations at the red noise experiment, but a continuous decline at the blue noise simulation. This decay is associated with the levitation in  $T$ .

We further conduct cross-colour analyses. We match the variance scaling parameter  $\beta$ , the origin market value of assets  $V_0$ , and the default threshold  $Max\{\Phi(-d_2)\}$  and compare the average number of years to default, the mean default probability, and the volatility measures across the different simulations. In essence, we examine the impact of changes in the autocorrelation variable  $\alpha$  on these credit simulated parameters.

Once we sort the simulations according to their autocorrelation levels we find three consistent relations as follows. When  $\alpha$  rises across the noise colours, the average number of years to default as well as the mean default probability simultaneously decrease. This striking evidence suggests that although the chances to default decline, firms tend to default more quickly when a series of economic noises exhibits a higher autocorrelation. This means that when the economy is more reddened, i.e. with a stronger positive autocorrelation within the sequential economic shocks, it would be more difficult for traders to predict corporate failure because of the growing impact of a potential extended catastrophe.

To evaluate whether a single random shock damages a firm's survivability more or less than a series of reduced noises, we compare the red and the black noise simulations. We find that both the average number of years to default and the mean default probability are higher within almost all of the black noise tests. We therefore conclude that a longer memory series with weaker autocorrelation increases default likelihoods but simultaneously allows firms to survive over a longer period of time, as opposed to a shorter memory series having higher autocorrelation.

In addition, when we evaluate the volatility measures at the blue, the white, and the red noise simulations, we observe that when the autocorrelation variable  $\alpha$  rises, both the theoretical variance  $\sigma^2$  and the expected variance  $E[s^2]$  first decrease but then increase. This non-monotonic behavior of assets' volatility suggests a higher likelihood of extreme fluctuations from economic shocks when conditions are either blue or red, compared to markets inherently having random shocks as in the white noise simulation.

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### Notes

Note 1. Benjamin Graham (1894 – 1976) is considered one of the first advocates of “value investing” and an early mentor of Warren Buffett.

Note 2. Although in practice the remaining time until maturity of the outstanding debt  $T$  is gradually decreasing, we wish to isolate the effects of economic noises on default risk, and therefore we fix this parameter along the simulations, while assuming that firms issue more debt over time and through that maintain a constant weighted average time to maturity on their denominated bond issuances.

Note 3. Alternatively we could have generated daily fluctuations, then scaled it to annual volatility, and further calibrated  $\beta$  to be a smaller variance scaling value. But since it often takes many years for firms to default, this would have obligated us to considerably increase the number of iterations and to face computation difficulties. In addition, we aim the five different colours of noise to represent significant macroeconomic shocks that can alter a firm’s market value of assets from various industries and diverse geographic markets, yet these economic shocks rarely happen every day. It is therefore more intuitive and more applicable to consider aggregate monthly noises.

Note 4. Occasionally firms default prior to the moment they are forced to do so by creditors. For example, mall owner General Growth Properties filed for chapter eleven on April 16, 2009, while its assets’ value was estimated as \$29.5 billion and its outstanding debt was merely \$27.3 billion.

Table 1. White Noise Monte Carlo Simulations

$\alpha$	$\beta$	$V_0$	$D$	Growth Limit	Default Threshold	Number of Monthly Observations	Total Number of Firms	Total Number of Defaults	Average Number of Years to Default	Average Default Probability	$\sigma^2$	$E[s^2]$
0	10	\$100	\$100	\$300	90%	60,000	448	336	14.881	0.269	100.00	100.00
0	15	\$100	\$100	\$300	90%	60,000	1,050	819	6.105	0.345	225.00	225.00
0	20	\$100	\$100	\$300	90%	60,000	1,843	1,444	3.463	0.394	400.00	400.00
0	15	\$150	\$100	\$450	90%	60,000	381	287	17.422	0.206	225.00	225.00
0	22.5	\$150	\$100	\$450	90%	60,000	775	571	8.757	0.268	506.25	506.25
0	30	\$150	\$100	\$450	90%	60,000	1,430	1,040	4.808	0.323	900.00	900.00
0	20	\$200	\$100	\$600	90%	60,000	361	262	19.084	0.164	400.00	400.00
0	30	\$200	\$100	\$600	90%	60,000	733	513	9.747	0.215	900.00	900.00
0	40	\$200	\$100	\$600	90%	60,000	1,366	980	5.102	0.293	1,600	1,600
0	10	\$100	\$100	\$300	95%	60,000	377	284	17.606	0.327	100.00	100.00
0	15	\$100	\$100	\$300	95%	60,000	859	641	7.800	0.386	225.00	225.00
0	20	\$100	\$100	\$300	95%	60,000	1,511	1,140	4.386	0.442	400.00	400.00
0	15	\$150	\$100	\$450	95%	60,000	287	181	27.624	0.209	225.00	225.00
0	22.5	\$150	\$100	\$450	95%	60,000	699	475	10.526	0.296	506.25	506.25
0	30	\$150	\$100	\$450	95%	60,000	1,304	929	5.282	0.356	900.00	900.00
0	20	\$200	\$100	\$600	95%	60,000	306	195	25.641	0.170	400.00	400.00
0	30	\$200	\$100	\$600	95%	60,000	715	487	10.267	0.250	900.00	900.00
0	40	\$200	\$100	\$600	95%	60,000	1,228	869	5.754	0.314	1,600	1,600
0	10	\$100	\$100	\$300	99%	60,000	315	221	22.624	0.342	100.00	100.00
0	15	\$100	\$100	\$300	99%	60,000	664	466	10.730	0.420	225.00	225.00
0	20	\$100	\$100	\$300	99%	60,000	1,266	898	5.568	0.483	400.00	400.00
0	15	\$150	\$100	\$450	99%	60,000	285	194	25.773	0.245	225.00	225.00
0	22.5	\$150	\$100	\$450	99%	60,000	679	489	10.225	0.325	506.25	506.25
0	30	\$150	\$100	\$450	99%	60,000	1,113	767	6.519	0.395	900.00	900.00
0	20	\$200	\$100	\$600	99%	60,000	294	193	25.907	0.192	400.00	400.00
0	30	\$200	\$100	\$600	99%	60,000	618	407	12.285	0.272	900.00	900.00
0	40	\$200	\$100	\$600	99%	60,000	1,136	767	6.519	0.355	1,600	1,600

Table 2. Red Noise Monte Carlo Simulations

$\alpha$	$\beta$	$V_0$	$D$	Growth Limit	Default Threshold	Number of Monthly Observations	Total Number of Firms	Total Number of Defaults	Average Number of Years to Default	Average Default Probability	$\sigma^2$	$E[s^2]$
0.6	10	\$100	\$100	\$300	90%	60,000	2,680	1,560	3.205	0.167	156.25	144.55
0.6	15	\$100	\$100	\$300	90%	60,000	4,280	2,551	1.960	0.218	351.56	309.71
0.6	20	\$100	\$100	\$300	90%	60,000	5,973	3,658	1.367	0.240	625.00	521.82
0.6	15	\$150	\$100	\$450	90%	60,000	2,601	1,491	3.353	0.115	351.56	326.26
0.6	22.5	\$150	\$100	\$450	90%	60,000	4,377	2,563	1.951	0.164	791.02	696.43
0.6	30	\$150	\$100	\$450	90%	60,000	5,698	3,424	1.460	0.190	1,406	1,187
0.6	20	\$200	\$100	\$600	90%	60,000	2,610	1,499	3.336	0.097	625.00	579.96
0.6	30	\$200	\$100	\$600	90%	60,000	4,249	2,479	2.017	0.145	1,406	1,243
0.6	40	\$200	\$100	\$600	90%	60,000	5,794	3,451	1.449	0.168	2,500	2,108
0.6	10	\$100	\$100	\$300	95%	60,000	2,487	1,460	3.425	0.181	156.25	145.27
0.6	15	\$100	\$100	\$300	95%	60,000	4,216	2,494	2.005	0.241	351.56	310.58
0.6	20	\$100	\$100	\$300	95%	60,000	5,758	3,475	1.439	0.254	625.00	526.42
0.6	15	\$150	\$100	\$450	95%	60,000	2,647	1,508	3.316	0.130	351.56	326.08
0.6	22.5	\$150	\$100	\$450	95%	60,000	4,277	2,498	2.002	0.183	791.02	698.66
0.6	30	\$150	\$100	\$450	95%	60,000	5,834	3,437	1.455	0.205	1,406	1,187
0.6	20	\$200	\$100	\$600	95%	60,000	2,608	1,480	3.378	0.107	625.00	580.51
0.6	30	\$200	\$100	\$600	95%	60,000	4,194	2,426	2.061	0.156	1,406	1,246
0.6	40	\$200	\$100	\$600	95%	60,000	5,778	3,404	1.469	0.182	2,500	2,113
0.6	10	\$100	\$100	\$300	99%	60,000	2,596	1,480	3.378	0.199	156.25	145.13
0.6	15	\$100	\$100	\$300	99%	60,000	4,223	2,434	2.054	0.261	351.56	311.49
0.6	20	\$100	\$100	\$300	99%	60,000	5,776	3,426	1.459	0.279	625.00	527.66
0.6	15	\$150	\$100	\$450	99%	60,000	2,577	1,471	3.399	0.147	351.56	326.68
0.6	22.5	\$150	\$100	\$450	99%	60,000	4,235	2,442	2.048	0.192	791.02	700.58
0.6	30	\$150	\$100	\$450	99%	60,000	5,576	3,298	1.516	0.229	1,406	1,195
0.6	20	\$200	\$100	\$600	99%	60,000	2,560	1,452	3.444	0.120	625.00	581.31
0.6	30	\$200	\$100	\$600	99%	60,000	4,306	2,477	2.019	0.171	1,406	1,243
0.6	40	\$200	\$100	\$600	99%	60,000	5,739	3,355	1.490	0.195	2,500	2,118

Table 3. Pink Noise Monte Carlo Simulations

$\alpha_t$	$\beta$	$V_0$	$D$	Growth Limit	Default Threshold	Number of Monthly Observations	Total Number of Firms	Total Number of Defaults	Average Number of Years to Default	Average Default Probability
sin(.)	10	\$100	\$100	\$300	90%	60,000	989	688	7.267	0.124
sin(.)	15	\$100	\$100	\$300	90%	60,000	1,890	1,360	3.676	0.290
sin(.)	20	\$100	\$100	\$300	90%	60,000	3,100	2,235	2.237	0.328
sin(.)	15	\$150	\$100	\$450	90%	60,000	816	544	9.191	0.161
sin(.)	22.5	\$150	\$100	\$450	90%	60,000	1,704	1,183	4.227	0.234
sin(.)	30	\$150	\$100	\$450	90%	60,000	2,620	1,778	2.812	0.266
sin(.)	20	\$200	\$100	\$600	90%	60,000	831	542	9.225	0.140
sin(.)	30	\$200	\$100	\$600	90%	60,000	1,602	1,041	4.803	0.199
sin(.)	40	\$200	\$100	\$600	90%	60,000	2,509	1,679	2.978	0.246
sin(.)	10	\$100	\$100	\$300	95%	60,000	833	560	8.929	0.265
sin(.)	15	\$100	\$100	\$300	95%	60,000	1,665	1,122	4.456	0.329
sin(.)	20	\$100	\$100	\$300	95%	60,000	2,535	1,736	2.880	0.376
sin(.)	15	\$150	\$100	\$450	95%	60,000	725	480	10.417	0.199
sin(.)	22.5	\$150	\$100	\$450	95%	60,000	1,501	961	5.203	0.250
sin(.)	30	\$150	\$100	\$450	95%	60,000	2,451	1,618	3.090	0.307
sin(.)	20	\$200	\$100	\$600	95%	60,000	720	482	10.373	0.155
sin(.)	30	\$200	\$100	\$600	95%	60,000	1,495	974	5.133	0.227
sin(.)	40	\$200	\$100	\$600	95%	60,000	2,326	1,515	3.300	0.271
sin(.)	10	\$100	\$100	\$300	99%	60,000	721	458	10.917	0.292
sin(.)	15	\$100	\$100	\$300	99%	60,000	1,406	909	5.501	0.382
sin(.)	20	\$100	\$100	\$300	99%	60,000	2,368	1,552	3.222	0.426
sin(.)	15	\$150	\$100	\$450	99%	60,000	661	414	12.077	0.220
sin(.)	22.5	\$150	\$100	\$450	99%	60,000	1,419	913	5.476	0.289
sin(.)	30	\$150	\$100	\$450	99%	60,000	2,206	1,394	3.587	0.346
sin(.)	20	\$200	\$100	\$600	99%	60,000	710	450	11.111	0.182
sin(.)	30	\$200	\$100	\$600	99%	60,000	1,426	915	5.464	0.255
sin(.)	40	\$200	\$100	\$600	99%	60,000	2,185	1,397	3.579	0.305

Table 4. Blue Noise Monte Carlo Simulations

$\alpha$	$\beta$	$V_0$	$D$	Growth Limit	Default Threshold	Number of Monthly Observations	Total Number of Firms	Total Number of Defaults	Average Number of Years to Default	Average Default Probability	$\sigma^2$	$E[s^2]$
-0.6	10	\$100	\$100	\$300	90%	60,000	380	328	15.244	0.325	156.25	156.89
-0.6	15	\$100	\$100	\$300	90%	60,000	997	882	5.669	0.410	351.56	355.46
-0.6	20	\$100	\$100	\$300	90%	60,000	2,004	1,797	2.782	0.456	625.00	639.20
-0.6	15	\$150	\$100	\$450	90%	60,000	225	184	27.174	0.248	351.56	352.37
-0.6	22.5	\$150	\$100	\$450	90%	60,000	632	525	9.524	0.323	791.02	796.22
-0.6	30	\$150	\$100	\$450	90%	60,000	1,364	1,172	4.266	0.371	1,406	1,427
-0.6	20	\$200	\$100	\$600	90%	60,000	206	155	32.258	0.181	625.00	626.21
-0.6	30	\$200	\$100	\$600	90%	60,000	531	420	11.905	0.259	1,406	1,414
-0.6	40	\$200	\$100	\$600	90%	60,000	1,173	978	5.112	0.329	2,500	2,531
-0.6	10	\$100	\$100	\$300	95%	60,000	266	225	22.222	0.360	156.25	156.69
-0.6	15	\$100	\$100	\$300	95%	60,000	745	641	7.800	0.430	351.56	354.39
-0.6	20	\$100	\$100	\$300	95%	60,000	1,421	1,201	4.163	0.505	625.00	634.46
-0.6	15	\$150	\$100	\$450	95%	60,000	169	124	40.323	0.249	351.56	352.11
-0.6	22.5	\$150	\$100	\$450	95%	60,000	550	427	11.710	0.338	791.02	795.25
-0.6	30	\$150	\$100	\$450	95%	60,000	1,058	878	5.695	0.415	1,406	1,422
-0.6	20	\$200	\$100	\$600	95%	60,000	209	153	32.680	0.224	625.00	626.20
-0.6	30	\$200	\$100	\$600	95%	60,000	466	356	14.045	0.280	1,406	1,413
-0.6	40	\$200	\$100	\$600	95%	60,000	1,090	923	5.417	0.378	2,500	2,529
-0.6	10	\$100	\$100	\$300	99%	60,000	175	124	40.323	0.322	156.25	156.49
-0.6	15	\$100	\$100	\$300	99%	60,000	521	387	12.920	0.431	351.56	353.27
-0.6	20	\$100	\$100	\$300	99%	60,000	1,024	829	6.031	0.547	625.00	631.51
-0.6	15	\$150	\$100	\$450	99%	60,000	168	126	39.683	0.254	351.56	352.12
-0.6	22.5	\$150	\$100	\$450	99%	60,000	421	321	15.576	0.388	791.02	794.20
-0.6	30	\$150	\$100	\$450	99%	60,000	873	683	7.321	0.464	1,406	1,418
-0.6	20	\$200	\$100	\$600	99%	60,000	173	133	37.594	0.250	625.00	626.04
-0.6	30	\$200	\$100	\$600	99%	60,000	393	299	16.722	0.322	1,406	1,412
-0.6	40	\$200	\$100	\$600	99%	60,000	799	601	8.319	0.419	2,500	2,519

Table 5. Black Noise Monte Carlo Simulations

$\alpha_{1,2,3}$	$\beta$	$V_0$	$D$	Growth Limit	Default Threshold	Number of Monthly Observations	Total Number of Firms	Total Number of Defaults	Average Number of Years to Default	Average Default Probability
.3,.2,.1	10	\$100	\$100	\$300	90%	60,000	1,785	1,205	4.149	0.192
.3,.2,.1	15	\$100	\$100	\$300	90%	60,000	3,280	2,182	2.291	0.238
.3,.2,.1	20	\$100	\$100	\$300	90%	60,000	4,648	3,112	1.607	0.269
.3,.2,.1	15	\$150	\$100	\$450	90%	60,000	1,923	1,179	4.241	0.125
.3,.2,.1	22.5	\$150	\$100	\$450	90%	60,000	3,198	2,003	2.496	0.172
.3,.2,.1	30	\$150	\$100	\$450	90%	60,000	4,307	2,735	1.828	0.202
.3,.2,.1	20	\$200	\$100	\$600	90%	60,000	1,974	1,193	4.191	0.109
.3,.2,.1	30	\$200	\$100	\$600	90%	60,000	3,273	1,995	2.506	0.142
.3,.2,.1	40	\$200	\$100	\$600	90%	60,000	4,476	2,759	1.812	0.177
.3,.2,.1	10	\$100	\$100	\$300	95%	60,000	1,966	1,185	4.219	0.192
.3,.2,.1	15	\$100	\$100	\$300	95%	60,000	3,298	2,031	2.462	0.251
.3,.2,.1	20	\$100	\$100	\$300	95%	60,000	4,413	2,831	1.766	0.292
.3,.2,.1	15	\$150	\$100	\$450	95%	60,000	2,098	1,240	4.032	0.128
.3,.2,.1	22.5	\$150	\$100	\$450	95%	60,000	3,248	1,945	2.571	0.182
.3,.2,.1	30	\$150	\$100	\$450	95%	60,000	4,429	2,694	1.856	0.226
.3,.2,.1	20	\$200	\$100	\$600	95%	60,000	1,992	1,177	4.248	0.114
.3,.2,.1	30	\$200	\$100	\$600	95%	60,000	3,285	1,952	2.561	0.157
.3,.2,.1	40	\$200	\$100	\$600	95%	60,000	4,401	2,644	1.891	0.196
.3,.2,.1	10	\$100	\$100	\$300	99%	60,000	2,141	1,254	3.987	0.208
.3,.2,.1	15	\$100	\$100	\$300	99%	60,000	3,182	1,929	2.592	0.278
.3,.2,.1	20	\$100	\$100	\$300	99%	60,000	4,360	2,672	1,871	0.317
.3,.2,.1	15	\$150	\$100	\$450	99%	60,000	2,030	1,171	4.270	0.145
.3,.2,.1	22.5	\$150	\$100	\$450	99%	60,000	3,250	1,928	2.593	0.205
.3,.2,.1	30	\$150	\$100	\$450	99%	60,000	4,262	2,563	1.951	0.250
.3,.2,.1	20	\$200	\$100	\$600	99%	60,000	1,991	1,168	4.281	0.120
.3,.2,.1	30	\$200	\$100	\$600	99%	60,000	3,223	1,883	2.655	0.172
.3,.2,.1	40	\$200	\$100	\$600	99%	60,000	4,143	2,474	2.021	0.216



# Using Basis, Futures Price, and Futures Price Spread as Barometers for Storage Decisions

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## Abstract

The purpose of this paper is to determine the importance of the strength and weakness of basis, futures spread, and futures prices as barometers for producers to use in deciding whether to store or not. Basis is the most important market signal for wheat producers to use when deciding whether to store and hedge or sell their wheat at harvest.

**Keywords:** Basis, Futures, Storage, Wheat

## 1. Introduction

Every year grain producers and grain elevator managers must decide whether to store grain or sell it at harvest. This decision is complex and it is like a game of chance in which the probability of winning or losing changes each time the game is played (Heifner, 1966). The purpose of this study is to determine the importance of the strength and weakness of basis, futures price, and futures price spread, in predicting returns to storage.

Producers and managers want to know if there are market signals that they can use to make a harvest time store/sell decision. They desire rules of thumb that can be used to make decisions. Extension economists and market advisors frequently use indicators such as basis, futures prices, and futures price spread as signals for a storage decision. Usset (2009), for example, in the context of a marketing plan for producers, includes those indicators in a marketing decision tree. (Note 1)

Another example of rules of thumb is shown in table 1. The source of this table is unknown, but its author emphasized the use of two of these signals, futures price and basis, in making storage decisions. Some undergraduate agricultural marketing instructors teach their use as well. One textbook, for example, advocates using “basis as a barometer” when making storage decisions (Purcell and Koontz p.32).

From a theoretical perspective, Working (1953) suggested that basis should be a useful indicator of potential returns to storage. In contrast, futures price level is not expected to be a signal since past studies have shown that futures markets are mostly efficient (Kastens and Schroeder, 1996; Tomek, 1997). The empirical research, however, is inconsistent regarding whether basis, futures price spread, and/or futures price level can be used as a signal to store

or not (Zulauf and Irwin, 1998; Kastens and Dhuyvetter, 1999; Yoon and Brorsen, 2002). Thus, we propose to revisit this issue in the hope of providing a more definitive answer to the empirical question of whether basis, futures price level, and/or futures price spread can serve as a barometer of whether to store or not. This study is quite similar to Zulauf and Irwin (1998) as well as Kastens and Dhuyvetter (1999). However, our regression approach should lead to a more powerful test than the simulation strategies in past research and thus will more clearly measure the usefulness of these signals for storage decisions. Simulation methods are roughly equivalent to regression against a dummy variable of whether or not a signal is above or below a threshold. Such simulation methods may have lower power than the regression approach used here.

In section 2, the theory of the price of storage is presented to provide an understanding of inter-temporal price relationships between spot and futures prices. Theory suggests that futures price level should be a worthless signal, but that the level of basis potentially has value as a storage indicator. Futures price spread is a market indicator of storage returns in that it provides market prices for a commodity to be stored and sold in the future relative to selling it earlier, but little empirical evidence exists to support its usefulness. In section 3, the data used in this study is described; in section 4, the econometric models are presented to measure various returns to storage against measures of the strength and weakness of basis, futures price level, and futures price spread; in section 5, the model misspecification tests are presented to verify that the underlying model assumptions hold; and in sections 6 and 7 results and conclusions are presented.

## 2. Theory

The theory of the price of storage was first proposed by Kaldor (1939) to explain the inter-temporal price relationship between spot and futures prices. Working (1949) viewed the returns to storage as being determined by the supply and demand for storage. Thus when wheat stocks are large, the demand for storage is large and the price of storage is expected to be relatively large. However, if wheat stocks are low, then the economic benefits/returns of storing wheat are small. Furthermore, the theory of the price of storage only holds for highly storable and continuous inventory commodities such as wheat (Brennan, 1958). Over the years, studies on the theory of the price of storage have evolved following Kaldor (1939) including Telser (1958), Williams and Wright (1982), Benirschka and Binkley (1995), and Seamon, Kahl, and Curtis (2001).

The theory of the price of storage includes two different but overlapping views. The first view explains the difference between the spot and futures prices in terms of interest forgone in storing a commodity, physical storage costs, and convenience yield on inventory. This view was shown in the works of Kaldor (1939), Brennan (1958, 1991), and Telser (1958). Under the second view, Cootner (1960), Dusak (1973), Breeden (1980), and Hazuka (1984) show that the theory of the price of storage can be explained by dividing futures prices into an expected risk premium and predicted future spot price (Fama and French, 1987).

Combining these slightly different views, we define the following variables that explain theory of the price of storage. Define  $F_T$  as the future price for delivery of a commodity and  $S_t$  as the spot price. The price of storage at time  $t$  from holding a commodity until time  $T$  is defined as

$$F_T - S_t = S_t R + W + P - C \quad (1)$$

Where  $R$  is the interest rate, and thus  $S_t R$  is the opportunity cost of holding stocks,  $W$  is physical storage cost,  $P$  is risk premium, and  $C$  is convenience yield.

The concept of basis is important because it combines both the spot and futures prices, which reflects the current and expected demand and supply conditions, respectively (Leuthold and Peterson, 1983; Purcell and Koontz, 1999). While equation (1) relates the spot and futures prices (the basis), the key question that arises is "what does the theory of the price of storage say about basis and/or futures price as a market signal?" The theory of the price of storage suggests that initial basis can help producers and grain managers decide whether to store or sell their grain at harvest since the spot and futures prices should converge as  $t$  approaches  $T$ . The reliability of this prediction might be affected if physical storage costs (including costs of maintaining quality) or opportunity cost of storing grain change over time, or if risk premium or convenience yield vary, so that the ending basis at time  $T$  varies over time. Further, physical storage costs increase depending on the quantity of commodity stored. As more grain needs to be stored, it must be stored in higher cost facilities or locations. Moreover, if convenience yield is high then returns to storage should be low as a signal for grain owners to sell their stocks. A measure that compares the initial basis with expected basis at time  $T$  should provide a prediction of returns to storage.

Conversely, although a high futures price indicates that wheat will be valuable later, to the extent futures markets are efficient, that value should already be reflected in current prices so that futures prices cannot be used as a barometer

by grain owners to decide whether to store or sell their grain. As Kastens and Schroeder (1996) stated, the futures market is expected to be mostly efficient, so futures price level should not help predict price changes. Alternatively, as Yoon and Brorsen (2002) explained, behavioral finance aspects such as overconfidence, anchoring, and regret by grain traders provide a possible theoretical reasoning to argue for mean reversion in futures prices, and thus for futures price level to aid in predictions.

Finally, futures price spread, the difference between the price of a distant contract and the price of a nearby contract, is a market signal of storage returns that some have recommended as a storage signal (see, for example, Usset). To the extent cash prices converge to futures prices at contract expiration, the distant futures price minus the nearby futures price should also provide a prediction of returns to storage.

Therefore, this study generates three testable hypotheses about the theory of the price of storage. First, grain producers and elevator managers can use basis as a market signal to decide whether to store or sell their grain; second, they can use futures price as a market signal to decide whether to store or sell their grain; and third, they can use futures price spread as a market signal to decide whether to store or sell their grain.

### 3. Data

The commodity chosen is Oklahoma wheat. Oklahoma monthly average cash wheat prices are obtained from the National Agricultural Statistics Service (NASS) of the United States Department of Agriculture (NASS/USDA) from 1975-2005. (Note 2) Monthly average Kansas City Board of Trade (KCBT) December wheat contract prices are obtained from the KCBT for the same periods as the monthly average cash wheat price series. The daily commercial storage costs represent the physical cost of storage charged by elevators and the opportunity cost of interest. The commercial grain storage rates were from Oklahoma Grain and Feed Association from 1975-2005. The monthly cost-of-carry loan interest rates were obtained from 1975-2005 Economic Research Service of the United States Department of Agriculture (ERS/USDA). Although an individual producer would find analysis using prices from a particular location more useful than state average prices, the purpose of the paper is to test usefulness of recommended rules of thumb. Using state averages reduces noise in the data, raising the power of the statistical tests.

### 4. Econometric Model

#### 4.1 Dependent Variables

The dependent variables considered are gross revenue, net gross revenue, basis change, basis change less cost of carry, and futures price change. It is assumed that a producer choosing to store grain at harvest in June stores until November. Klumpp, Brorsen, and Anderson (2007) note that on average during the years 1991-2001 Oklahoma wheat prices declined after December, so there is little likelihood of profitable storage after then, especially after storage costs are deducted. (In southern Oklahoma the net price declines after September, so a selling date of September is considered as well.)

Gross revenue is defined as the difference between the November and June cash price for each year from 1975-2005.<sup>2</sup> Mathematically, gross revenue is expressed as

$$\text{Gross Revenue} = P_N^C - P_J^C \quad (2)$$

where  $P_N^C$  is the November (or September) cash price and  $P_J^C$  is the June cash price. This is the equivalent of a producer's price gain from holding grain in storage, unhedged, until November (or September) rather than selling at harvest in June. Net revenue, where storage costs are deducted from gross revenue, was also considered, but since results using net revenue did not differ from those with gross revenue only results with gross revenue are presented here.

Basis change is the return to hedged storage as in Zulauf and Irwin (1998). It is defined as the difference between November and June monthly average December basis. Mathematically, basis change is expressed as

$$\text{Basis Change} = (P_N^C - P_N^{DF}) - (P_J^C - P_J^{DF}) = B_N - B_J \quad (3)$$

where  $P_N^C$  is cash price in November,  $P_N^{DF}$  is December contract futures price in November,  $P_J^C$  is cash price in June,  $P_J^{DF}$  is December contract futures price in June,  $B_N$  is the basis in November, and  $B_J$  is the basis in June. This is the equivalent of a producer's gain from storing grain at harvest in June, hedging 100% of it on the December futures contract, and liquidating the hedge in November.

The variable *Basis Change less Cost of Carry* is basis change minus cost of carry from June through the sale date. This is the equivalent of a producer's gain net of storage cost from holding hedged grain in storage until November rather than selling at harvest in June.

Futures price change is defined as the difference between November and June monthly average December futures price. Futures price change is expressed as

$$\text{Futures Price Change} = P_N^{DF} - P_J^{DF} \quad (4)$$

where  $P_N^{DF}$  is the November average futures price for December contract, and  $P_J^{DF}$  is the June average futures price for the December contract.

#### 4.2 Independent Variables

Working (1953) suggested that initial basis could be used to forecast basis convergence. Initial basis is defined as June's observation of cash price minus the December futures contract price. Working's suggestion of using initial basis implicitly assumes that ending basis is approximately the same in every year, so that initial basis would be closely correlated with basis convergence. However, storage costs, transportation costs, and supply/demand fundamentals in the cash market relative to the futures market may have changed over time, affecting expected ending basis. Some authors (e.g., Purcell and Koontz, 1999, p.35) have suggested using expected basis convergence as a storage signal. Basis deviation, or expected basis change, is an estimate of the expected amount of basis convergence from June through November, and is considered here as an alternative to Initial Basis. (Note 3) Dhuyvetter (2010) presents crop basis maps of both basis and basis deviation, showing that the two measures can differ over time and across locations. Basis deviation is defined here as June's observation of cash price minus the December futures contract price observed in June ( $B_J$ ), minus an expectation of the basis in November. Here, that expectation is formed using an average of the previous five years' November observations of cash price less the December futures contract price observed in the same November ( $B_{NAvg}$ ), and is expressed as

$$\text{BasisDeviation} = B_J - B_{NAvg} \quad (\text{Note 4}) \quad (5)$$

Similarly, futures price deviation is defined as the difference between June's price for the December futures contract ( $P_J^{DF}$ ) minus the average of the previous five years' November observations of the December futures contract prices ( $P_N^{DFAvg}$ ), and is expressed as

$$\text{FuturesPriceDeviation} = P_J^{DF} - P_{NAvg}^{DF} \quad (6)$$

This variable could capture mean reversion in futures prices. Kim, Brorsen, and Anderson (2010) argue that research on profit margin hedging and rollover hedging typically shows larger returns than selling at harvest, but the difference is rarely statistically significant. Thus, there is at least some weak empirical evidence in favor of considering the futures price deviation variable.

Futures price spread is defined as June's price for the December futures contract ( $P_J^{DFut}$ ) minus June's price for the July futures contract ( $P_J^{JulF}$ ), so that

$$\text{Futures Price Spread} = P_J^{DF} - P_J^{JulF} \quad (7)$$

This difference reflects the market-forecasted gross return to storage, in that arbitraging those two contracts (e.g., simultaneously selling a December contract and buying a July futures contract, and then taking delivery on the July futures contract, and then liquidating the hedge as the December contract is nearing expiration) will provide that difference as revenue to the decision maker. This measure is also equivalent to using the harvest basis (July contract in June) to forecast the storage basis, which Taylor, Dhuyvetter, and Kastens (2006) argued provided better forecasts of basis than did moving averages.

The second step is to determine the relationship between the dependent variables (gross revenue, basis change, basis change less storage cost, and futures price change) and independent variables (initial basis or basis deviation, futures price deviation, and futures price spread). This will provide a way to test the hypotheses that grain owners can use basis, futures prices, and futures price spread as market signals to store or sell their wheat at harvest.

Ordinary least squares regression models are developed for each model using data from 1975-2005. Using equations (5), (6), and (7) the dependent variables are each regressed on the independent variables as either

$$Y_t = \gamma_0 + \gamma_1 \text{Initial Basis}_t + \gamma_2 \text{Futures Price Deviation}_t + \gamma_3 \text{Futures Price Spread}_t + \varepsilon_t \quad (8)$$

or

$$Y_t = \gamma_0 + \gamma_1 \text{Basis Deviation}_t + \gamma_2 \text{Futures Price Deviation}_t + \gamma_3 \text{Futures Price Spread}_t + \varepsilon_t \quad (9)$$

where  $Y_t$  is the dependent variable at time  $t$  and  $\varepsilon_t$  is the error term. The regression model presented in equation (8) is applied using basis change as the dependent variable. The regression model presented in equation (9) is

applied using basis change, basis change less cost of carry, futures price change, and gross revenue as dependent variables.

### 5. Model Misspecification Tests

The third step is to conduct misspecification tests for all the regression models. The misspecification tests conducted are normality, static homoskedasticity, autocorrelation, joint conditional mean, and joint conditional variance (McGuirk, Driscoll, and Alwang, 1993). Each misspecification equation as well as its corresponding null and alternative hypotheses is presented.

The omnibus test ( $K^2$ ) is used to detect deviation from normality as a result of either skewness or kurtosis. This test and its corresponding null and alternative hypotheses are expressed as

$$K^2 = Z^2(\sqrt{b_1}) + Z^2(b_2) \sim \chi_2^2 \quad (10)$$

$$H_0 = \mu \sim N \Rightarrow \sqrt{b_1} = 0 \text{ and } b_2 = 3 \quad (11)$$

$$H_a = \mu \text{ not } \sim N \Rightarrow \sqrt{b_1} \neq 0 \text{ or } b_2 \neq 3$$

where  $K^2$  is the omnibus test statistic,  $Z(\sqrt{b_1})$  represents skewness and is asymptotically standard normal with mean zero and variance one, and  $Z(b_2)$  represents kurtosis and is asymptotically standard normal with mean zero and variance one.

The static homoskedasticity test is conducted using regression specification error test Kolmogorov-Gaborpolynomials (KG2). Mathematically, the artificial regression is

$$\widehat{\varepsilon}_t^2 = \alpha + \Delta' \Psi_t + v_t \quad (12)$$

$$H_0 : \Delta' = 0 \quad (13)$$

$$H_a : \Delta' \neq 0$$

where  $\widehat{\varepsilon}_t^2$  is the predicted error term squared,  $\Psi_t$  is the KG2 test, and  $v_t$  is the error term.

The autocorrelation test is conducted with an artificial regression as

$$\widehat{\varepsilon}_t = \beta'_0 X_t + \Lambda' \widehat{\varepsilon}_{t-1} + v_t \quad (14)$$

$$H_0 : \Lambda' = 0 \quad (15)$$

$$H_a : \Lambda' \neq 0$$

where  $\widehat{\varepsilon}_t$  is the predicted error term,  $X_t$  is the independent variable,  $\widehat{\varepsilon}_{t-1}$  is predicted lagged dependent variable, and  $v_t$  is the error term.

Conditional mean tests are conducted together to test for parameter stability, functional form, and independence. Mathematically, the artificial regression is

$$\widehat{\varepsilon}_t = \beta'_0 X_t + \Gamma_P' \Psi_t^P + \Gamma_F' \Psi_t^F + \Gamma_I' \Psi_t^I + v_t \quad (16)$$

$$H_0 : \Gamma_P = \Gamma_F = \Gamma_I = 0$$

$$H_a : \Gamma_P \neq 0 \text{ or } \Gamma_F \neq 0 \text{ or } \Gamma_I \neq 0 \quad (17)$$

where  $\widehat{\varepsilon}_t$  is the predicted error term,  $X_t$  is the independent variable,  $\Psi_t^P$  represents the structural change using time trend,  $\Psi_t^F$  represent non-linearity using KG2 test,  $\Psi_t^I$  is the lagged error term, and  $v_t$  is the error term.

Conditional variance tests are conducted to check for static and dynamic heteroskedasticity. This test is based on the following artificial regression

$$\widehat{\varepsilon}_t^2 = \Gamma_P' \Psi_t^P + \Gamma_S' \Psi_t^S + \Gamma_D' \Psi_t^D + v_t \quad (18)$$

$$H_0 : \Gamma_P = \Gamma_S = \Gamma_D = 0 \quad (19)$$

$$H_a : \Gamma_P \neq 0 \text{ or } \Gamma_S \neq 0 \text{ or } \Gamma_D \neq 0$$

where  $\hat{\varepsilon}_t^2$  is the predicted error term square,  $\Psi_t^P$  allows structural change using time trend,  $\Psi_t^S$  allows the static heteroskedasticity using KG2 test, and  $\Psi_t^D$  allows for dynamic heteroskedasticity, and  $v_t$  is the error term.

In models where the normality assumption is violated, the nonparametric bootstrap method is used. This method does not make any distributional assumption such as normality (Greene, Chapter 16). When the autocorrelation assumption is violated, the model is estimated using maximum likelihood (Gujarati, 1995).

## 6. Results

Tables 2 and 3 report parameter estimates for four different models in which the dependent variables (basis change, basis change less storage cost, futures price change, and gross revenue) are regressed on basis deviation, futures price deviation and futures price spread. A fifth model regresses basis change on initial basis (rather than basis deviation), futures price deviation and futures price spread. The results in table 2 assume that grain is stored from harvest until the end of November, and the December contract is used for hedging. The results in table 3 assume that grain is stored from harvest until the end of August, and the September contract is used for hedging. (Note 5)

The regression results indicate that basis deviation is statistically significant in predicting basis change and basis change less storage cost. Initial basis is also statistically significant in predicting basis change. The signs are negative in these cases, indicating that the lower June basis is, or the lower June basis is relative to the expected basis at delivery, the higher is the return to hedged grain. Basis deviation is not significant in predicting futures price change or gross revenue. Neither futures price deviation nor futures price spread is significant in predicting any of the dependent variables. This result is consistent with efficient markets theory, with a statistically more powerful empirical test than some previous approaches have provided.

Zulauf and Irwin (1998) found that basis is a useful signal for hedged storage, but not for unhedged storage. Although our results essentially agree with theirs, our interpretation is slightly different. We argue that basis is a useful indicator whether the grain is hedged or unhedged, but the statistical power of the test is larger with hedged storage.

Although the coefficient on basis deviation is not statistically significant in predicting gross revenue (unhedged storage), the results in table 2 suggest that to the extent that futures prices are efficient, basis deviation is a useful predictor of returns to even unhedged storage. By definition, the dependent variable Basis Change equals Gross Revenue minus Futures Price Change – in other words, Basis Change (return to hedged storage) is equal to the change in cash prices less the change in futures prices. If futures prices are efficient, expected Futures Price Change is zero, and expected basis change (Basis Deviation) predicts an equivalent change in basis (Basis Change) and in Gross Revenue (unhedged return to storage).

Supporting this theoretical argument, in table 2, the coefficient on Basis Deviation in the Basis Change regression (-0.4182) is very near the difference between the coefficients on Basis Deviation in the Gross Revenue and Futures Price Change regressions (- 0.2312 - 0.20225 = -0.4376). If the coefficient on Basis Deviation in the Futures Price Change regression were zero, the effect of Basis Deviation on Basis Change would be almost equal to its effect on Gross Revenue. The extra randomness in our gross revenue regression (“unhedged storage” in Zulauf and Irwin (1998)) leads to high variability in returns to storage, so that the insignificance of the basis as a barometer in these regressions is due to this variability (“noise”) and not because basis is not a useful indicator.

The explanatory power of the regression using initial basis to predict basis change is slightly higher than that of the regression using basis deviation, for hedging on the December futures contract and liquidating at the end of November. In contrast, for hedging on the September contract and liquidating the hedge at the end of August, the results in table 4 show that the explanatory power of the regression using initial basis is much lower than that using basis deviation, and the coefficient on initial basis is statistically insignificant. For a hedge on the September contract, adjusting for past variation in ending basis added predictability.

Tables 4 and 5 report results of misspecification tests for these models. The misspecification tests employed were: normality test (omnibus test), homoskedasticity test (Harvey and Godfrey LM test), autocorrelation test (Durbin-Watson test), joint conditional mean, and joint conditional variance. The results in tables 4 and 5 indicate that we reject the null hypothesis of normality for the basis change and basis change less cost of carry models. For these models nonparametric bootstrapping, which does not require normality, was employed.

## 7. Conclusions

The results show that basis is a more consistent market signal than futures price or futures price spread for wheat producers and grain elevator managers to use when deciding to store or sell their wheat at harvest. This finding is important because although the theoretical argument is strong, the empirical research has been more suggestive than

conclusive. Thus, these results answer our earlier research question, “Are there market signals that grain producers and elevator managers can use to make the harvest store/sell decision?” The answer is “Yes, basis should be used as a market signal by wheat producers and grain elevator managers.” For greater assurance, however, in achieving expected returns to storage, the grain should be hedged using the futures market, not just stored.

Earlier research relied on simulation methods that may have lower power than the regression approach used here. The results indicate that basis is the single most important indicator that can affect the decision to store or sell wheat at harvest. The theoretical argument is strong and the empirical research results are strong for using basis as a barometer.

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## Notes

Note 1. Usset uses the term “carry charge” for the indicator referred to here as spread.

Note 2. Although an individual producer would find analysis using prices from a particular location more useful than state average prices, the purpose of the paper is to test usefulness of recommended rules of thumb. Using state averages reduces noise in the data, raising the power of the statistical tests.

Note 3. Working (1953) notes that basis by itself is a good predictor of a hedger’s profit from storage. Basis deviation as defined here is a similar measure, but may be more useful as a rule of thumb for a hedger since it can be directly interpreted as being high or low whereas initial basis alone still needs a benchmark to compare to in order to reach a decision.

Note 4. Hatchett et al. (2010) found that a 1-yr moving average of previous basis was a slightly better predictor of ending basis than a 3-yr. or 5-yr. moving average, but in our analysis a five-year moving average performed very slightly better.

Note 5. For storage until September, all November prices are replaced with September prices

Table 1. Pre-harvest Market Signals and Marketing Strategies to Consider

Market Signal (Basis)	Price	Potential Strategies
Weak	Low	Store unhedged
Weak	High	Store and hedge
Normal	Normal	Stagger sales
Strong	Low	Sell & buy call option;
Strong	High	Basis contract
		Sell at harvest

Source: Original source is unknown.



Table 2. Parameter Estimates for Five Models: Storing until November

Variables	Basis Change (w/Basis Deviation <sub>t</sub> )	Basis Change (w/Initial Basis <sub>t</sub> )	Basis Change Less Cost of Carry	Futures Price Change	Gross Revenue
Intercept	0.1817 (0.2365)	-7.3628 (4.8795)	0.1363 (0.2390)	8.8407 (18.2494)	17.3601 (17.9953)
Basis deviation	-0.4182** (0.0030)	-	-0.4376** (0.0015)	0.20225 (0.9160)	-0.2312 (0.9033)
Initial Basis	-	-0.5393** (0.14662)	-	-	-
Futures price deviation	0.0217 (0.4165)	0.0217 (0.0205)	0.0135 (0.3470)	-0.1685 (0.1487)	-0.1506 (0.1466)
Futures Price Spread	0.2578 (0.4480)	0.1123 (0.24892)	0.1992 (0.3920)	-0.2761 (1.7102)	-0.0605 (1.6864)
R <sup>2</sup>	0.6029	0.6294	0.5784	0.0539	0.0444

Note: P-values are in parentheses under the coefficients for *Basis Change(w/Basis Deviation)*, and *Basis Change Less Cost of Carry* as these models were re-estimated using a non-parametric bootstrap method because the normality assumption was violated (see Table 4 & 5). However, standard errors are in parentheses under the coefficients for the *Basis Change(w/Initial Basis, Futures Price Change, and Net Revenue* models.

\*\* indicates significance at the 5% level.

Table 3. Parameter Estimates for Dependent Variables Basis Change, Futures Price Change, and Net Revenue (1975-2005): Storing until September

	Basis Change (w/Basis Deviation <sub>t</sub> )	Basis Change (w/InitialBasis <sub>t</sub> )	Basis Change Less Cost of Carry	Futures Price Change	Gross Revenue
Intercept	0.0122 (0.2555)	-3.6497 (6.1215)	0.1869 (0.2305)	8.6928 (19.7276)	19.3069 (19.4741)
Basis deviation	-0.3082** (0.0115)	-	-0.3219** (0.0125)	0.2293 (0.8465)	-0.0866 (0.8355)
Initial Basis	-	-0.1984 (0.1838)	-	-	-
Futures price deviation	0.0163 (0.3825)	0.0079 (0.02495)	0.0082 (0.3105)	-0.1744 (0.1444)	-0.1608 (0.1425)
Futures Price Spread	0.4502 (0.4865)	0.4018 (0.3139)	0.3952 (0.4710)	-0.3363 (1.6123)	0.0675 (1.5916)
R <sup>2</sup>	0.5365	0.3414	0.5115	0.0630	0.0515

Note: P-values are in parentheses under the coefficients for Basis Change with Basis Deviation (*BD*), and Basis Change Less Storage Cost as these models were re-estimated using a non-parametric bootstrap method because the normality assumption was violated (see Table 4 & 5). However, standard errors are in parentheses under the coefficients for the Basis Change with Initial Basis (*IB*), Future Price Change, and Net Revenue models. \*\* indicates significance at the 5% level.

Table 4. Misspecification Tests for Basis Change, Futures Price Change, and Net Revenue (1975-2005):  
Storing until November

	<i>Basis Change</i> (w/ <i>Basis Deviation<sub>t</sub></i> )	<i>Basis Change</i> (w/ <i>Initial Basis<sub>t</sub></i> )	<i>Basis Change</i> <i>Less Cost of Carry</i>	<i>Futures Price Change</i>	<i>Gross Revenue</i>
Normality (Omnibus test)	(0.0682)**	(0.1562)	(0.0739)**	(0.5639)	(0.5390)
Static Homoskedasticity (White test)	0.9600 (0.4462)	1.0900 (0.3854)	1.0900 (0.3869)	0.9600 (0.4796)	1.0200 (0.4319)
Autocorrelation (Durbin-Watson test)	1.8709 (0.2984)	1.8914 (0.3391)	1.8744 (0.3107)	2.2079 (0.6255)	2.1574 (0.5712)
Joint Conditional Mean	1.0800 (0.4077)	1.2200 (0.3374)	1.2400 (0.3290)	1.1900 (0.4797)	0.2500 (0.9346)
Joint Conditional Variance	1.5000 (0.2396)	1.2400 (0.3270)	1.3000 (0.3004)	1.1200 (0.5020)	0.9200 (0.5493)

Note: For static homoskedasticity, joint conditional mean, and joint conditional variance tests the  $F$  critical value is presented with the  $p$ -value in parentheses. For the autocorrelation and normality tests the  $p$ -value is in parentheses. \*\* indicates significance at the 5% level.

Table 5. Misspecification Tests for Basis Change, Futures Price Change, and Net Revenue (1975-2005):  
Storing until September

	<i>Basis Change</i> (w/ <i>Basis Deviation<sub>t</sub></i> )	<i>Basis Change</i> (w/ <i>Initial Basis<sub>t</sub></i> )	<i>Basis Change</i> <i>Less Cost of Carry</i>	<i>Futures Price Change</i>	<i>Gross Revenue</i>
Normality (Omnibus test)	(0.0298)**	(0.2270)	(0.0360)**	(0.6333)	(0.6613)
Static Homoskedasticity (White test)	1.1400 (0.3613)	0.9500 (0.4542)	1.1900 (0.3426)	0.9200 (0.4988)	2.1700 (0.1261)
Autocorrelation (Durbin-Watson test)	1.8581 (0.2951)	1.7633 (0.1883)	1.8690 (0.3135)	2.2010 (0.6120)	2.1682 (0.5766)
Joint Conditional Mean	1.3200 (0.2931)	0.8500 (0.5438)	1.5200 (0.2218)	2.2100 (0.2756)	3.0000 (0.1535)
Joint Conditional Variance	1.1300 (0.3824)	0.6800 (0.6642)	1.0200 (0.4416)	3.0000 (0.2711)	3.8700 (0.1470)

Note: For static homoskedasticity, joint conditional mean, and joint conditional variance tests the  $F$  critical value is presented with the  $p$ -value in parentheses. For the autocorrelation and normality tests the  $p$ -value is in parentheses. \*\* indicates significance at the 5% level.

# Political Corruption, Economic Incentive, Educational Resource Input, and the Quality of Human Capital: A Panel Analysis Over Twenty-Five Years for the Fifty U.S. States

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## Abstract

This paper uses panel regression analysis on annual data for the fifty states for the period 1980 to 2004 to estimate the potential impact of political corruption on the quality of human capital, as measured by mean state student performance on scholastic aptitude math and verbal exams. The findings are consistent with the hypothesis that political corruption has a negative effect on the quality of human capital, and, as a result, a detrimental effect on economic growth. In addition, the results of the paper suggest that economic incentive also matters for educational performance, and that, unlike the findings of some earlier studies, input into the educational process, in terms of expenditure per pupil, has a positive effect on educational performance.

**Keywords:** Human Capital, Corruption, Educational performance

## 1. Introduction

Studies using international data suggest that corruption has a negative effect on economic growth (Mauro, 1995). One of the possible paths by which corruption may exert a damaging negative influence on economic growth is through its effect on human capital. The study of human capital focuses on income distribution and returns on investment in human capital as measured by income variances in society (Mincer, 1970). In an international setting, human capital is becoming more and more important as a factor in international competition with the emergence of the knowledge economy. In a knowledge economy, value is placed on knowledge-based productivity rather than resource-based productivity typically associated with an industrial economy (Levine, 2001). In recent years, governments, banks and researchers have attempted to measure and evaluate countries based on a Knowledge Economic Index (KEI). This index offers a new view of productivity that, along with theoretical measurement models, attempts to incorporate the value of knowledge into the valuation of production. Seen as a key factor in the development of wealth among countries, knowledge is recognized as a valuable resource and strong education systems are cited as essential for economic development in a knowledge economy (World Bank, 2010). This lends increasing importance to the assessment of the impact of financial resources on educational outcomes.

This paper serves to analyze the effects of corruption on educational outputs and utilizes an economic perspective to identify potential relationships between corruption, economic motivation, economic inputs and the development of human capital. An economic view of resources and the influence of corruption across states provide a new perspective on the connection between inputs and student outcomes. The integration of economic theory and educational theory, combined with a panel analysis considers the relationships between these variables in a way that has not been considered in prior studies.

In order to accomplish these objectives, this paper is organized to address three specific objectives. The first is to see whether state political corruption has a negative effect on the quality of human capital as measured by mean state scholastic aptitude test scores in verbal and math tests. The second is to see whether an economic motivational variable is relevant for educational performance. If an economic motivational variable is important, then the omission this variable may be a serious problem in models that attempt to explain educational performance. It could lead some studies to the economically non-intuitive statistical result that greater educational spending categorically has no impact on educational performance. When one increases educational input in a setting in which there is little or no economic motivation, it should be expected, not surprising, that an increase in educational inputs has little or no effect on performance. The third purpose of the paper is to see whether, once one accounts for an economic motivational variable, increased educational spending per student increases educational performance.

The paper is divided into six sections. The second section briefly highlights some of the pertinent literature. The third section discusses a simple production function style model that incorporates political corruption, resource expenditure, and economic motivation as arguments to explain educational quality. In addition, the third section identifies the variables that are used in the empirical analysis, their sources, and their relevance. The fourth section presents the results of regression runs across states and over time on a panel consisting of fifty states and twenty-five years of data. The fifth section provides a brief discussion and conclusion and the sixth and final section addresses limitations of the study.

## **2. Literature**

### *2.1 Economic Impact of Corruption*

While the consequences of corruption on an economy are discussed in economic literature, the relationship between corruption and the economic investment in human capital is considered in this study.

Corruption may take many forms within a given society. Politicians have incentive to distribute public resources to special interests, and simultaneously have an expectation of receiving personal resources in exchange to such distributions. In addition, public employees may claim benefits to which they are not entitled or provide preferential treatment in exchange for personal resources. In performing their duties, public employees may avoid performing necessary job duties, neglect oversight of employees or resources, or secure resources from sources that provide individual incentives (Hopkins, 2002).

Given that education is publicly funded, the issue of corruption holds relevance when considering the public distribution of funds, the choices regarding the effective deployment of resources, and the potential outcomes for student learning. Hanushek (1997) stated that, the structure of legislative funding presumes that spending decisions are best made by individual school districts, as they would be highly motivated to deploy resources effectively. At the same time, both the states and the federal government maintain a broad range of requirements and regulations to exert control over local districts' actions, which suggests "considerable distrust of the motivations and/or abilities of the local districts" (Hanushek, 1997, p. 154). At the same time, he noted that, in order for legislators and local districts to direct funding in ways that would improve student performance, one must know which initiatives would be most effective (Hanushek, 1997).

An initial review of the literature on the subject of corruption provides a number of articles that evaluate the economic impact of corruption. Mauro (1995) analyzed a cross-section of countries and found that corruption reduced economic growth by lowering physical investment. He also suggested that low levels of corruption may lead to high investment and growth (Mauro, 1995). Meon and Sekkat (2005) also analyzed the effects of corruption on the economy noting that corruption has a negative effect on both economic growth and investment.

One study that looked at the potential pathways by which corruption may negatively affect economic growth is the article by Pak Hung Mo (2001). Using the corruption perception index of Transparency International as a measure of corruption in a cross-country panel, Mo found that corruption exerts a negative effect on economic growth. This negative effect operates through three distinct channels: by reducing the level of physical investment in a country; by lowering the amount of investment in human capital; and by increasing political instability that results from the generation of unjustified income differences (Mo, 2001).

Political corruption may be detrimental to the quality of educational human capital for two reasons. First, corruption is likely to distort incentives (Mo, 2001) which, when applied to the field of education may affect the budgeting of educational funds within the legislature as well as the use of funds within the schools themselves. Such corruption could lead to misappropriation of funds, resource misallocation, and inefficiency. Second, corruption reduces the rate of return of investment in legitimate productive activities (Mo, 2001), thereby suggesting that both productivity gains as well as investment of resources in human would be reduced.

Aside from the issue of corruption, Chubb and Moe (1990) express skepticism that normally functioning democratic institutions are compatible with an efficient educational system. They indicate that democratic institutions, due to the very nature of democracy itself, fail to put adequate pressure on poorly performing schools to improve or that they do not sufficiently encourage successful schools. This suggests that corruption within a democratic institution may meet little resistance, and has broad implications for poorly performing schools.

Much of the literature on the topic of political corruption considers corruption across countries using published corruption indices as proxies for corruption. Mauro (1995) analyzed institutional factors and corruption to assess the impact of these factors on economic growth. We could not identify any similar established index of corruption to provide a proxy for measuring corruption across states within the U.S., so the data was compiled using data described in the Methods section of this study.

### *2.2 Economic Motivation and the Gini Index*

This study employs the Gini index as a measure of inequality of income, which may serve as a form of incentive or economic motivation within a society (Aghion, Caroli & Garcia-Penalosa, 1999). The Gini index has evolved as a principal measure of inequality within the field of economics within the last century, and may be used to measure the dispersion of a distribution of many types of data (Xu, 2004). While often used as a means to measure general income or resource disparity between countries, the Gini index has been used within the context of education to evaluate disparities in family income, school resources, funding (Baird, 2008; Peternick, et al., 1997; Wyckoff, 1992) and inequality in educational attainment (Mayer, 2000; Thomas, Wang & Fan, 2001).

Both the field of education and the field of economics consider the concept of human capital in terms of accumulated education and suggest that human capital serves to support economic returns to individuals and society (Mincer, 1970; Thomas, Wang & Fan, 2001). Hanushek (2006, p. 869) notes the importance of long-term academic outcomes and states that “future incomes of individuals are related to their past investments”. While economic theory suggests that income inequality provides incentive for greater productivity (Aghion, Caroli, & Garcia-Penalosa, 1999), educational inequality has been shown to be counter-productive for economic growth within a society (Thomas, Wang & Fan, 2001).

In support of the view of economic inequality as a motivator, Aghion, Caroli and Garcia-Penalosa (1999, p. 1615) state that “the conventional textbook approach is that inequality is good for incentives and therefore, good for growth, even though incentive and growth considerations might (sometimes) be traded off against equity”. The term incentive and motivation are often used interchangeably in economic literature.

At the same time, Cornia and Court (2001) suggest that inequality must be at a balanced level in order to provide an incentive or motivation for achievement. Extreme inequality (either too high or too low) can depress economic growth. Total lack of inequality removes incentive for increased effort as noted in certain socialist economies in the 1980s. Conversely, high inequality can lead to inefficient economies and can have a detrimental effect on education and the development of human capital. The researchers suggest that Gini coefficients of 25 to 40 appear to provide efficient levels of economic growth, and those societies seeking to reduce poverty should aim for a Gini index in the low level (25) of the efficiency range. They rationalize that economic inequality at the lower level of the range would generate the same economic growth with a faster decline in poverty levels (Cornia and Court, 2001).

In developing this study, we recognize that there is an issue with regard to the interpretation of motivation itself. While this paper takes an economic view of motivation, we recognize that motivation has been studied from other perspectives. Weiner (1990) in his “History of Motivational Research in Education,” noted the many dimensions and perspectives regarding the study of motivation. He explored the perspective of various researchers and educational psychologists who have studied motivation in an effort to identify factors that stimulate learning. The review also discussed the view that the educational research regarding motivation is confounded by the research on learning. He noted that academic performance has often be interpreted as a sign of motivation in the literature, and recognized that many variables related to learning and outcomes are inseparable or, at least, not individually identifiable. In performing this study, we recognize that the interpretations of motivation, as well as the foundational views of motivation, are varied. We believe that an economic perspective of motivation may offer a view that is relevant for policy and funding of education in the future (Weiner, 1990).

### *2.3 Educational Resources and Productivity*

The literature investigating educational productivity, which looks into the reasons for school effectiveness, is quite extensive. While the concept of productivity originates in the field of economics and centers around the relationship between economic inputs and outputs, the concept of productivity has been applied to the field of education. Within

the context of an education system, productivity generally refers to the use of inputs or resources to produce educational outcomes (Ladd & Hansen, 1999).

Reynolds, Teddlie, Creemers, Sheerens and Townsend (1999) categorized the U.S. literature on the subject into four different stages of development, noting the evolution in the literature regarding educational resources and productivity. They note that research in the 1960's began with a focus on the outcomes resulting from the application of resources while, by early 1970, research centered on the concepts of 'effective schools' and school outcomes. As the decade progressed, the 'effective school' practices evolved into targeted programs for improvement in school performance. Toward the late 1980's, research considered contextual factors and integrated previous theories on school effectiveness (Reynolds, et al., 1999).

Since that time, Reynolds et al. (1999), noted a decline in research on school effectiveness within the U.S. as compared with other countries and attribute the decline to a number of factors, including growing criticism of effective schools theory and the emergence of research that suggested that economic inputs did not affect student achievement (Reynolds, et al., 1999). They did indicate, however, that other countries such as the United Kingdom and the Netherlands actively pursued research in this field, noting increasing sophistication of their research methods.

A second review published by The National Research Council (1999), sorts past research efforts on the basis of whether researchers use an input-output approach, an educational practice, or an institutional approach in their research methodologies.

For the purposes of the present study, the major focus is the overall finding of the early input output studies with regard to educational performance and total educational expenditures. The frequently quoted original empirical study supporting the economically unpalatable theme that money does not matter for student educational achievement was the Coleman Report in the 1960s (Coleman et al. 1966). Using a sample of four thousand schools, Coleman and his colleagues concluded that, across schools, differences in school resources had little effect on achievement. The Coleman Report was quickly followed by a host of other empirical studies looking into the matter. Subsequently, Hanushek reviewed the outcomes of a substantial number of these studies and, collaborating Coleman, concluded that, overall, the studies, as a group, did not support any real systematic relationship between school spending and student achievement (Hanushek 1986, 1989, 1997).

The Coleman and Hanushek position of no resource effect on achievement, while taking on the auspices of conventional wisdom, has not gone completely unchallenged. Hedges, Laine and Greenwald (1994a) performed a meta-analysis on the same studies used by Hanushek, noting a significant, positive relationship between resource input and educational performance. They also cited as a methodological limitation of the Hanushek study noting that it employed a tally of previous research outcomes and, therefore, did not address the magnitude of the statistical effects.

In response, Hanushek (1997) maintained that there is little relationship between school resources and student outcomes, and suggested the potential for positive outcomes from additional resource allocations, even though the data indicated that such gains are infrequent. He also offered potential reasons for this conclusion, focusing on the effectiveness of resources. He suggested that the political economy may influence the ways in which school districts utilize resources and this may have considerable impact on the potential for gains in student performance. While some districts may use their resources effectively, he noted that ineffective use of resources could actually be detrimental to gains in student performance (Hanushek, 1997).

In response to Hanushek (1997), Hedges, Laine, and Greenwald (1994b) maintained that the relationship between resources and student performance is positive and significant, and suggest that the focus of further study should be on analyzing the magnitude of the positive relationship.

Research by Peltzman (1993) noted that, despite increases in overall spending on education, changes in political priorities and the rise of unions is correlated with the decline in student performance between 1960 and 1970. He suggested that competition among pressure groups for distribution of resources may have signaled a shift in the ways in which resources were utilized within school districts. He further states that schools are poorly organized to support allocation of resources in ways that improve student performance (Peltzman, 1993). As school districts shifted the ways in which they utilize resources over time, this may affect student achievement when viewed from a historical perspective (Hanushek, 1997; Peltzman, 1993). Using this theory, the level of spending may be less a factor than the political decisions employed in utilization.

Ladd and Hansen (1999) echo the idea that the effectiveness is dependent upon linking deployment to educational goals. They suggest that bureaucracy may interfere with productivity improvement initiatives and can contribute to a lack of accountability in terms of resources and educational outcomes.

Despite this ongoing discussion in the literature, Hanushek (1997) states that, while he found no significant increase in outcomes as a result of additional resources, the lack of sufficient resources would certainly result in a decline in student achievement.

Although these resource-based studies consider the potential impact of resources on educational outcomes, they fail to give adequate weight to the economic motivational dimension provided by unequal income distribution, which may influence educational performance.

#### 2.4 Measurement of Education Productivity

This study uses SAT scores generated between years 1980 – 2004 to analyze student performance. Hanushek and Kimko (2000) suggest that math and science skill serves as a reasonable proxy for the measurement of human capital. SAT scores have been used frequently in the literature as a measure of student performance (Hanushek, 2006; Peltzman, 1993). Hanushek (2006) performed an analysis of 376 studies of educational outcomes noting that 75% of them measured student performance using standardized test scores. Using SAT scores as the basis for measuring student performance offers a long-term perspective on student performance. At the same time, SATs are taken on a voluntary basis and may not reflect overall performance of all eligible students (Hanushek, 2006).

In measuring the affect of income disparity on SAT scores, the College Board provided 2010 data showing that students with family incomes of more than \$200,000 showed test results that were 29.9% higher in Critical Reading, 27.4% higher in Mathematics, and 31.3% higher in Writing than students whose families earned between \$0 and \$20,000 annually (College Board, 2010). This disparity suggests that income inequity is related to disparity in SAT results on an individual level. This is consistent with the literature that links low education levels to lower income (Thorbecke & Charumilind, 2002).

In addition to the relationship between income and SAT scores, the literature indicates that disparity in SAT scores is generally interpreted to reflect differences in school quality (Hanushek, 2006).

How are SAT scores linked to the discussion of human capital? Hanushek and Kimko (2000) indicate that math and science ability serve as a appropriate measures of human capital and are integral to the evaluation of skill levels of the labor force. Research also indicates that students' skill-based test performance has a long-term impact on future earnings (Murnane, Willett, Duhaleborde & Tyler, 2000).

### 3. Method

#### 3.1 Procedure

In an effort to evaluate the relationship between corruption, human capital, resource input and income differentiation, this study employs a simple production function for educational quality. It consists of a single equation with its associated partial derivatives. The single equation that makes up the model is as follows.

$$Q = f(C, I, M, \mathbf{Z}) \quad \delta Q / \delta C < 0, \delta Q / \delta I > 0, \delta Q / \delta M > 0 \quad (1)$$

In the equation, Q represents the quality of human capital in the form of education, C is the extent of public corruption, I represents the amount of resource input into the educational process, M represents the level of economic motivation, and  $\mathbf{Z}$  is used to represent other potential cultural and environmental variables of relevance, which for purposes of this study, considers population.

The negative partial derivative between the quality of educational human capital and public corruption means that public corruption is expected to have a negative effect on educational quality. This would be consistent with the literature on projected expectations for consequences of corruption (Chubb & Moe, 1990; Mo, 2001).

$$\delta Q / \delta C < 0$$

The literature on the impact of increased resources is divided between some researchers who have found no significant increase in student outcomes (Coleman, et al., 1966; Hanushek, 1986, 1989, 1996, 1997, 2006) and those who have found a positive impact to student outcomes (Hedges, Laine, & Greenwald, 1994a, 1994b). To test the impact of additional resources on student performance, this study predicts that increased resource input leads to improvement in the quality of educational capital.

$$\delta Q / \delta I > 0$$

Lastly, it is anticipated that income disparity may serve as an economic motivator (Aghion, Caroli, & Garcia-Penalosa, 1999), and that economic motivation has a positive effect on educational human capital quality.

$$\delta Q / \delta M > 0$$

The literature notes that people, including parents and students, respond to incentives. As parents perceive a greater return on investment from education, their incentive to support education for their children increases (Thorbecke & Charumilind, 2002). A fundamental presupposition of economics is that behavior depends on incentives. Thus, the model maintains that the greater the reward, the greater the perceived reward, from engaging in an activity, the more motivated people will be to undertake an activity, and the more energy and effort they will devote to the activity. One can consider two important factors in educational performance, educational inputs and motivation. If inputs and motivation are high, then performance will be high, but if inputs and motivation are low, then performance will be low. Now, what is important, indeed critical to realize, is that, when there is little expected reward from an activity, even if inputs into an activity are enormous, then performance is still likely to be poor. A fortiori this is apt to be the case for student educational performance in a school environment in which education is provided free.

This study further assumes that student expectations on the rewards from differences in school performance are formed by looking at the current distribution of income and evaluating its sources. The more people feel that inequality in the distribution of income is due to differences in school performance, and, the greater is the inequality in the distribution of income due to differences in school performance, the more motivated students will be to perform well in school. In the very extreme, if income is distributed equally, that is, if there is absolutely no inequality in distribution of income in society, then, assuming no intrinsic value to education itself, there is no incentive to perform well in school, that is, the motivation for school performance is absolutely non-existent. In this situation, high levels of educational input will be accompanied by low levels of educational performance and increasing educational expenditures per student will have no effect on student performance.

Hanushek (2006) did point out that, contrary to the economic assumption that individuals make decisions regarding investments in education and expected future benefits, in the case of education, parents serve as trustees to make many educational choices for students. Those choices made by parents on behalf of children may include such things as choice of school district, and may be influenced by expected future returns on educational investment. From an economic standpoint, this study maintains that income disparity serves as a motivator, whether directly or indirectly via parent choice.

### 3.2 Variable Sources

The panel data set for the analysis consists of six variables for the fifty states in the United States for the twenty-five year period from nineteen eighty to two thousand and four. The six variables in the panel, followed, in parenthesis, by their assigned variable names for the paper, are the math scholastic aptitude scores (MATHSAT), the verbal scholastic aptitude score (VERBALSAT), political corruption (PUBCORRUPT), the Gini income coefficient (GINI), real expenditures per pupil (REALEXPPERPUPIL), and population per square mile (POPDEN).

The average yearly state scholastic aptitude verbal (VERBALSAT) and math (MATHSAT) scores for high school seniors for the years 1981 to 1984 and 1990 to 2004 are abstracted from the college board website (College Board 2009). The years 1985 to 1989 and 1980 come from the Duke University Economics Department website (Duke University 2009).

We were unable to locate any established index to use for corruptions by state; therefore, this data was compiled for this study. The political corruption variable (PUBCORRUPT) uses the yearly number of federal convictions of corrupt public officials by state. The Public Integrity Section of the Criminal Division of the United States Justice Department, in their annual report to Congress, provides figures on the number of federal prosecutions of corrupt public official convictions of public officials by judicial districts (U.S. Department of Justice, Public Integrity Section, 1980-2005). The annual judicial district numbers were tallied to obtain the number of convictions by state.

The Gini coefficient of annual real state personal income inequality (GINI), is employed in the paper as a motivational variable for the years 1963 through 2003 (Guetzkow, 2009). Guetzkow calculates the Gini coefficients using the annual March Current Population Survey for smoothed data on total family income. The figures are adjusted to 2002 dollars by using the consumer price index deflator for all urban consumers (Guetzkow, 2009).

The measure of real 2005 dollar spending per student (REXPPERPUPIL) is the current expenditure per pupil in average daily attendance in public elementary and secondary schools by state divided by the U.S. GDP deflator for 2005. As the U.S. GDP deflator data is quarterly, the mean of the four quarters during the year is used as the yearly deflator in the conversion of annual nominal expenditures per pupil into real expenditures per pupil. The GDP deflator was obtained from the St. Louis Federal Reserve (St. Louis Federal Reserve, 2009). The Federal Reserve's original source for the data comes from the U.S. Department of Commerce. Current expenditures per pupil in



average daily attendance were obtained from the Department of Education's Digest of Current Educational Statistics (U.S. Department of Education 1990, 1999, 2000, & 2005).

The overall state environmental variable, population density (POPDEN), is equal to state population divided by the area of the state in square miles. Yearly state population comes from the United States Census Bureau (U.S. Census Bureau 2009). The area of each state in square miles was obtained from the Enchanted Learning website (Enchanted Learning, 2009).

The only missing values in the data set are on the public corruption variable for the years 1997 and 1999 for the State of New Mexico. Without these two missing values, the entire panel of data would be balanced for the fifty states over the twenty-five year period.

## 4. Results

### 4.1 Educational Performance Panel Regressions

Table I shows the results of regressions of the quality of human educational capital, measured by average state high school senior math and verbal SAT scores, on a set of variables proposed by the theoretical model in the second section of the paper.

Table 1 is organized as follows. The first column lists the independent variables. Each of the four subsequent columns shows the results of an individual regression run. The four different regression runs are numbered at the very top of the columns in the first row. The second row shows the estimating technique used in the equation and the third row identifies the dependent variable in the equation, math scholastic aptitude scores (MATHSAT) or verbal scholastic aptitude scores (VERBALSAT). The first pair of equations in Table 1, equations (1) and (2), shows the regression of mean state math sat scores and mean state verbal sat scores on public corruption and the three other explanatory variables using ordinary least squares. The second pair of equations, equations (3) and (4) re-estimates equations (1) and (2) using period seemingly unrelated regression (SUR).

For any given variable and equation, the top most value in the body of the table shows the estimated coefficient for the selected variable and equation. The individual t-statistic for the coefficient is underneath the estimated coefficients in parenthesis. Variables significant at the one percent level of significance or better are marked with a single asterisk beneath the individual t-statistic. The last three rows of the table show the R squared value (RSQ), the number of observations (N), and the Durbin Watson statistic (DW) for the four equations in the table.

Together, the four variables in the equations estimated by ordinary least squares (equations (1) and (2)) explain over twenty-one percent of the variation in math SAT scores in the panel data, and over twenty-seven percent of the variation in verbal SAT scores. Although there are indications of serial correlation with the two ordinary least squares equations evidenced by their low Durbin-Watson statistics, when the equations are re-run again using period seemingly unrelated regressions (period SUR), which adjusts for both serial correlation and heteroskedasticity, the findings are quite comparable to the least squares results, and the Durbin-Watson statistics move close to two.

### 4.2 Analysis

The results lend support to each of the three hypotheses put forth in the paper. First, they corroborate the hypothesis that the quality of human capital in a state is sensitive to the level of political corruption in a state. Political corruption (POLCORRUPT) is negative and significant at the one percent level of significance in each of the four equations appearing in the table.

Second, the results lend credence to the notion that economic motivation is related to student performance. Inspecting the table reveals that the Gini coefficient on income (GINI) is positive and significant at the one percent level of significance in each of the equations. From the quantitative evidence in the table, it certainly appears as though greater variance in expected future incomes is positively related to higher levels of human capital.

Third, as theorized, if an equation estimating educational performance includes a motivational variable, then the statistical results indicate that educational input is not inconsequential for student performance, but rather, that increases in educational input enhances educational performance. All the equations in table I include the motivational variable GINI, and real state expenditure per pupil (REXPPERPUPIL) is found to be positive and significant at the one percent level of significance in these equations. In addition, the predicted impact of real state expenditure per pupil on educational performance is not small. Looking at the coefficient of real expenditure per pupil in the math equation estimated by period SUR indicates that an increase in state expenditures per student by a thousand dollars in real 2005 dollars was related to an average state math SAT scores increase of two and a half points.

The other two elements in the equation, the constant term (CONSTANT) and population density (POPDEN) also act reasonably.

If one assumes that the motivational variable and the student resource input variable enter multiplicatively in Cobb-Douglas style fashion in the educational quality production function (equation (1)), and then one takes logarithms of both sides, one obtains an alternative logarithmic specification that can be used for estimation. This specification is likely to be more realistic since one expects nonexistent student educational performance when either resource inputs into the educational process are zero or economic motivation is zero. The results of estimating the logarithmic specification for math and verbal SAT scores using ordinary least squares and period SUR are given in table II.

The outcome shown in Table 2 is similar to Table 1. Once again, all the variables in each of the four equations have their theoretically anticipated signs and are highly significant. Once again, the results tend to substantiate the three hypothesis of the paper.

## 5. Conclusion

The panel regression analysis of the paper suggests that the quality of human capital can be increased by reducing political corruption, that student motivation is positively related to student performance, and that higher per pupil expenditure has a positive effect on educational quality once economic motivation and other variables are taken into account.

Well then, does money matter? The data indicate that resources are positively related to academic outcomes; however, increased student performance may depend on the effective deployment of resources towards initiatives that are directly related to improving student outcomes as suggested by Ladd & Hansen (1999) and Peltzman (1993). If political corruption causes money to be spent ineffectively, inefficiently, and solely in response to rent-seeking political forces, then it is unlikely that more money will have much positive effect on school performance (Ladd & Hansen, 1999; Peltzman, 1993). The issue of linking resource deployment to student outcomes may contribute to differences in student performance. Ideally, of course, in any situation, one would hope that money is allocated so that the incremental increase in the quality of human capital per dollar spent is the same in all uses. In this way, one maximizes the effect dollars spent to increase educational quality.

This article suggests that there are conditions under which spending matters for educational performance and conditions for which it may not. Educational school expenditures for school systems in which there is a lack of student motivation, is likely to be just a waste of taxpayer money. Similarly, in line with Peltzman (1993), spending more money in corrupt school systems seems to be of no avail. In addition, the findings of the paper also suggest that in order to improve educational performance and increase economic growth through enhancement and improvement of human capital, there needs to be, not just increases in expenditures, but that steps must be taken to create an environment in which increases in educational expenditures lead to improved student outcomes. Public officials, administrators, and everyone involved in the educational process must be held strictly accountable so that there is little or no corruption and that spending decisions are driven by the priority to improve educational outcomes. In the literature, Hanushek (1997) and Peltzman (1993) indicate that the ways in which school districts utilize resources affect student outcomes, indicating that the issue of accountability and targeted spending must become high priorities for the efficient use of resources.

In addition, the literature also notes that the potential for differential income serves as an incentive to individuals. This suggests, consistent with our findings, that individuals who perceive the potential for reward based on their efforts will be more motivated to achieve. Thorbecke and Charumilind (2002) note that parent support for education increases when they perceive a greater return on investment from education. A potential concern for the educational system thus arises when students do not perceive the value of education in terms of its potential affect on their future earnings due to their socio-economic situation or their level of self-efficacy. As a result, motivation to work hard in school may be viewed as futile. Given the potential for such a negative scenario, policies must be enacted to increase the real future rewards of education and to make both students and parents aware of these rewards.

## 6. Limitations

In performing this study, several limitations must be noted. Although we attempt to evaluate the relationship between political corruption, economic motivation, educational resources, and quality of human capital, we recognize that the outcomes may also be affected by factors that are impossible to measure or impossible to separate as distinct variables.

In addition, we have employed the concept of income inequality as a measure of motivation and recognize that this view of motivation stands in contrast to the concept of behavioral or student motivation that is covered extensively

in education literature. Although researchers have studied the various factors that may influence student motivation, we utilized income disparity, which serves as a motivational factor within the economic literature, to determine the impact on student outcomes across states. Our study considers variables at the state level, and does not consider individual data or sources of motivation. This decision reflects a broad economic focus on the relationships between the test variables.

It would be nice to have a measure of corruption specifically related to school districts, state education departments, and other agencies directly involved in education of students. Lacking such direct data, we compiled data based on corruption within the states but recognize that the lack of direct data serves as a limitation of this study.

We must also acknowledge that student outcomes, as represented in this study by SAT scores, may reflect the cumulative effect of many years of learning as well as investment of resources as noted by Hanushek (2006). If this is the case, one could argue that the SAT scores for any given year reflect cumulative values whereas the study data related to spending and corruption is linked to specific years. Although we do not address this issue, our use of panel data analysis does look at data across both time and states for each year. It is our belief that this approach provides a rigorous analysis of the potential relationships between the data, and addresses to the extent possible, the issue of the cumulative investment in education and student outcomes.

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Table 1. Panel Regressions Estimating the Effect of Political Corruption and Other Variables on Average Math and Verbal Scholastic Aptitude Scores for the Fifty States for the Years 1980 through 2004

	(1)	(2)	(3)	(4)
	ORDINARY LEAST SQUARES	ORDINARY LEAST SQUARES	PERIOD SUR	PERIOD SUR
	MATHSAT	VERBALSAT	MATHSAT	VERBALSAT
CONSTANT	399.56 (26.13) *	226.96 (11.74) *	437.80 (70.22) *	322.54 (32.62) *
PUBCORRUPT	-.21371 (-4.56) *	-.42729 (-7.20) *	-.04707 (-4.33) *	-.08665 (-4.74) *
GINI	307.14 (7.07) *	690.79 (12.58) *	184.66 (11.32) *	390.70 (14.35) *
REXPPERPUPIL	.00025 (4.03) *	.00466 (5.90) *	.00249 (7.58) *	.00539 (11.63) *
POPDEN	-74.44 (-10.85) *	-72.31 (-8.33) *	-46.80 (-3.56) *	-58.67 (-3.40) *
RSQ	.212	.279	.982	.975
N	1048	1048	1048	1048
DW	.097	.245	1.774	1.618

Table 2. Panel Regressions Estimating the Effect of Political Corruption and Other Variables on the Log of Average Math and Verbal Scholastic Aptitude Scores for the Fifty States for the Years 1980 through 2004

	(1)	(2)	(3)	(4)
	ORDINARY LEAST SQUARES	ORDINARY LEAST SQUARES	PERIOD SUR	PERIOD SUR
	LOG (MATHSAT)	LOG VERBALSAT	LOG MATHSAT	LOG VERBALSAT
CONSTANT	6.18 (65.68) *	6.10 (49.17) *	6.07 (129.97) *	5.74 (82.08) *
PUBCORRUPT	-.00042 (-4.68) *	-.00088 (-7.42) *	-.00009 (-4.47) *	-.00002 (-4.91) *
LOG(GINI)	.2388 (7.64) *	.5446 (13.21) *	.1434 (11.82) *	.3201 (15.60) *
LOG(REXPPERPUPIL)	.0373 (4.12) *	.0770 (6.57) *	.0382 (7.96) *	.0915 (13.31) *
POPDEN	-.1376 (-10.90) *	-.1383 (-8.25) *	.0858 (-3.35) *	-.1148 (-3.43) *
RSQ	.220	.296	.999	.999
N	1048	1048	1048	1048
DW	.104	.264	1.75	1.618

# Corporate Social Responsibility Disclosure and Employee Commitment: Evidence from Libya

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## Abstract

Most research on corporate social responsibility disclosure (CSR) describes its relationships with external factors such as financial performance and corporate reputation. There are relatively few studies that have focused employee's behaviours towards CSR. This paper examines the relationship between CSR on employee commitment. An exploratory approach is used in this paper by this study. This study utilizes interview method to collect data from 31 financial managers and information managers of 22 organisations; Miles and Huberman (1994) approach is used to analyse the qualitative data. The researchers have chosen the Libyan context as one of the world's developing countries that has undergone many changes over a short period of time in terms of economic, environmental and social changes. The majority view of managers interviewed is that as CSR related to employee activities and consumer activities increases employee commitment towards its company increase. However, there is no relationship between CSR related to environmental and employee disclosures and employee commitment in Libyan companies. The study discusses and explains important implications regarding uses of CSR for enhancing employee's commitment.

**Keywords:** Corporate social responsibility (CSR), Corporate social responsibility disclosure (CSR), Environmental disclosure (ENV), Consumer disclosure (COND), Community involvement disclosure (COMD), Employee disclosure (EMPD), Employee commitment (EC) and stakeholder theory

## 1. Introduction

Major corporate ethical disasters impacting on the environment, human resources, and the community have heightened the demand for public firms to voluntarily disclose their CSR activities to stakeholders. As a result, CSR and disclosure have become an important issue in the business world (Waller & Lanis 2009). In addition, CSR is an extension of the financial disclosure system, which reflects the wider anticipation of society concerning the role of the business community in the economy. Furthermore, with the rapid collapse of cross-border economic barriers and the globalization of business, the role of CSR is being debated in an international arena (van der Laan Smith et al. 2005). The World Business Council for Sustainable Development (WBCSD) (1998, p. 3) defined CSR as: 'the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large'. Also Mathews (1993) has defined CSR as: organisations voluntarily disclosing both quantitatively and qualitatively

about their CSR activities in order to inform their stakeholders. According to these definitions, CSR activities and disclosures play relevant roles in organisational performance. In addition, CSRD includes many activities such as community, environmental, employee, investor, customer, and supplier responsibilities.

There is growing attention towards the impact of CSR and disclosure, in particular about environmental activities on company performance for many years. There has been only a limited emphasis on CSR and disclosure related to employees and the possible impacts of CSRD on performance in terms of employee commitment. Therefore, this paper attempts to explore the relationship between CSRD and employee commitment in order to cover this neglected aspect of CSRD research.

The number of studies investigates increases to identify the relationship between CSR and CSRD with employees commitment has increased in recent years (Branco and Rodrigues, 2006). Regarding employees, the benefits of CSR and CSRD in terms of the impact on employees has been related to know-how, corporate culture and corporate reputation (Branco & Rodrigues 2006). Consequently, CSRD is perceived to be of a significant importance in enhancing corporate reputation through improving employee commitment (Branco & Rodrigues 2008; Hasseldine et al. 2005; Toms 2002).

Although most companies disclose CSR activities to obtain the external factors such as improved reputation and financial performance, there are other reasons that are internal factors related to their employees. This paper contends the importance of using CSRD to improve the employee commitment of a company. The argument outlined in the literature review illustrates the importance of CSRD to employees and their companies. Most companies perceived to have a high level of CSR activities have an increased ability to attract and to retain employees, and to maintain employee morale. This, in turn, leads to reduced recruitment, training costs, and turnover (Albinger and Freeman, 2000; Backhaus et al., 2002; Greening and Turban, 2000; Peterson, 2004; Turban and Greening, 1997). Therefore, CSRD may enable a company to maintain a positive image with its employees and lead to improved company reputation. This factor also leads to developing capabilities and employee-related internal resources and organizational efficiency.

To date, research on the relationship between CSRD and employee commitment has been limited to the use of either quantitative or qualitative data. The paper provides interviews with thirty one financial managers and information managers. The paper has one objective which is to explore and understand the relationship between CSRD and employee commitment.

The paper is organized as follows. Section 2 outlines the literature review and research framework. Section 3 outlines the research methods in terms of the sample and the data collection, the interview process and analysis of information. Section 4 outlines the results of this study. Finally, sections 5 and 6 discuss the results and show summary and conclusion.

## 2. Literature Review and Research Framework

Employees consider one of the most important factors in a firm; they affect an organisation. Therefore, “the effective delivery of corporate social and environmental responsibility initiatives is dependent on employee responsiveness” (Collier et al. 2007, p. 22). In recent years, employee commitment is one of the most studied indicators of the strategies value of CSR. According to Jaworski and Kohli (1993, p 60) defined (as cited in (Rettab et al. 2009)) employee commitment

*“[T]he extent to which a business unit’s employees are fond of the organisation, and see their future tied to that of the organisation, and are willing to make personal sacrifices for the business unit”*

Carroll (1979) notices that CSR and community contributions and reflects the way in which the firm interacts with the physical environment and its ethical stance towards consumers and other external stakeholders. External CSR on internal and external information sources including the media and their personal experience within the company may be expected to base their employee opinions about these activities. Employees and managers have a greater stake in the success of the corporation than investor, owners, because their jobs and economic livelihood are at stake (Post 2003). Branco and Rodrigues (2006) discussed that CSRD leads to important results on the creation or deletion of other fundamental intangible resources, and may help build a positive image with employees and managers. Some studies expected that there is a positive relationship between CSR and employee commitment (Backhaus et al. 2002b; Brammer et al. 2007; Maignan & Ferrell 2001, 2004; Peterson 2004). Furthermore, Albinger and Freeman (2000), Backhaus, Stone and Heiner (2002b), Greening and Turban (2000), Maignan, Ferrell and Hult (1999), and Peterson (2004) revealed that there is relationship between CSR and employee commitment. At the same time, relationship between procedural justice and affective commitment may be expected a positive because employees may be expected to identify with ethical organizations (Brammer & Millington 2005). The existing literature



provides compelling empirical support for these arguments; a strong relationship has been found between the ethical climate of organizations and job satisfaction (Koh & Boo 2001; Viswesvaran et al. 1998) and studies of the relationship between organizational commitment and procedural justice suggest that they are positively and significantly related (Albinger & Freeman 2000; Backhaus et al. 2002a; Cohen-Charash & Spector 2001; Greening & Turban 2000; Meyer et al. 2002; Peterson 2004; Turban & Greening 1997) illustrated that a firm's social responsibility deals with matter to its employee and expect to have a positive impact on employee's commitment. In addition, Maignan et al (1999) expected that firms that disclose in CSR activities might enjoy enhanced levels of employee commitment for two reasons: they have devoted to ensuring the quality of workplace experience, and they inform their stakeholders about social issues such as the welfare of the community or the protection of the environment.

Rupp et al (2006) noticed that employees' perceptions of their firms CSR activities lead their perceptions of the firm. In addition, firms that disclose CSR activities work to ensure their employees protect through fair and socially responsible practices (Rupp et al. 2006). Thus, it can be seen that firms that engage in CSR activities and disclosure will appear a positive relationship with their employee commitment because they might earn employees commitment compared with firms that do not engage in CSR activities (Aguilera et al. 2007). Exploring a positive relationship between CSR and financial performance is more likely to lead a positive relationship between CSR and employee commitment. Rettab, Brik & Mellahi (2009) explored that there is a positive relationship between CSR and employee commitment in the UAE market. On the other hand, Turker (2009) found that there is no link between CSR to government and the commitment level of employee by using social identity theory.

Most of the studies above indicated that there is a positive relationship between CSR and disclosure with employee commitment, whereas few studies found a negative, no significant and fixed relationship between them. In addition to that there is limited research that has investigated CSR and employee commitment either in developing countries especially in Libya. In addition, no known study has examined the relationship between CSR and financial performance in Libya. Therefore, we asked our interviewees for their views on the relationship between higher levels of CSR provided by firms and its higher employee commitment in Libya. This was to obtain a sense of how higher levels of CSR provided by firms are positively associated with higher employee commitment among firms in Libya.

### **3. Research Methods**

#### *3.1 Sample and Data Collection*

This paper was to gather information from face to face of semi-structured interview. Interviews with one of the most important social and environmental stakeholder groups were conducted to help the researchers to gather data relevant to this issue. In addition, knowledge gathered from consulting with other researchers in CSR and literature reviews enabled the researchers to design an interview guide with common questions in order to ask the interviewees (see appendix 1). The questions were focused on the disclosure of information that is considered for the study is merely through published annual reports and its relationship with employee commitment in Libya.

Appendix 1 shows that financial managers and information managers were interviewed because they have to some extent formulated opinions on CSR while preparing annual reports. The total number of interviewees was 31 from 22 organisations of different sectors. Twenty-four (77%) interviewees were financial managers and seven (23%) were information managers. According to the level of CSR in the selected sectors, twenty two companies in the four sectors were selected as having the higher level of CSR.

#### *3.2 Interview Process and Analysis of Information*

This paper consists of the above mentioned 40 firms which were collected in the quantitative stage. Thirty one managers were interviewed to express their perceptions about the relationship between CSR and employee commitment. Data gathered from interviews was recorded by a note and tape recorders with financial managers and information managers of the firms enabled the researchers to gain the deeper insights on this issue in this research. The interviews took place between October 2010 and February 2011. Interviews lasted between twenty minutes to one hour and half. The meetings were held in the manager's office.

Miles and Huberman (1994) approach was used to analyse the qualitative data. CSR activities were classified into four categories (employee, community involvement, consumers and products and environment). Analysing the qualitative data was employed in two stages. First, the researchers classified the interview content (transcript) into similar or different responses. Second, identifying key, substantive points and putting them into categories were the two main aspects involved in the current study (Gillham 2000). Identifying a code was the first analysis process with each transcript. Then all the transcripts were readable more than one time by the researcher. At the same time, they

highlighted the substantive statements that were related to the research focus (Gillham 2000; Marshall & Rossman 1999). After going through all the transcripts, at the same time which the researchers went back to read the first one of the transcripts, they listened to the tape in order to find any intonations and statements that they have failed to highlight (Kamla 2007). A very big representation of statement from interviews was resulted by this stage, which involved further composition. After that, the researchers gave the highlighted and statements simple heading through derivation a set of categories for the responses to each question (Gillham 2000). These categories and headings checked against the highlighted statements and any necessary amendments were made. The researchers repeated this procedure more than one time to ensure that no categories and headings were missed (Hanafi 2006). Subsequently, each broad research question employed a big sheet in the form of a matrix. The matrix sheets entered these questions which classified categories and headings into them. The researchers then went through the transcripts, assigning each highlighted statements to a category (Gillham 2000). In addition, the researchers maintained a second separate file to record the overall observations in the meaning of data for all interviews.

The same mentioned procedures have been applied in the four CSR categories. The researchers used two stages. First stage was to identify the type of interview content response if similar or different. The second stage was to identifying the items of CSR categories in to the four categories (employee categories, environmental categories, consumer categories and community involvement categories) through identifying a code with each transcript. Then all the transcripts were reviewed with the tape in order to find any intonations and statements that they have failed to highlight related to each category (CSR categories). The previous procedure was used more than one time to ensure that headings related to CSR categories were missed. After that, the researchers used the matrix sheets which include all questions and headings regarding each CSR categories. According to the previous stages, therefore the researcher could collect all data and information related to each CSR categories to identify the relationship between higher levels of CSR and employee commitment in Libya.

#### 4. Results

After accurate reading and reflecting on the transcripts, ordinal categories were developed by the researcher for the responses related to the key topics and questions that were asked. The researcher summarise the following findings in appendix 2. Appendix 2 was used for ease of interpretation; one answer represents the view of each interviewee on a specified topic. Hence the answers in appendix show the perception of financial managers and information managers in Libyan companies about the association between CSR and employee commitment.

##### 4.1 The Perceptions of Libyan Managers on the Relationship between CSR and Employee Commitment

###### 4.1.1 The Association between CSR and Employee Commitment

The current study investigates the association between CSR and employee commitment with considering the responsibilities and the interests to different stakeholders. Some prior studies have identified how CSR and CSR are related to employees in terms of the commitment (Branco & Rodrigues 2009; Hsu 2006; Kleiner & Morris 1988; Peccei et al. 2005). These studies supported the notion that CSR and CSR can increase its attractiveness as an employer.

The researcher asked whether greater levels of CSR would be associated with employee commitment through the three questions (see appendix 2). The answers were identical with the majority of interviewees about the relationship between each category of CSR and employee commitment.

The researcher asked the first question about whether levels of each category of CSR have a potential effect on employee commitment of a company. There were different opinions about the effect of each category on employees. To obtain deeper understanding about the potential effect of both employee disclosure and consumer disclosure on employee commitment, the majority of interviewees were in agreement about the existence of this effect. Twenty one managers (68%) confirmed that employee activities and level of employee disclosure have the biggest impact employees via increasing their commitment towards their companies and three (10%) said that a certain level of employee disclosure would have affect employee commitment with credibility, transparency and employee activities as mentioned by some interviewees:

*When employees are convinced of this information compared with what the bank really performed, this information about social activities will give them the satisfaction which lead to fulfil their duties in the bank... also, although some services did not present to all employees, such as treatment of difficult cases, which require large amounts of money to a small group of employees, we noted that the publication of this information ensured increasing employees understanding about what the extent of the company interest, which gave them the incentive to perform their jobs.*

In addition, disclosure about the interest of a company towards their employees such as employees training, employees rewards, employees safety, salary value and so on could push some persons who have high skills and long experience to prefer a job in this company as well as increasing its attractiveness as an employer. Furthermore, employee disclosure gives most employees good motivation to use all their abilities for achieving company goals.

*Informing employees about activities of the bank, especially employee activities, such as employee training, employee health and employee remuneration have given an incentive and motivation to employees for committing and improving their performance in order to get these features... Also disclosure of these activities attracted some skills and experiences to work in the company...for example, when the company has prepared the annual report 2009, which showed the information about employee remuneration, this information motivated the employees to say, we could work all day and at any time determined by the company for achieving the company goals.*

while Twelve (39%) believe that providing more consumers disclosure would definitely affect employee commitment, because this information would give employees the confidence and obtain their sense of belonging and pride towards the products that were offered by the company, this in turn were reflected on the employee's commitment.

*Employees in this company had a feeling of satisfaction and belonging for their company as a result providing this products with a high degree of quality and great benefit to the consumer,... this led to increasing their attentions on the interests of the company and their performance, improving their discipline in work and motivate the performance of the employees... that reflected in their level of commitment for the continuation of the company in producing, developing and maintaining the quality of this product.*

Furthermore, seven (23%) said that an identified level of consumers disclosure could influence employee commitment, but with the considering of some factors. The credibility of disclosure about quality product and product development would be the biggest effect with a certain level of consumer disclosure compared with product safety. Moreover, positive information about consumer activities with a certain level of this information would have an effective impact on employee commitment as well as reputation.

*For example, the company has replaced some idle machines with new ones and disclosing this active in its annual report, this gave a good image and increased employee's satisfaction, because of the important role that performed their company, its interest to satisfy customers, providing a good product and the maintaining on its good reputation.*

Most interviewees see that both employee and consumers disclosure are more importance and useful than other categories, because most stakeholders in particular shareholders and employees noticed a lack of benefit from environmental and community disclosure compared with both information about employee and consumers activities to affect employee commitment.

*It is noticeable in the company, most shareholders supported expense and disclosure of employees and consumers activities, while some shareholders (employees) are reluctant or hesitant in spending some money on both community and environment activities, because they consider it squandering of their money.*

However, seven managers (10% and 13%) believe that this effect on employee comment would not exist in a company, because employees did not realize the importance of employee disclosure and they focus only on the amount of their salaries and continuing their salaries due to their difference in level of culture and education.

*We think that some employees are primarily interested in the continuation of obtaining on their salary, regardless of other things and this is due to the different level of the culture and education between the employees.*

While eight of thirty one (26%) believe that the application of labour laws, the effect of religion, level of culture, level of education and interests of stakeholders only could be more effective to commit employees for achieving their works to the fullest towards their companies, and some of them found some difficulties to measure employee commitment due to multiplicity and overlap of the above mentioned causes, therefore customer disclosure would not be likely to only affect employee commitment. In theory, the companies can notice the effect of consumer disclosure on employee commitment. Four (13%) asserted that this effect practically does not be clear. All of these interviewees believe that both of employee and consumer activities could affect employee commitment, but not level of disclosure of them.

*The difficulties to measure employee commitment and Multiplicity of its causes have been more difficult to determine the impact of the level of social disclosure, therefore the company did not measure this effect in the past, but I think that all of the Libyan environment determines such as religion, level of culture, level of education, laws, and interests of stakeholders have a greater role to affect the commitment of the employee...more specifically, it is noted in these companies that employees that do not have sufficient knowledge and do not have high education*

*about employee activities and consumes activities did not care with the situation of their company, do not have good feeling towards their company, therefore this is reflected negatively on their performance within the company such as leaving work.*

There was a wide vary of opinion expressed when the researcher asked whether greater level of community disclosure and environmental disclosure would affect employee commitment, but the majority of interviewees do not see the effect of community disclosure and environmental disclosure on employee commitment. Twenty managers (13% and 52%) said that employee commitment would not be affected by level of community disclosure in the companies, because of a lack of the awareness of employees towards the importance of this disclosure and focus on what a company introduced to them, while fifteen (48%) think a lack of the probability of environmental disclosure to affect on employee commitment, because companies do not inform their employees about this information disclosed. This result also was proved by (Ahmad 2005); he presented quantitative evidence from Libya as most Libyan companies did not tell their employees about environmental information disclosed through all the channels. They confirmed that the Libyan law sanction play a main role to improve employee commitments in the Libyan companies more than other reasons.

*In fact, we do not care greatly over the impact of the dissemination of information about community and environmental activities in the preparation of the annual report on the commitment of the employees, because we believe the law of sanctions and rewards may be more impact on them.*

In this context, three of financial managers (10%) mentioned that this effect between environmental information disclosed and employee commitment exists and can affect financial performance and reputation of a company, but in theory.

*Theoretically, the management of this company does not realize the importance of activities related to the community service contributions, especially donations probably do not enable the bank to obtain the benefits of disclosure regarding this activity and thus it affects negatively employee in addition to its impact on the financial performance of the bank and the reputation of the bank.*

In the other hand, the findings found that five of financial managers (16%) see that there would be an effect on employee commitment by level of community disclosure, while six (19%) said that community disclosure and some mentioned factors could be an impact on employee commitment. In the other hand, four of financial managers (13%) note that providing a great-practice level of environmental disclosure or better would allow employees to know about what the extent of the importance of environmental activities for a company, in particular inside a company, this in turn would be reflected on level of their commitment toward a company, while the remaining nine (29%) believe that a certain level of environmental disclosure would not be adequate to affect employee commitment, because it considers the minor factor.

*Yes, there is an impact on the commitment of the employee because the Islamic culture has a great role in the culture of the environment surrounding the company, so there is the impact of positive and up to that the employee can accept to continue working in the company that made and continue to contribute to society despite the lack of salary compared to other companies and that he was proud because of the work at this company.*

*Employees' recognition about the negative effects of company on the environment and its employees, particular who work in the management of production could create negative impact on their health and their level of satisfaction on their performance in the company and... some employees may leave their jobs to keep their health safety.*

*I think that the company does not take into account the protection of the environment through greenhouse gas emissions that have a negative effect and its disclosure would lead to reduced employee commitment and the inability of the employee to continue within the company and vice versa.*

Related to the second question about identifying the association between employee disclosure and consumer disclosure with employee commitment, the findings found that twenty six (84%) and twenty one of the interviewees (68%) indicted a positive link between high level of both employee and consumer information disclosed and employee commitment. All of them said that disclosing of both employee and consumer disclosure in annual reports would give a type of loyalty to a company and would obtain sticking with this company.

*We think that emerging information about the extent of interest companies related to quality and development of our products as well as employees training, employee safety and health and employee rewards through all canals Stimulates and increases belonging and striking employees towards their company.*

However, only five managers (16%) think no link between employee and employee commitment due to a lack of the interest of most employees in a company for reading this disclosure, while ten (32%) see that there is no association between consumer disclosure and employee commitment for the same reason. They asserted that these employees

were affected by the activities which performed their companies but not by what a company said in its annual reports.

*We do not think that there is a relationship between both employee and consumers information with employee commitment... because most employees do not care with this information... but increasing both employee and consumer activities reflects positively with the commitment of employee.*

One the other hand, the majority of interviewees believe that there is no link between both community and environmental information disclosed with employee commitment. Nineteen of thirty one managers (61%) think that employees in the Libyan companies are not interested in information disclosed about both community and environmental activities which are prepared in their annual reports, but more their focus are on the activities that give some direct benefits such as employee activities. However, there were two opinions about the type of the association between community disclosure and employee commitment, one of interviewee (3%) said that there is a negative association between them, but eleven managers (35%) mentioned to exist a positive association.

*Disclosure about the company contributions in the community service would be a negative effect on employee's performance, when the company spent its money on outside the company without the employee's interest, because the employees get few salaries.*

Regarding the link between environmental disclosure and employee commitment, there is a general agreement between twelve of interviewees (39%) that indicated a positive link.

*Sure I think there is a positive relationship, because, in the one of previous years a company disseminated both financial and social information and some employees interacted with this information to be more effectiveness and importance. This led to developing this report and increasing the amount of information as the annual report in the past was not exceed five pages and now is not less than fifty pages. In addition, this information stimulated the employees who work in departments, particular that are issued this information in the report (such as financial section), as well, the company provided the letters of thanks and rewards for the preparation of this report. Moreover, there was clearly evident during the preparation of the report that all employees in the departments presented full cooperation so that each department sent its information to a competent administration in preparing the report quickly in order not to delay publication of this information.*

Two of twelve interviewees said that the sort of the relationship between CSRD regardless the type of category used and employee commitment depended on the extent of the relationship between financial performance and CSRD, if positive the relationship was positive and vice versa. They think that a level of financial performance of a company would play an important role to identify attitude of employees, because high level of financial performance of a company would increase striking employees with their companies and would claim employees for improving their ability via maintaining a company performance.

*Some employees are focused on the relationship between social disclosure and financial performance, and they think that this relationship has a positive interaction with employee commitment, when employee find social disclosure impact on the profitability and revenues and sales of the company, this creates a friendly kind of confidence and safety, and this in turn reflects on the loyalty towards their company because the company is financially stable and the relationships is interlocking between the company's interest and the interest of the employee.*

The researcher also asked whether information disclosed about CSR activities can improve employee commitment. Approximately the same findings were expressed by most interviewees; two categories were used to improve the commitment of employees.

In respect of both of employee commitment and consumers disclosure with employee commitment, most interviewees confirmed that both of them could increase employee commitment. Eleven of thirty one (35%) stated that great level of employee disclosure would help an increase of loyalty to this company and sticking with this organization, this increase would lead to the improvement of employee commitment, because employees in these companies are interested in the activities which are offered. In this regard, most employees seek to obtain these benefits such as remunerations, training, loans without any interests, etc. All of these benefits stimulate most employees to perform their duties to fullest towards their company, consequently, improving employee commitment. Six managers (19%) believe that most employees feel proud when read some information concerning about their product and good services provided to consumer of their company through the annual report or other channels, such as the quality of a product or the development of a product or good facilities offered by their company to customers. Ten (32%) asserted that positive information about employee activities would create good

image/reputation which in turn was reflected on employees through performing their responsibilities towards their company and eleven managers (35%) also confirmed the prior reason regarding consumer disclosure.

*Yes, one of the reasons for the process of disclosure is to targets employees in order to gains their satisfaction and to gives a full picture of social activities provided by the company, thus this improves their commitment to the company... also providing positive information and detailed information about staff and quality products activities as well as products safety would reflect positively in increasing sales and this means that there is no goods stacked in warehouses which ensures continuing to benefit from the company in the form of salaries and other features, such as training and so on. All of these would stimulate and increase association between a company and its employees... also they would support an image and reputation of a company.*

However, nine of the interviewees (29%) said that employee disclosure could not improve employee commitment and thirteen (42%) mentioned that there is no any improving in employee commitment due to providing good-practice of consumer disclosure. They commented that the reason may refer to a lack of informing of employees about this information and a lack of interest of both employee and consumers disclosure from some employees. The remaining one (3%) did not know whether high level of both employee and consumers disclosure can lead improve employee commitment.

*The main objective is to increase the share price, but the improvement of employee commitment comes implicit by the dissemination of this information and the effect of employee and consumer information is not obvious due to a lack of informing of employees and a lack of employee interest.*

Most interviewees were general agreement that the Libyan companies did not use information disclosed about community and environmental activities for improving employee commitment. Twenty (65%) and eighteen (58%) managers believe that employees in their companies do not care with disclosure about both community and environmental activities and there is little information disclosed about both of these activities published in their annual reports, therefore increasing a level of information disclosed in both of these activities do not improve employee commitment in the Libyan companies. In addition to that, three of the interviewees (10%) did not know whether this disclosure improve the commitment of employee.

*Yes, a company presented some services to the community, for example, a company has opened branches in many urban and rural areas for the purpose of profitability and create jobs, this reflected positively on the employees in a company through improved performance. But I do not think that the amount of disclosure of this information increase or increased commitment to the employee in a company... and employees did not care with environmental information in particular if these activities did not affect their health, but focus on providing this activity.*

On the other hand, few interviewees confirmed that high level of both community and environmental disclosure could improve employee commitment in their companies. Only one information manager (3%) believe that a certain level of both community and environmental disclosure regardless the type of this information disclosed may improve employee commitment, while seven (23%) see that the type of disclosure plays an important role to improve employee commitment and nine (29%) also noticed the same thing. They believe that positive information about both community and environmental information disclosed may interact with employees' behaviours; this would lead to improve their commitment.

#### 4.1.2 More Details on Association CSRD with Employee Commitment

The researcher also asked whether choice of accounting policy interact with the amount of CSRD policy to affect employee commitment. There were some variations about this question; most interviews see that accounting policy used (accounting principles) in their companies is not sufficient to interact with a level of CSRD for improving employee commitment. Eight managers of twenty eight (29%) believe that accounting policy used in their companies would not interrelate with this information to affect the commitment of employee, with five (18%) were not aware whether accounting policy used in their companies plays an important role with a level of CSRD to influence employee commitment. They think that obligation the Libyan companies to apply international accounting standards and privatization public companies as well as realizing the importance of CSR activities and its disclosure may create an effect on employee commitment through its interaction with the amount of CSRD.

*Not enough but intention is to attempt to apply international accounting standards... privatization public companies...and realizing the importance of social activities... that provide and enable the Libyan companies that disclose more the amount of social information.*

However, few numbers of interviewees see accounting policy used in their companies is adequate to interact with this relationship. Four (14%) interviewees believe that accounting policy used cover most of employee and consumer activities items in terms of quantity disclosure. For example, all companies show employment cost in

which includes employee salaries, employee health, employee training, employee remuneration, quality expenses, research and development expenses, etc. all of items were showed in statement income. In addition, annual reports showed some qualitative details about employee and consumer activities such as employee benefits, number of employees, service type and so on. While they noticed that accounting policy used in their companies were not enough to interact with some categories of another CSR activities to affect employee commitment. Eleven (39%) said that there is possibility to interact this policy with some categories such as employee and consumer activities to influence employee commitment.

*We show employee information and consumers information through applying accounting principles in the statement income such training costs, salaries costs, loans cost and quality costs of product, etc... This indicates that this policy works with these principles that are in turn reflected on the link between this information and employee commitment.*

The research asked whether the effect of CSRD on employee commitment relay on establishing a sustained commitment to improve CSRD. Eight of the twenty eight interviewees (29%) see that company's commitment to disclosing CSR activities in its annual reports would allow this information to affect employee commitment. They believe that this commitment came to obtain a company the benefits of disclosing CSR activities. One of the financial managers stated that:

*Yes, improving or obligation for disclosing social information help to confirm the impact of this information on the commitment of the employee because the increased attention to human resources, products and contributions to community service as well as disclosing CSRD could obtain most benefits to employees, whether the benefits are tangible such as bonuses, training etc. or intangible such as gaining motivation, pride and increasing loyalty with the employee of the bank.*

Most of the eight interviewees mentioned that most companies in Libya Most of Libyan companies are committed to showing the most information about the employees and consumers and this information increase from year to year which this may lead to improving employee commitment.

*I think that there is an indirect effect due to the commitment to social disclosure through the improvement of the amount of social information from year to year in the annual report and especially the human resources information on employee commitment.*

They also think that non-disclosure of CSR activities would give a bad reason to their employees for decreasing employee commitment as mentioned in the following quotation. Eleven (39%) think that the impact of CSRD on employee commitment may relay on establishing sustained commitment to improve CSRD.

*Yes, to some extent, because the lack of commitment for disclosing social information would be given the justification or reason to the employee that there is a problem in the company, it therefore leads to reduce the commitment of the employee.*

On the other hand, six managers (21%) believe that establishing a sustained commitment in a company to improve CSRD did not find the impact of CSRD on employee commitment. They think that employee commitment was not the main objective to improve CSRD; therefore companies increase a level of CSRD for improving their financial performance and gaining a good reputation or maintaining their reputation. In addition, the remaining three (11%) did not know whether this commitment led to the effect of CSRD on employee commitment.

*Perhaps the company is seeking to achieve other goals in order to obtain a greater share or increase sales, maximize profits or to obtain a good reputation, but it is not intended to increase or improve the employee's commitment through increasing social disclosure in the annual report... because employees consider publishing social information, especially which related to human resources to serve their interests, so they seek to increase their skills and improve its performance in order to take advantage of these activities provided by the company.*

Eventually, the findings partially support the research question. The key result is that most managers believe that CSRD in terms of employee and consumer disclosures are closely associated with employee commitment than of CSRD in terms of community and environmental disclosures. More specifically, the findings explain that higher level of employee and consumer disclosure can increase and improve employee commitment in Libyan companies. However, higher level of environmental and community disclosures do not lead to increase employee commitment in the selected sample.

## 5. Discussion

The results of this paper have emerged concerning the extent of the association between CSRD and employee commitment, although previous literature mentioned that most companies do not understand the importance of

CSR in their annual reports. In addition, these companies are not aware the impacts of CSR on their business outcomes. Furthermore, there is no motivation to disclose CSR activities in their annual reports because the disclosure of CSR activities is voluntary in most developing countries such as Libya. This concern is emerged due to the pressure and claimant of stakeholders, in particular employee and management. The impact of CSR activities and CSR also create more pressure on firms from several stakeholders to enhance their organisational performance. Companies attempt to have good relation with their stakeholders through using an appropriate communication channel to maintain their performance. This communication can also influence on their environmental and social performance and CSR. These companies have become aware the importance of CSR information in their annual reports and the extent of the effect of these information on employee commitment. They realize that the success of a firm relies on the extent to which the firm is capable of managing its relationship with main groups, such as shareholders, debt holders, and employees. Therefore, stakeholders consider information about CSR activities in annual reports is an effective factor on employee commitment.

In the results of this study, it became clear that both level of employee and consumer disclosure have a positive relationship with employee commitment. The perceptions of the financial managers and information managers correspond with stakeholder theory that predicts a positive relationship between the two types of CSR and employee commitment. The results in this study provided some evidences about this relationship in the following paragraphs.

This finding relates strongly to the perception of managers about level of employee information disclosure, consumer information disclosure and employee commitment. It is clear that level of both employee and consumer disclosure can affect employee commitment through the following results. This effect is working due to the following some reasons. First, employee and consumer activities and disclosure can attract and retain good employees. Both of them can also attract better job applicants and lead to increasing organisational commitment on their part if they are the aware of the importance of CSR for businesses. In addition, employee and consumer information disclosure may increase current employees' morale and motivation as well as their commitment, sticking and loyalty to the company, which in turn may lead to achieving company's goals such as financial outcomes. Furthermore, companies that disclose CSR activities in their annual reports may give confidence and obtain employees sense of belonging and pride towards a company's products. The results of this paragraph in this study are consistent with the results of Peccei et al. (2005), Lawler et al. (1995), Lawler et al. (2001) and Pfeffer (1996) indicated that disclosure is seen as an important factor in management transparency, motivation, yielding benefits in employee satisfaction and management, and therefore in business performance. the results of Peccei et al. (2005) found that there is a significant positive direct and direct relationship between the type of information disclosed, the level of employee organisational commitment and the performance outcome involved, but both direct and direct relationship depends on the differences between the levels of employee organisational commitment and the performance outcome involved. In this regard, information disclosed about wage levels is positively related to employee commitment, but unrelated to productivity. These findings are consistent with some studies indicated in the literature review section (Branco & Rodrigues 2006).

Second, high level of employee and consumer information disclosure can improve a company's reputation which in turn, affects employee commitment level. The positive information about these activities would create good image/reputation which in turn may be reflected on employees through performing their responsibilities towards their companies. The results of Branco and Rodrigues (2009) suggested that companies which have a good CSR reputation and CSR performance relating to their employees is good, recognize the need to use CSR also to affect their perception of its reputation. This means that having good communication channel between companies and their employees lead to improving employee commitment and company's reputation. It also means good reputation with high level of CSR in particular employee and consumer information disclosure is likely to improve employee commitment.

Third, the credibility with a certain level of information disclosure about some items of employee and consumer activities has major effect on employee commitment. More specific, information disclosure about salaries, training, rewards, quality product and product development are considered as the most important factors which in turn reflect positively on employee's performance. In effect, both relationship and effect refer to pressure from stakeholders. Pressure from internal and external stakeholders strongly influences companies to maintain a positive employee commitment (Branco & Rodrigues 2006). Particularly, the consumers and potential employees and actual employees' pressure consider the main reason to identify this effect, therefore investments in CSR activities have internal benefits to help a company in developing new human resources.

Finally, the results of this study revealed that the awareness of management about the importance of CSR plays a significant role in improving both CSR and employee commitment in a company. Top management control



employee commitment through good communication. In this regard, Hatch and Schultz (1997, p. 359) stated that top management make “deliberate attempts to influence public impression.” Companies are aware of the positive association between CSR and a strong employee commitment through pressure from stakeholders such as employees. On the other hand, there is a negative association between poor CSR and employee commitment through stakeholder’s reactions, in particular to company’s products. This paper indicates a positive association between higher levels of employee and consumer disclosure with employee commitment.

## 6. Summary and Conclusion

This paper analyses the relationship between CSR on employee commitment by a sample of the Libyan companies in four sectors (manufacturing sector, banks and insurances sector, services sector and mining sector), using a theoretical framework which combines stakeholder theory. This framework shows that an importance of CSR related to four categories (environmental activities, consumer activities, community activities and employee activities) to stakeholders. Managers and employees increasingly require considering CSR as a signal of improved CSR conduct in those fields because disclosure affect the business performance such as a company reputation. CSR also leads to important results in creation or deletion of other fundamentally intangible resources, and may help build a positive commitment image with employees and managers. By demonstrating that a company does emerge CSR activities for their enhancing organisational performance, whereas non-emerging CSR can destroy organisational performance for a company, hence stakeholders require their companies to disclose CSR activities in their annual reports.

The results in this paper indicate that companies exhibit greater concern to improve employee commitment via an increase of some types of CSR in annual reports. In this regard, to improve employee commitment in these sectors, there is greater concern for consumer disclosure and employee disclosure. On the other hand, there is no concern for environmental disclosure and community involvement disclosure to improve employee commitment. Hence, the results of this paper provide a good support for the use of a combination of stakeholder theory with resource-based perspectives to explicate the impact of CSR on employee commitment by Libyan companies.

This paper has a number of contributions and limitations: first, it presents the first empirical data related to Libyan companies to the previous research on CSR; second, it extends previous research that links level of CSR with employee commitment using a combination of institutional and resource-based perspectives. Third, it reveals the nature of the relationship between level of CSR and employee commitment in spite of a lack of CSR data of developing countries comparing with developed countries. However, this paper focuses on only CSR in annual reports, although these companies use other mass communication mechanisms. Therefore, the future research should use other mass communication mechanism such as internet website to explore the relationship between CSR and employee commitment in Libyan companies.

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#### Appendix 1: Profiles of interviewees

Sectors Name	Sectors Number	Selected sectors	Financial Managers	Information Managers	Total
Manufacturing	12	6	8	4	12
Services	14	10	11	1	12
Banks and Insurance	13	5	4	2	6
Mining	1	1	1	0	1
Total	40	22	24	7	31
Participants rate			77%	23%	100%

Appendix 2: Summary of key findings by topics

Questions	Answers	EMPD and employee commitment		COMD and employee commitment		COND and employee commitment		ENVVD and employee commitment		CSRSD and employee commitment	
		No	%	No	%	No	%	No	%	No	%
CSRSD and Employee Commitment:											
The association between CSRSD and employee commitment.											
Does information about CSR activities affect employee commitment?	Yes, definitely. Yes, but not only a certain level of CSRSD. Yes, in theory. Probably not.	21 of 31 3 of 31 3 of 31 4 of 31	68% 10% 10% 13%	4 of 31 9 of 31 3 of 31 15 of 31	13% 29% 10% 48%	12 of 31 7 of 31 4 of 31 8 of 31	39% 23% 13% 26%	5 of 31 6 of 31 4 of 31 16 of 31	16% 19% 13% 52%		
What is the extent of the association between levels of CSR information and employee commitment?	Positive. Negative. No link.	26 of 31 0 of 31 5 of 31	84% 0 16%	11 of 31 1 of 31 19 of 31	35% 3% 61%	21 of 31 0 of 31 10 of 31	68% 0 32%	12 of 31 0 of 31 19 of 31	39% 0 61%		
Does information about CSR activities improve employee commitment?	Yes. Yes, but with positive information. No. Do not know.	11 of 31 10 of 31 9 of 31 1 of 31	35% 32% 29% 3%	1 of 31 7 of 31 20 of 31 3 of 31	3% 23% 65% 10%	6 of 31 11 of 31 13 of 31 1 of 31	19% 35% 42% 3%	1 of 31 9 of 31 18 of 31 3 of 31	3% 29% 58% 10%		
More details on association CSRSD with employee commitment.											
Does choice of accounting policy interact with the amount of CSR information policy to affect employee commitment?	Yes. Possibly. No. Don't know.										
Does the effect of CSRSD on employee commitment depend on establishing a sustained commitment to improve CSRSD?	Yes. Possibly. No. Don't know.										
										4 of 28 11 of 28 8 of 28 5 of 28	14% 39% 29% 18%
										8 of 28 11 of 28 6 of 28 3 of 28	29% 39% 21% 11%

Note. These tables show the results of the perceptions of financial managers and information managers about corporate social responsibility disclosure (CSRSD) (environmental disclosure (ENVVD), consumer disclosure (COND), community disclosure (COMD) and employee commitment (EMPD)) and employee commitment in the Libyan context

# How Does the Selection of Hedging Instruments Affect Company Financial Measures? Evidence from UK Listed Firms

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## Abstract

The study investigates the financial attributes of firms that utilise different hedging instruments. The findings show that firms that use interest rate swaps and futures and forwards tend to display higher size, growth, profitability, dividend payout and leverage measures as opposed to firms that do not use hedging. By distinguishing between two major types of hedging instruments, the findings assist users in understanding the economic consequences that stem from the selection of different hedging tools and in making unbiased predictions about firms' future financial prospects and position.

**Keywords:** Accounting policy choice, Corporate hedging, Interest rate swaps, Futures, Forwards

*JEL Classification:* M41

## 1. Introduction

The literature provides evidence that firms with large size and high growth and leverage measures are likely to use hedging in order to protect their financial position and performance (Adam, 2002; Guay and Kothari, 2003). Hedging may be used in order to reduce the possibility for debt covenant violation and financial distress as well as to mitigate earnings and cash flow volatility and subsequently to stabilise the tax obligation (Joseph, 2000). Hedging also reduces firms' financing costs and alleviates the possibility of bankruptcy (Cooper and Mello, 1999). The reduction of earnings volatility that may be achieved via hedging would be likely to reduce agency costs and reinforce firms' dividend policy (Nance et al, 1993; Bodnar et al, 1998). The use of hedging may also improve the quality of reported earnings and influence firm value (Krawiec, 1998; Bartram et al, 2009). Further, hedging can reduce a firm's riskiness and beta coefficient (Allayannis and Weston, 2001).

Firms may be inclined to hedge if external capital is costly (Froot et al, 1993). Managers may adopt certain hedging strategies that serve their interests even if they are detrimental for shareholders or for the firm's long-term prosperity (Stulz, 1990; Guay, 1999). It is implied that managers may seek to influence the reported earnings in order to meet financial analysts' forecasts and investors' expectations (Chung et al, 2002; Brown and Caylor, 2005). They may also desire to maximise their compensation and influence investors' perceptions and avoid attracting market authorities' attention and scrutiny (Fields et al, 2001; Doukas et al, 2005).

The study seeks to describe the financial attributes of hedgers that use different hedging instruments. In particular, it focuses on the use of futures, forwards and interest rate swaps and examines how their use affects the financial performance and position of hedgers. To further confirm the empirical findings, the study also draws comparisons with firms that do not use hedging. The findings provide evidence that the implementation of futures, forwards and interest rate swaps tends to significantly improve hedgers' growth, liquidity, profitability and dividend payout. It is implied that the degree of influence over hedgers' financial numbers would vary based on the type of hedging instrument used.

The remaining sections of the study are as follows. Section 2 describes the research hypothesis. Section 3 presents the datasets of the study. Section 4 discusses the empirical findings, and Section 5 presents the conclusions of the study.

## 2. Research Hypothesis

### 2.1 Use of Hedging Instruments

The study examines the differences in the financial attributes of firms that implement corporate hedging using different hedging instruments. It is noted that 46% and 39% of the sample firms use interest rate swaps, and futures and forwards respectively. A survey carried out by the Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity in 2001, confirms our findings and indicates the relative significance of forwards and swaps of foreign exchange and interest rate. Hence, the study focuses on firms that use interest rate swaps and futures and forwards. It has been found that only 11% and 4% of the sample use options and caps and collars respectively (see Figure 1).

Insert Figure 1 Here

The dependent dummy variables that are used in the logistic regressions are respectively as follows: 1 for hedgers using interest rate swaps and 0 for non-hedgers; and 1 for hedgers using futures and forwards and 0 for non-hedgers. The hypothesis that is tested is the following:

$H_1$  Firms that use certain hedging instruments to cover their open market positions are likely to exhibit different financial attributes compared to firms that use no hedging instruments.

The regression models that are employed are respectively as follows:

$$IRS_{i,t} = a_0 + a_1 Profitability_{i,t} + a_2 Growth_{i,t} + a_3 Leverage_{i,t} + a_4 Liquidity_{i,t} + a_5 Size_{i,t} + a_6 Investment_{i,t} + e_{i,t} \quad (5)$$

$$FF_{i,t} = a_0 + a_1 Profitability_{i,t} + a_2 Growth_{i,t} + a_3 Leverage_{i,t} + a_4 Liquidity_{i,t} + a_5 Size_{i,t} + a_6 Investment_{i,t} + e_{i,t} \quad (6)$$

where  $IRS_{i,t}$  is a dummy variable indicating the use of interest rate swaps.  $IRS_{i,t} = 1$  for hedgers using interest rate swaps and  $IRS_{i,t} = 0$  for non-hedgers,

$Profitability_{i,t}$

$Growth_{i,t}$

$Leverage_{i,t}$

$Liquidity_{i,t}$

$Size_{i,t}$

$Investment_{i,t}$

$FF_{i,t}$

$e_{i,t}$

are proxies used to control for firm profitability, growth, leverage, liquidity, size and investment respectively (see Appendix 1),

$FF_{i,t}$  is a dummy variable indicating the use of futures and forwards.  $FF_{i,t} = 1$  for hedgers using futures and forwards and  $FF_{i,t} = 0$  for non-hedgers.

$e_{i,t}$  is the error term.

### 3. Datasets

Accounting and financial data were collected from DataStream. Financial statement information required for the empirical investigation was collected from the Financial Times Annual Report Service. The sample consists of 229 UK firms listed on the London Stock Exchange. All sample firms have adopted International Financial Reporting Standards (IFRSs). The study focuses on firms that utilised hedging practices, i.e. hedgers, and firms that did not, i.e. non-hedgers. 134 sample firms used corporate hedging, while 95 firms did not. The study focuses on industrial firms and has excluded banks, insurance, pension and brokerage firms. The study concentrates on the post IFRS adoption year 2006 and examines 2006 financial numbers. In order to test the research hypothesis, the study makes use of binary logistic regression analysis.

### 4. Research Findings

#### 4.1 Use of Hedging Instruments

Focusing on firms that use hedging instruments to provide cover for open market positions, the study finds evidence that users of certain hedging instruments tend to exhibit better financial measures than non-users. Hence,  $H_1$  holds. Table 1 (Panel A) shows that firms that use interest rate swaps appear to exhibit higher leverage (CGEAR), and subsequently higher interest charges (INTMV). Thus, they would need to hedge the inherent interest rate risk and cover themselves against the possibility of financial distress and debt covenant violation. Panel A also indicates that firms that use interest rate swaps tend to be larger (LNMV). This would imply that the size of the firm would cause the usage of derivatives. They also display higher measures of growth (DIVSHG), suggesting that they need to protect and enhance their development and prosperity (see Fong, 2005). Additionally, they tend to exhibit higher profitability (OPM and EPS), implying that the use of such instruments has benefited their financial performance.

Panel B shows that firms that use futures and forwards display similar financial attributes, in the sense that their financial performance tends to be favourably affected by the use of such instruments. In particular, Panel B indicates that the use of futures and forwards has a favourable impact on firms' profitability (OPM) and growth (EPSG, PEG and DIVSHG), which appear to be higher. The use of such instruments has enabled firms to distribute higher dividends (DIVSH) to shareholders, while it has also improved their liquidity (CFSH) (see Realdon, 2007). A motive behind the use of futures and forwards may be the higher short-term leverage (CLSFU) that is evident, expressing the need to protect firm financial position and credibility.

The fact that the use of different instruments leads to different financial attributes for hedgers as opposed to non-hedgers may be explained by the underlying characteristics of companies that use interest-rate swaps compared to those that use futures and forwards. For example, the use of interest-rate swaps would be likely related to significant levels of debt, which would call the company to use interest-rate swaps for a cover against an interest rate increase. This is supported by the higher leverage (CGEAR) that users of interest-rate swaps display as shown in Panel A. Bartram et al (2009) also report that firms with high interest rate exposure are likely to use interest rate derivatives. On the other hand, the users of futures and forwards exhibit a different picture. They appear to present higher growth (e.g. EPSG and PEG) and also higher liquidity (CFSH) and dividend payout (DIVSH), implying that they likely seek to expand, improve their financial position and attract investors. Future research should examine the differences between hedgers and non-hedgers using both interest rate swaps and futures and forwards.

## 5. Conclusions

The study investigates the financial attributes of firms that utilise different hedging instruments. The findings show that firms that use interest rate swaps and futures and forwards tend to display a significant improvement in their financial numbers as opposed to firms that do not use hedging. The effective use of hedging would tend to reduce the level of riskiness and variability and would have a favourable effect on company fundamentals. Firms that utilise interest rate swaps and futures and forwards appear to exhibit higher size, growth, profitability, dividend payout and leverage measures. The findings are useful for hedgers and financial analysts, as they provide insightful information about the effects of hedging on firms' financial performance and position. By distinguishing between two major types of hedging instruments, the findings assist users in understanding the economic consequences that stem from the selection of different hedging tools and in making unbiased predictions about firms' future financial prospects and position.

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Table 1. Logistic Regression Analysis

Use of Hedging Instruments			
Panel A Use of Interest Rate Swaps		Panel B Use of Futures and Forwards	
Variables	Hedgers vs. Non-hedgers	Variables	Hedgers vs. Non-hedgers
	Coefficients		Coefficients
LNMV	0.6738 ** (0.9225)	EPSG	5.8699 ** (3.3637)
DIVSHG	23.2049 ** (11.9192)	PEG	3.2062 ** (1.6691)
OPM	2.5733 * (1.6676)	DIVSH	8.3634 * (7.1547)
EPS	14.3240 * (11.5182)	DIVSHG	5.9919 * (3.5453)
INTCOV	0.1500 * (0.004)	OPM	25.9622 * (15.7423)
GEAR	0.2241 * (1.1239)	CFSH	4.0097 ** (1.7383)
Constant	0.0209 (1.9812)	CLSFU	0.3223 * (0.2835)
		Constant	0.753 (0.7767)
Model $\chi^2$	0.29 ***		1.721 **
% correctly classified	52.3 ***		51.8 ***
Sample size	N <sub>0</sub> =61, N <sub>1</sub> =95		N <sub>0</sub> =53, N <sub>1</sub> =95

\*\* and \* indicate statistical significance at the 5% and 10% level (two-tailed) respectively. All the explanatory variables were entered/removed from the logistic regression using a step-wise procedure with a p-value of 0.05 to enter and a p-value of 0.10 to remove. The Wald statistic was used to test the null hypothesis that each coefficient is zero. 61 sample firms have used interest rate swaps and 53 firms have used futures and forwards. The rest 20 sample firms (not examined here) have used options and caps and collars.



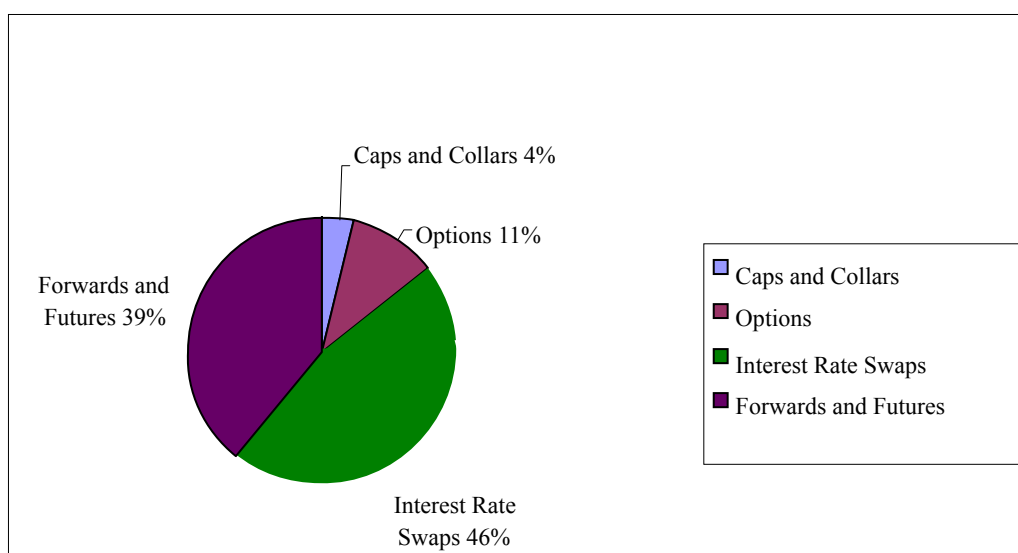


Figure 1. Hedging Instrument Usage for 2006

### Appendix 1. Explanatory Variables

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<i>Size</i>	
LNMV	Natural logarithm of market value
<i>Dividend</i>	
DIVSH	Dividend divided by number of ordinary shares in issue
<i>Growth</i>	
EPSG	Earnings per share growth
PEG	Price to earnings growth
DIVSHG	Dividend per share growth
<i>Profitability</i>	
OPM	Operating profit divided by sales
EPS	Earnings available to shareholders divided by number of ordinary shares in issue
<i>Liquidity</i>	
CFSH	Cash flow from operating activities divided by number of ordinary shares in issue
<i>Leverage</i>	
CLSFU	Current liabilities divided by shareholders' funds
INTCOV	Profit before interest and taxation divided by interest expense
GEAR	Total borrowings divided by total borrowings plus total equity

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# Stock Market Investors: Who Is More Rational, and Who Relies on Intuition?

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## Abstract

Contemporary research documents various psychological aspects of economic and financial thought and decision-making. The main goal of our study is to analyze the effects of five well-documented behavioral biases, namely, disposition effect, herd behavior, availability heuristic, gambler's fallacy and hot hand fallacy, on the mechanism of stock market decision-making, and, in particular, the individual differences in the degrees of these effects. Employing an extensive online survey, we document that on average, active stock market investors exhibit moderate degrees of behavioral biases. Furthermore, we find that, on the one hand, more experienced investors are less affected by behavioral patterns, yet, on the other hand, professional portfolio managers do not behave, in this respect, differently (more rationally) from non-professional investors. We, therefore, infer that investor's experience in stock market matters, but not the "status" itself of being a professional, may decrease the effect of behavioral biases on her. In addition, we detect that the major "rationalizing" effect of experience is already accumulated in the first years of investors' stock market activity. Finally, we document that female investors are more strongly affected by all the five behavioral biases.

**Keywords:** Availability Heuristic, Behavioral finance, Disposition effect, Gambler's fallacy, Herd behavior, Hot hand fallacy, Individual differences

*JEL Classification:* D81, D84, G11, G14, G19.

## 1. Introduction

Human judgments fall prey to a variety of systematic biases and distortions that may result in "incorrect" patterns of behavior and inferior performance (for an overview, see, for example, Kahneman, et al. (1982), Stracca (2004)). In this study we analyze the effect of five well-documented behavioral biases on market investors' decision-making, and in particular, we wish to shed light on the nature of the individual differences in the magnitudes of these biases, the matter which is almost not discussed in previous financial literature.

The behavioral patterns (biases) we analyze are:

Disposition effect (Shefrin and Statman (1985)) – investors' tendency to sell stocks that gained value and to hold on to stocks that lost value.

Herd behavior (for a recent survey, see, e.g., Hirshleifer and Teoh (2003)) - behavior of an investor imitating the observed actions of others or the movements of market instead of following her own beliefs and information.

Availability heuristic (Tversky and Kahneman (1973)) - phenomenon of determining the likelihood of an event according to the easiness of recalling similar instances.

Gambler's fallacy (Laplace (1796)) - incorrect belief in negative autocorrelation of non-autocorrelated random sequences.

Hot hand fallacy (Gilovich, Vallone and Tversky (1985)) – incorrect belief that certain random sequences may in fact be non-random (human-related) and therefore, positively autocorrelated.

We perform an online survey asking stock market investors, both professional and non-professional, a number of questions concerned with their personal way of making investment decisions. The questions are formulated so as to detect if the participants are affected by the above-mentioned biases. For each participant, we calculate her personal "bias grades", which are higher the more her reported behavior, as appears from her answers, is consistent with the respective behavioral effects. On average, our survey participants exhibit moderate degrees of behavioral biases.

Furthermore, as a major focus of our research, we analyze the individual differences in the "bias grades". First of all, we document that professional portfolio managers are just non-significantly weaker affected by the behavioral patterns, than non-professional investors. On the other hand, we find that the magnitude of the biases is significantly lower for more experienced investors. Moreover, professional investors appear to be significantly stronger influenced by the behavioral effects, than non-professional but experienced investors. Thus, we infer that investor's experience in stock market matters, but not the "status" itself of being a professional, may decrease the effect of behavioral biases on her. Also in this context, we detect that the major "rationalizing" effect of experience is already accumulated in the first years of investors' stock market activity.

Finally, we document that female investors are more strongly affected by all the five behavioral biases. This result may be potentially explained in the framework of psychological literature, showing that women are, on average, more driven by feelings and emotions and more willing to follow the ideas suggested by others, while men are more assertive and independent in their thoughts and actions (see for example, Feingold (1994), Helgeson (1994, 2003), Fritz and Helgeson (1998)).

The rest of the paper is structured as follows. In Section 2, we review the literature on behavioral biases, featuring both psychological aspects and economic applications. In Section 3, we describe our survey design and research approach. Section 4 defines our hypotheses and provides the empirical tests and the results. Section 5 concludes and provides a brief discussion.

## **2. Psychological Biases in Finance: Literature Review**

Recent literature demonstrates that economic and financial behavior and decision-making may be affected by various psychological effects. These effects, often referred to as "biases" or "fallacies", are based on feelings, emotions and intuition, rather than on rational considerations, and often result in inferior financial performance. In present research, we concentrate on five well-documented effects.

### *2.1 Disposition Effect*

One of the most striking behavioral patterns is the tendency of investors to sell "winners" (stocks that gained value) and to hold on to "losers" (stocks that lost value). The term "disposition effect" is first dubbed by Shefrin and Statman (1985), who also offer a behavioral explanation for it, based on the combination of loss aversion (Kahneman and Tversky (1979)) and mental accounting (Thaler (1985)). In essence, the disposition effect is a reflection of investors keeping a separate mental account for each stock and, according to prospect theory, maximizing an S-shaped (concave for gains and convex for losses), reference-level based, value function within that account. Three different kinds of data are applied for studying the disposition effect: aggregate (on the level of stock exchanges), individual (on the level of individual investors) and experimental.

The first to employ aggregate data are Lakonishok and Smidt (1986). Using historical stock prices as possible reference points, they find that winners tend to have higher abnormal volume than losers. A similar technique is employed by Ferris et al. (1988) and Bremer and Cato (1996), yielding comparable results. Huddart et al. (2007) find that a significantly higher volume when stock prices are above (below) their fifty-two week highs (lows). Kaustia (2004) uses the price and volume information on US initial public offerings (IPOs) to find that for negative

initial return IPOs, trading below the offer price (which is assumed to be the reference point) is suppressed in comparison to trading above the offer price, and that there is an increase in trading volume as their stock prices reach new record highs.

The second major group of papers studying the disposition effect is based on individual data. The reference point in these studies is taken to be the stocks' purchase prices. In a comprehensive research, Odean (1998) takes the average purchase price (for each investor and stock) as a reference point and then distinguishes between paper, vs. realized, gains and losses. For each day and investor, he calculates the Proportion of Gains Realized (PGR) and the Proportion of Losses Realized (PLR), taking the ratio of PGR to PLR as a measure of the disposition effect. Odean's main findings include the observation that individual investors demonstrate significant preferences for selling winners and holding losers. Dhar and Zhu (2002) find that the disposition effect is mainly pronounced by low-income and non-professional investors. Goetzmann and Massa (2003) argue that investors' disposition bias affects the firms' returns. Grinblatt and Han (2005) were the first to connect the disposition effect and momentum, showing, both theoretically and empirically, that the disposition effect may account for the tendency of past winning stocks to subsequently outperform past losing stocks. Frazzini (2006) finds that in the presence of disposition-prone investors, prices under-react to news, generating thereby a post-event price drift. Locke and Mann (2005) find that the average holding period for losing trades is longer than for winning trades. They argue that, while all traders hold losers longer than winners, the least successful traders hold losers the longest, while the most successful traders hold losers for the shortest time. Shapira and Venezia (2000) compare the duration of winning and losing round trips and document the disposition effect for all groups of accounts, finding that it is less pronounced for managed, than for independent, accounts. Kliger and Kudryavtsev (2008) discover that investors update their reference points on stocks following stock exchange-listed firms' quarterly earnings announcements perceived as "good" or "bad surprises", and subsequently exhibit disposition effect with respect to these reference points.

The third group of papers that sheds light on the disposition effect consists of papers employing experimental design. Weber and Camerer (1998) carry a multi-stage experiment examining different characteristics and determinants of the disposition effect and find that subjects tend to sell fewer shares when the price falls than when it rises and also sell less when the price is below the purchase price than when it is above. Similarly to Weber and Camerer (1998), Oehler et al. (2002) use the purchase price and the last period price as alternative reference points. The disposition effect is found to be stronger when the purchase price is taken as a reference point.

## 2.2 Herd Behavior (Herding)

In financial markets, herding is usually termed as the behavior of an investor imitating the observed actions of others or the movements of market instead of following her own beliefs and information. Possibly herd behavior is among the most mentioned but least understood terms in the financial lexicon. Difficulties to measure and quantify the existence of the behavior form obstacles for extensive research. Even so, there are at least two points people tend to unanimously agree upon. First, as one of the founding pillars in newly developed behavioral asset pricing area, herd behavior helps to explain market wide anomalies. Since individual biases are not influential enough to move market prices and returns, they have real anomalous effect only if there is a social contamination with a strong emotional content, leading to more widespread phenomena such as herd behavior. Second, it is generally accepted that the flood of herding may lead to a situation in which the market price fails to reflect all relevant information and thus the market becomes unstable and moves towards inefficiency.

Theoretical and empirical research of herd behavior has been conducted in an isolated manner. The theoretical work (e.g., Avery and Zemsky (1998), Lee (1998), Cipriani and Guarino (2008), Park and Sabourian (2010)) tries to identify the mechanisms that can lead traders to herd. Papers in this literature emphasize that in financial markets, the fact that prices adjust to the order flow makes herd behavior more difficult to arise than in other setups, studied in the social learning literature, where there is no price mechanism. Nevertheless, it is possible that rational traders herd, because there are different sources of uncertainty in the market, because traders have informational and non-informational (e.g., liquidity or hedging) motives to trade or because trading activity is affected by reputation concerns.

Empirical studies of herd behavior employ either laboratory or market data. In all the models, "herding" means making the same decision independently of the private information that one receives. The problem for the empiricist is that there are no data on the private information available to the traders and, therefore, it is difficult to understand whether traders make similar decisions because they disregard their own information and imitate (as opposed, for instance, to reacting to the same piece of public information). To overcome this problem, some authors (e.g., Cipriani and Guarino, (2005, 2009), Drehman et al. (2005)) test herd behavior in laboratory financial markets, and document types of behavior consistent with herd motives.

A series of empirical studies make an effort to detect and measure herd behavior in real market situations. Lakonishok et al. (1992) measure herd behavior as the average tendency of a group of money managers to buy or sell particular stocks at the same time, relative to what could be expected if the managers make their decision independently. Wermers (1995) proposes a portfolio-change measure, by which herd behavior is measured by the extent to which portfolio weights assigned to the various stocks by different money managers move in the same direction. Christie and Huang (1995) document lower volatility of individual security returns in the periods of extremely positive and extremely negative market returns, which is in line with herding behavior and contradicts rational asset pricing. Hwang and Salmon (2004) and Wang and Canela (2006) employ cross-sectional variance of the betas to study herd behavior towards market index in major developed and emerging financial markets. They find a higher level of herding in emerging markets than in developed markets, and higher correlations of herding between two markets from the same group compared to those between two markets from different groups. They also argue that herd behavior shows significant movements and persistence independently from market conditions.

### *2.3 Availability Heuristic*

The availability heuristic (Tversky and Kahneman (1973)) refers to the phenomenon of determining the likelihood of an event according to the easiness of recalling similar instances. In other words, the availability heuristic may be described as a rule of thumb, which occurs when people estimate the probability of an outcome based on how easy that outcome is to imagine. As such, vividly described, emotionally-charged possibilities will be perceived as being more likely than those that are harder to picture or difficult to understand. Tversky and Kahneman (1974), provide examples of ways availability may provide practical clues for assessing frequencies and probabilities. They argue that "recent occurrences are likely to be relatively more available than earlier experiences" (p. 1127), and, thus, conclude that people assess probabilities by overweighting current information, as opposed to processing all relevant information.

A number of papers discuss the influence of the availability heuristic on market investors. Shiller (1998) argues that investors' attention to investment categories (e.g., stocks versus bonds or real estate; investing abroad versus investing at home) may be affected by alternating waves of public attention or inattention. Similarly, Barber and Odean (2008) find that when choosing which stock to buy, investors tend to consider only those stocks that have recently caught their attention (stocks in the news, stocks experiencing high abnormal trading volume, stocks with extreme one day returns). Daniel et al. (2002) conclude that investors and analysts are on average too credulous, that is, when examining an informative event or a value indicator, they do not discount adequately for the incentives of others to manipulate this signal. Credulity may be explained by limited attention and the fact that availability of a stimulus causes it to be weighed more heavily. Frieder (2003) finds that stock traders seek to buy after large positive earnings surprises and sell after large negative earnings surprises, and explains this tendency by the availability heuristic, assuming that the salience of an earnings surprise increases in its magnitude. Ganzach (2001) brings support for a model in which analysts base their judgments of risk and return for unfamiliar stocks upon a global attitude. If stocks are perceived as good, they are judged to have high return and low risk, whereas if they are perceived as bad, they are judged to be low in return and high in risk. Lee et al. (2007) discuss the "recency bias", which is the tendency of people to make judgments about the likelihood of events based on their recent experience. They find that analysts' forecasts of firms' long-term growth in earnings per share tend to be relatively optimistic when the economy is expanding and relatively pessimistic when the economy is contracting. This finding is consistent with the availability heuristic, indicating that forecasters overweight current state of the economy in making long-term growth predictions. Kliger and Kudryavtsev (2010) find that positive stock price reactions to analyst recommendation upgrades are stronger when accompanied by positive stock market index returns, and negative stock price reactions to analyst recommendation downgrades are stronger when accompanied by negative stock market index returns. They dub this finding "outcome availability effect" and explain it by higher availability of positive (negative) outcomes on days of market index rises (declines). Moreover, Kliger and Kudryavtsev (2010) document weaker (stronger) reactions to recommendation upgrades (downgrades) on days of substantial stock market moves. They dub this finding "risk availability effect" and explain it by higher availability of risky outcomes on such "highly volatile" days.

### *2.4 Gambler's Fallacy*

The gambler's fallacy is defined as an (incorrect) belief in negative autocorrelation of a non-autocorrelated random sequence. For example, individuals who believe in the gambler's fallacy believe that after three red numbers appearing on the roulette wheel, a black number is "due," that is, is more likely to appear than a red number.

The first published account of the gambler's fallacy is from Laplace (1796). Gambler's fallacy-type beliefs are first observed in the laboratory (under controlled conditions) in the literature on probability matching. In these

experiments subjects are asked to guess which of two colored lights would next illuminate. After seeing a string of one outcome, subjects are significantly more likely to guess the other, an effect referred to in that literature as negative recency (see Estes, 1964, and Lee, 1971, for reviews). Ayton and Fischer (2004) also demonstrate the existence of gambler's fallacy beliefs in the lab when subjects choose which of two colors will appear next on a simulated roulette wheel. Gal and Baron (1996) show that gambler's fallacy behavior is not simply caused by boredom. They ask participants in their experiments how they would best maximize their earnings, and get responses based on gambler's fallacy type logic.

The gambler's fallacy is thought to be caused by the representativeness heuristic (Tversky and Kahneman (1971), Kahneman and Tversky (1972)). Here, chance is perceived as "a self-correcting process in which a deviation in one direction induces a deviation in the opposite direction to restore the equilibrium" (Tversky and Kahneman (1974), p. 1125). Thus after a sequence of three red numbers appearing on the roulette wheel, black is more likely to occur than red because a sequence "red-red-red-black" is more representative of the underlying distribution than a sequence "red-red-red-red".

A number of researchers demonstrate the existence of the gambler's fallacy empirically, in lottery and horse or dog racing settings. For example, Clotfelter and Cook (1991, 1993) and Terrell (1994) show that soon after a lottery number wins, individuals are significantly less likely to bet on it. This effect diminishes over time; months later the winning number is as popular as the average number. Metzger (1984), Terrell and Farmer (1996) and Terrell (1998) show the gambler's fallacy in horse and dog racing. Croson and Sundali (2005) and Sundali and Croson (2006) use videotapes of play of a roulette table in casino and document a significant gambler's fallacy in betting. That is, following a sequence of one color outcomes, people are more likely to place their bets on the other color.

Zielonka (2004) asks a group of stock market professionals a number of questions aimed at detecting their way of making decisions, and documents that market "signals" considered by technical analysts are consistent with a number of behavioral biases, including gambler's fallacy.

Overall, the gambler's fallacy is well-documented both in the laboratory and in the real-world, including money-related behavior. Yet, on the other hand, there seems to be little evidence of this pattern in financial, including stock market decision-making.

### *2.5 Hot Hand Fallacy*

In the same time when people exhibit the gambler's fallacy, which is a tendency to predict the opposite of the last event (negative recency), they also express beliefs that certain events will be repeated (positive recency). The latter tendency is known as hot hand fallacy, and unlike gambler's fallacy it refers to people's belief that a particular person, rather than outcome is hot. For example, if an individual has won in the past, whatever numbers she chooses to bet on are likely to win in the future, not just the numbers she has won with previously.

Gilovich, Vallone and Tversky (1985) are the first to dub the term of "hot hand". They demonstrate that individuals believe in the hot hand in basketball shooting, and that these beliefs are not correct (i.e., basketball shooters' probability of success is serially uncorrelated). They suggest that the hot hand also arises out of the representativeness heuristic, just as the gambler's fallacy. They write: "A conception of chance based on representativeness produces two related biases. First, it induces a belief that the probability of heads is greater after a long sequence of tails than after a long sequence of heads — this is the notorious gambler's fallacy. Second, it leads people to reject the randomness of sequences that contain the expected number of runs because even the occurrence of, say, four heads in a row — which is quite likely in a sequence of 20 tosses — makes the sequence appear non-representative". Another potential explanation for the hot hand fallacy may be related to Langer (1975) dealing with the illusion of control, that is, people's tendency to believe that they (or others) exert control over events that are in fact randomly determined.

Other experimental evidence shows that subjects in a simulated blackjack game bet more after a series of wins than they do after a series of losses, both when betting on their own play and on the play of others (Chau and Phillips (1995)). Further evidence of the hot hand in a laboratory experiment comes from Ayton and Fischer (2004) who document both the gambler's fallacy and the hot hand fallacy and conclude that the former is attributed to "randomly looking" processes and to inanimate chance mechanisms, while the latter refers to processes that seem to be non-random and to human skilled performance.

The evidence for the hot hand from the field is weaker. Camerer (1989) compares odds in the betting market for basketball teams with their actual performance and finds that bettors do appear to believe in the "hot team". Croson and Sundali (2005) and Sundali and Croson (2006) document hot hand consistent behavior in casino. Clotfelter and Cook (1989) note the tendency of gamblers to redeem winning lottery tickets for more tickets rather than for cash.

This behavior is also consistent with hot hand beliefs, since the individuals who have recently won seem to believe they are more likely to win again.

Overall, similarly to the gambler's fallacy, the hot fallacy is widely discussed by different branches of literature, but is not sufficiently documented in financial research, possibly, because it is quite difficult to establish the hot hand feelings particular investors may have at certain moments of time.

In present study, we first of all, wish to shed a little more light on the effects of the above-discussed psychological patterns on financial decision-making. This may be especially valuable for the case of the gambler's fallacy and the hot hand fallacy, whose potential effects on the field of finance are not sufficiently studied by previous literature. Yet, the major goal of this study is to analyze the individual differences in the magnitudes of these biases, the matter which is almost not discussed in previous financial literature.

### 3. Survey Design and Research Approach

We gathered the data for this study in the framework of a computerized survey, consisting of two stages:

First, we asked a group of professional portfolio managers (41 managers) at one of the major Israeli investment houses to fill in a short questionnaire.

Second, we conducted online survey via one of the leading financial web-sites in Israel. The web-site we used is widely recognized for being regularly visited by market investors, not necessarily professional. We got responses from 305 users (Note 1).

We asked all the respondents to indicate their gender, age, and number of years of active experience in the capital market. Table 1 (in Appendix 1) reports the basic descriptive statistics of our sample. The majority of our participants were males (78.05% and 74.10% in the professionals and non-professionals groups, respectively), 30 to 40 years old (53.66% and 55.08%, respectively), and had more than 10 years of experience in stock market investments (39.02% and 40.98%, respectively).

Our survey questionnaire consisted of 10 questions, which are presented in Appendix. In each question, participants were asked to rate appropriateness of a statement on a Likert scale between 1 (strongly disagree) and 5 (strongly agree).

The goal of the questionnaire was to detect if stock market investors were affected by different psychological biases. In this respect, the statements were formulated so that questions 1 and 2 referred to the disposition effect, questions 3 and 4 to the gambler's fallacy, questions 5 and 6 to the hot hand fallacy, questions 7 and 8 to the herd behavior, and questions 9 and 10 to the availability heuristic. According to the definition of the biases and the formulation of the questions, for all our questions, except question 2, a higher grade provided by a participant would be consistent with a stronger effect of the respective bias on her.

In order to capture the effect of each of the behavioral biases on each of our participants, we calculate their personal "bias grades". To do so, we first of all, control for the cross-sectional correlations of grades given by the participants within the "pairs" of the questions we employ for each of the biases.

The correlation coefficients between the grades within the pairs are reported in Table 2. The Table clearly demonstrates that the correlations within all the pairs are highly significant for both groups of participants. We also note that the sign of the correlation between the grades on questions 1 and 2 is negative, which is due to the fact that investment behavior consistent with the disposition effect would require a high grade on question 1 and a low grade on question 2.

Strong correlations within the pairs of questions allow us to aggregate the bias grades for each participant  $i$  and for each of the biases, in the following way:

Disposition grade ( $^{DG}_i$ ):

$$DG_i = G_{-1_i} + 6 - G_{-2_i} \quad (1)$$

(Note 2)

where:  $G_{-N_i}$  is the grade (answer) given by participant  $i$  for question (statement)  $N$ .

Gambler's grade ( $^{GG}_i$ ):

$$GG_i = G_{-2_i} + G_{-3_i} \quad (2)$$

Hot-hand grade ( $^{HG}_i$ ):

$$HG_i = G_{-5_i} + G_{-6_i} \quad (3)$$

Herd (behavior) grade ( $BG_i$ ):

$$BG_i = G_{-7_i} + G_{-8_i} \quad (4)$$

Availability grade ( $AG_i$ ):

$$AG_i = G_{-9_i} + G_{-10_i} \quad (5)$$

#### 4. Testable Hypotheses and Results

First of all, we look at the general picture of the bias grades in our sample. Table 3 concentrates descriptive statistics in this respect, and shows some general results:

All the bias grades for both groups range from 2 (minimal possible grade) to 9-10 (maximal possible grade). In other words, in our sample, we have both participants who seem to be fully affected and completely unaffected by the respective behavioral patterns.

The mean bias grades range from 4.927 to 5.646, and the majority of the participants have bias grades lower than 6. We, therefore, may infer that our participants are, on average, moderately affected by behavioral biases.

Yet, the major goal of our paper is to analyze the individual differences in the bias grades, and we now proceed to this analysis.

##### 4.1 Behavioral Biases and Investors' Trading Experience

Trading experience seems to be the most reasonable "candidate" for a factor eliminating (or at least, diminishing) behavioral biases. One might expect stock market investors to behave more rationally the more knowledge about the market they have accumulated. Still, previous evidence on the effect of experience on the magnitude of various behavioral biases is rather scarce. In an experimental setting, List (2003) finds that market experience plays a significant role in eliminating the endowment effect (Note 3). List further suggests that market experience is likely to diminish other "market anomalies", as well, yet, does not provide such evidence. Dhar and Zhu (2002), in addition to other findings, demonstrate that the disposition effect is mainly pronounced by non-professional investors.

We make an effort to fill this certain gap in literature dealing with behavioral economics and finance. Our sample allows us to analyze the magnitudes of the biases by two different proxies for investors' experience:

Investors' level of "professionalism",

Number of years of stock trading experience.

In this respect, we hypothesize two things:

Hypothesis 1a: All the behavioral effects are more strongly pronounced for non-professional investors.

and

Hypothesis 1b: All the behavioral effects are more strongly pronounced for less experienced investors.

In order to test Hypothesis 1a, for each of the five behavioral patterns, we compare the mean bias grades between the two groups of participants: (i) professional portfolio managers, and (ii) visitors of financial web-site (not necessarily professional).

Table 4 presents the mean comparison tests. Indeed, in line with Hypothesis 1a, mean bias grades for all the five behavioral patterns, are higher for the participants who answered via the web-site. Yet, all the differences are non-significant, which does not allow us to support the Hypothesis. In other words, we may infer that the "status" of being a professional does not by itself make stock market investors less affected by behavioral biases.

Furthermore, we test Hypothesis 1b. We compare the mean bias grades between the categories of participants according to their reported investment experience. Since the subsample of professional investors is relatively small, we employ only the subsample of web-site visitors for this analysis. Table 5 comprises the comparative statistics for adjacent categories of reported market experience: (i) "Less than 3 years" versus "3 to 5 years"; (ii) "3 to 5 years" versus "5 to 10 years"; and (iii) "5 to 10 years" versus "More than 10 years". The results strongly support Hypothesis 1b. For all the five behavioral effects, the longer is the reported investment experience the lower are the mean bias grades. All the differences (15) between the mean bias grades for the adjacent categories are significantly greater than zero (11 of them at the 1% level) (Note 4). That is, unlike investors' "professionalism", their experience in stock market investments does decrease the effect of behavioral biases on them. An additional thing we may observe from



Table 5 is that for all the behavioral effects, the differences themselves between the mean bias grades decrease with investors' experience (i.e., the difference between categories 1 and 2 is greater than the difference between categories 2 and 3, which in its turn, is greater than the difference between categories 3 and 4). So, it seems that investors always learn from experience and behave more and more rationally, yet, the major "rationalizing" effect of experience is already accumulated in the first years of active investment.

Finally, in order to amplify the findings of this Subsection, we directly confront the effect of investors' "professionalism" on their behavior with the respective effect of investors' experience. We compare the mean bias grades between the subsample of professional portfolio managers and the category of the most experienced investors (reporting market experience of more than 10 years) from the subsample of non-professional investors. Table 6 comprises the results and demonstrates that all the five differences are highly significant. That is, investors' experience has a definitely stronger "rationalizing" effect on their way of decision-making than the "status" itself of being a professional.

#### *4.2 Behavioral Biases by Investors' Gender*

Men and women are different, and their behavior may be different in many ways. Women (on average) are universally recognized to rely on their intuition and to be driven by feelings and emotions, while men (again, on average) are thought to rely on logic. Previous psychological literature concludes that men are more assertive and independent in their thoughts and actions, while women are more willing to follow the ideas suggested by others (Feingold (1994), Helgeson (1994, 2003), Fritz and Helgeson (1998)). In the same spirit, Cross and Madson (1997) argue that women are more likely than men to develop an interdependent or relational self-construal, reflecting the importance of social connections and relationships, whereas men are more likely than women to develop an independent or agentic self-construal, reflecting a concern for social dominance and assertiveness (see also, Gabriel and Gardner (1999), Hyde (2005)).

Therefore, one might expect female investors to be more affected by various "intuitive" behavioral patterns, than male investors. In line with this suggestion, Kudryavtsev and Cohen (2011) find that women exhibit stronger hindsight bias (Note 5) and anchoring bias (Note 6) in recalling recent stock market outcomes. Yet, to our best knowledge, there are no studies analyzing gender differences with respect to the effects of the five behavioral biases we are dealing with on economic and financial decision-making. We wish to fill this gap, and in accordance with the discussion above, hypothesize that:

Hypothesis 2: All the behavioral effects in financial decision-making are more strongly pronounced for female investors.

To test Hypothesis 2, we employ the same approach as in the previous Subsection. Table 7 reports, for each of the five behavioral effects, the mean bias grades for men and women and the test statistics for the respective differences. The results clearly support Hypothesis 2, indicating that for all the biases, the mean bias grades are significantly (at the 1% level) higher for women than for men. That is, as expected, female investors are more likely to employ simplifying rules of decision-making.

### **5. Conclusions and Discussion**

Our paper explores the effects of behavioral biases, namely, disposition effect, herd behavior, availability heuristic, gambler's fallacy and hot hand fallacy, on the mechanism of stock market decision-making, and, in particular, the individual differences in the degrees of these effects.

Employing an extensive online survey, we document that on average, active stock market investors exhibit moderate degrees of behavioral biases. Furthermore, we find that, on the one hand, more experienced investors are less affected by behavioral patterns, yet, on the other hand, professional portfolio managers do not behave, in this respect, differently (more rationally) from non-professional investors. Moreover, professional investors appear to be significantly stronger influenced by the behavioral effects, than non-professional but experienced investors. In addition, we detect that the major "rationalizing" effect of experience is already accumulated in the first years of investors' stock market activity. Finally, we document that female investors are more strongly affected by all the five behavioral biases.

Our results may have a number of interesting implications. First of all, in what concerns the rationality of stock market investment decisions, the time, as always, is the best healer. On the other hand, the "professionalism" of the portfolio managers, when viewed apart of the effect of experience, does not appear to change their way of decision-making. This finding may serve a useful food for thought for the financial companies' managers.

In addition, in line with previous psychological literature, we document that female investors are more likely to rely on some simple and "intuitive" rules and techniques of decision-making. It follows that stock market analysts and all

other potentially interested persons should probably find it easier to manipulate female investors' views, opinions and decisions with respect to some particular financial assets and the stock market, in general. Both "sides of the game" might pay attention to this finding.

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### Notes

Note 1. The first stage of the survey took place in January 2011, and the second one in March-April 2011. The "Bizportal" (<http://www.bizportal.co.il/>) web-site was involved.

Note 2. We subtract the grade on question 2, since it is negatively correlated with the magnitude of the disposition effect exhibited by the respective participants. The number "6" is added in order to reduce the disposition grade to the same "2-to-10" scale as the rest of the bias grades.

Note 3. Endowment effect is a tendency of people to demand more compensation to give up an object than they would be willing to pay for it.

Note 4. Of course, all the differences between the categories 1 and 3, 2 and 4, and 1 and 4 are significantly greater than zero at the 1% level.

Note 5. Hindsight bias denotes people's tendency to overestimate, in hindsight, how predictable an outcome was in foresight.

Note 6. Anchoring bias refers to people's tendency to form their estimates for different categories, starting from a particular available, and often irrelevant, value and insufficiently adjusting their final judgments from this starting value.

Table 1. Sample descriptive statistics

Panel A: Portfolio managers (41 respondents)		
Category	Number	Percent of total
1. Gender:		
Men	32	78.05
Women	9	21.95
2. Age:		
18-30	9	21.95
30-40	22	53.66
40-50	9	21.95
50-60	1	2.44
60+	0	0.00
3. Capital market investor for:		
Less than 3 years	5	12.20
3 to 5 years	10	24.39
5 to 10 years	10	24.39
More than 10 years	16	39.02
Panel B: Market investors (305 respondents)		
Category	Number	Percent of total
1. Gender:		
Men	226	74.10
Women	79	25.90
2. Age:		
18-30	76	24.92
30-40	168	55.08
40-50	49	16.07
50-60	11	3.61
60+	1	0.33
3. Capital market investor for:		
Less than 3 years	107	35.08
3 to 5 years	29	9.51
5 to 10 years	44	14.43
More than 10 years	125	40.98

Table 2. Cross-sectional correlation coefficients of grades within the bias-related pairs of questions

Panel A: Portfolio managers (41 respondents)	
Pair of questions	Cross-sectional correlation coefficient between the question grades
Questions 1 & 2 (Disposition effect)	-0.924***
Questions 3 & 4 (Gambler's fallacy)	0.928***
Questions 5 & 6 (Hot hand fallacy)	0.877***
Questions 7 & 8 (Herd behavior)	0.827***
Questions 9 & 10 (Availability heuristic)	0.842***
Panel B: Market investors (305 respondents)	
Pair of questions	Cross-sectional correlation coefficient between the question grades
Questions 1 & 2 (Disposition effect)	-0.937***
Questions 3 & 4 (Gambler's fallacy)	0.917***
Questions 5 & 6 (Hot hand fallacy)	0.862***
Questions 7 & 8 (Herd behavior)	0.841***
Questions 9 & 10 (Availability heuristic)	0.842***

Asterisks denote 1-tailed p-values: \* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

Table 3. Basic descriptive statistics of "bias grades"

The table reports, by groups of participants, basic statistics of the "bias grades" calculated as follows:

$$DG_i = G_{-1_i} + 6 - G_{-2_i}; \quad GG_i = G_{-2_i} + G_{-3_i}; \quad HG_i = G_{-5_i} + G_{-6_i};$$

$$BG_i = G_{-7_i} + G_{-8_i}; \quad AG_i = G_{-9_i} + G_{-10_i}$$

where:  $G_{-N_i}$  is the grade (answer) given by participant  $i$  for question (statement)  $N$ .

Panel A: Portfolio managers (41 respondents)					
Statistics	Disposition grade ( $DG_i$ )	Gambler's grade ( $GG_i$ )	Hot-hand grade ( $HG_i$ )	Herd (behavior) grade ( $BG_i$ )	Availability grade ( $AG_i$ )
Mean	5.463	4.927	5.122	5.000	5.171
Median	4	4	4	4	4
Standard Deviation	2.873	3.045	2.750	2.739	2.801
Maximum	10	9	9	10	9
Minimum	2	2	2	2	2
Grade $\in [6,10]$ , percent	41.46	41.46	39.02	39.02	41.46
Panel B: Market investors (305 respondents)					
Statistics	Disposition grade ( $DG_i$ )	Gambler's grade ( $GG_i$ )	Hot-hand grade ( $HG_i$ )	Herd (behavior) grade ( $BG_i$ )	Availability grade ( $AG_i$ )
Mean	5.646	5.105	5.331	5.243	5.416
Median	4	4	4	4	4
Standard Deviation	2.851	3.049	2.920	2.889	2.923
Maximum	10	10	10	10	10
Minimum	2	2	2	2	2
Grade $\in [6,10]$ , percent	43.93	41.64	41.64	41.64	42.62

Table 4. "Bias grades" comparison between professional and non-professional investors

The table compares interpersonal means of "bias grades", which are calculated for each participant  $i$  as follows:

$$DG_i = G_{-1_i} + 6 - G_{-2_i}; \quad GG_i = G_{-2_i} + G_{-3_i}; \quad HG_i = G_{-5_i} + G_{-6_i};$$

$$BG_i = G_{-7_i} + G_{-8_i}; \quad AG_i = G_{-9_i} + G_{-10_i}$$

where:  $G_{-N_i}$  is the grade (answer) given by participant  $i$  for question (statement)  $N$ .

between the groups of professional portfolio managers and market investors who filled in our research questionnaire on the web (non-necessarily professional).

The last row reports statistics for the test of the equality of means between the groups of participants.

Group of participants (Number of participants)	Mean bias grades				
	Disposition grade ( $DG_i$ )	Gambler's grade ( $GG_i$ )	Hot-hand grade ( $HG_i$ )	Herd (behavior) grade ( $BG_i$ )	Availability grade ( $AG_i$ )
Portfolio managers (41)	5.463	4.927	5.122	5.000	5.171
Market investors (305)	5.646	5.105	5.331	5.243	5.416
Difference	-0.183	-0.178	-0.209	-0.243	-0.245
Test of equality: t-statistic (1-tailed p-value, %)	<b>0.38 (35.05)</b>	<b>0.35 (36.28)</b>	<b>0.43 (33.24)</b>	<b>0.51 (30.59)</b>	<b>0.51 (30.60)</b>

Table 5. "Bias grades" comparison between the groups of participants, according to their investment experience  
The table compares interpersonal means of "bias grades", which are calculated for each participant  $i$  as follows:

$$DG_i = G_{-1_i} + 6 - G_{-2_i}; \quad GG_i = G_{-2_i} + G_{-3_i}; \quad HG_i = G_{-5_i} + G_{-6_i};$$

$$BG_i = G_{-7_i} + G_{-8_i}; \quad AG_i = G_{-9_i} + G_{-10_i}$$

where:  $G_{-N_i}$  is the grade (answer) given by participant  $i$  for question (statement) N

between the groups of participants, according to their reported stock market trading experience. We employ only the data from the subsample of participants who had answered on the web (305 participants).

The last rows of each section of the table report statistics for the tests of the equality of means between the respective categories of participants.

Reported years of investment experience (Number of participants)	Mean bias grades				
	Disposition grade ( $DG_i$ )	Gambler's grade ( $GG_i$ )	Hot-hand grade ( $HG_i$ )	Herd (behavior) grade ( $BG_i$ )	Availability grade ( $AG_i$ )
Less than 3 years (107)	8.794	8.374	8.411	8.271	8.467
3 to 5 years (29)	5.897	5.069	5.345	5.414	5.310
Difference	2.897	3.305	3.066	2.857	3.157
Test of equality: t-statistic (1-tailed p-value, %)	<b>10.47 (0.00)</b>	<b>8.66 (0.00)</b>	<b>8.04 (0.00)</b>	<b>7.45 (0.00)</b>	<b>7.91 (0.00)</b>
3 to 5 years (29)	5.897	5.069	5.345	5.414	5.310
5 to 10 years (44)	4.500	3.386	3.932	3.909	3.977
Difference	1.397	1.683	1.413	1.505	1.333
Test of equality: t-statistic (1-tailed p-value, %)	<b>2.79 (0.34)</b>	<b>2.79 (0.34)</b>	<b>2.53 (0.68)</b>	<b>2.57 (0.62)</b>	<b>2.33 (1.14)</b>
5 to 10 years (44)	4.500	3.386	3.932	3.909	3.977
More than 10 years (125)	3.296	2.920	3.184	3.080	3.336
Difference	1.204	0.466	0.748	0.829	0.641
Test of equality: t-statistic (1-tailed p-value, %)	<b>4.30 (0.00)</b>	<b>1.52 (6.52)</b>	<b>2.54 (0.59)</b>	<b>2.90 (0.21)</b>	<b>2.15 (1.64)</b>



Table 6. "Bias grades" comparison between professional and experienced investors

The table compares interpersonal means of "bias grades", which are calculated for each participant  $i$  as follows:

$$DG_i = G_{-1}_i + 6 - G_{-2}_i; \quad GG_i = G_{-2}_i + G_{-3}_i; \quad HG_i = G_{-5}_i + G_{-6}_i;$$

$$BG_i = G_{-7}_i + G_{-8}_i; \quad AG_i = G_{-9}_i + G_{-10}_i$$

where:  $G_{-N}_i$  is the grade (answer) given by participant  $i$  for question (statement) N

between the groups of professional portfolio managers and market investors who filled in our research questionnaire on the web (non-necessarily professional), reporting the longest stock market trading experience.

The last row reports statistics for the test of the equality of means between the groups of participants.

Group of participants (Number of participants)	Mean bias grades				
	Disposition grade ( $DG_i$ )	Gambler's grade ( $GG_i$ )	Hot-hand grade ( $HG_i$ )	Herd (behavior) grade ( $BG_i$ )	Availability grade ( $AG_i$ )
Portfolio managers (41)	5.463	4.927	5.122	5.000	5.171
Market investors with more than 10 years of trading experience (125)	3.296	2.920	3.184	3.080	3.336
Difference	2.167	2.007	1.938	1.920	1.835
Test of equality: t-statistic (1-tailed p-value, %)	<b>6.29 (0.00)</b>	<b>5.48 (0.00)</b>	<b>5.60 (0.00)</b>	<b>5.82 (0.00)</b>	<b>5.19 (0.00)</b>

Table 7. "Bias grades" for men and women

The table compares interpersonal means of "bias grades", which are calculated for each participant  $i$  as follows:

$$DG_i = G_{-1}_i + 6 - G_{-2}_i; \quad GG_i = G_{-2}_i + G_{-3}_i; \quad HG_i = G_{-5}_i + G_{-6}_i;$$

$$BG_i = G_{-7}_i + G_{-8}_i; \quad AG_i = G_{-9}_i + G_{-10}_i$$

where:  $G_{-N}_i$  is the grade (answer) given by participant  $i$  for question (statement) N

for men and women. We employ only the data from the subsample of participants who had answered on the web (305 participants).

The last rows of each section of the table report statistics for the test of the equality of means.

Gender (Number of participants)	Mean bias grades				
	Disposition grade ( $DG_i$ )	Gambler's grade ( $GG_i$ )	Hot-hand grade ( $HG_i$ )	Herd (behavior) grade ( $BG_i$ )	Availability grade ( $AG_i$ )
Men (226)	4.659	4.177	4.394	4.301	4.509
Women (79)	8.468	7.759	8.013	7.937	8.013
Difference	-3.989	-3.582	-3.619	-3.636	-3.504
Test of equality: t-statistic (1-tailed p-value, %)	<b>12.59 (0.00)</b>	<b>10.47 (0.00)</b>	<b>11.28 (0.00)</b>	<b>11.53 (0.00)</b>	<b>10.76 (0.00)</b>

## Appendix:

### Research questionnaire (translated)

1. I prefer to sell stocks whose prices recently increased. (Disposition effect)
2. I prefer to keep holding on stocks if their current market price is higher than the price I had purchased them for. (Disposition effect)
3. If in each of the last six months TA-100 Index value increased, I would expect the value of the Index to decrease in the next month. (Gambler's fallacy) (TA-100 Index tracks the prices of the shares of the 100 companies with the highest market capitalization on the Tel Aviv Stock Exchange – authors' remark)
4. If in each of the last six months TA-100 Index value decreased, I would expect the value of the Index to increase in the next month. (Gambler's fallacy)

5. After I manage to realize a profit on my stock portfolio, I increase the sum of my stock market holdings. (Hot hand fallacy)
6. If I find out that the market price of one of the stocks I hold decreased dramatically, I decrease the sum of my stock market holdings. (Hot hand fallacy)
7. I prefer to buy stocks if many "buy" orders were submitted for them from the beginning of the trading session. (Herd behavior)
8. If in the last month, the aggregate trading volume in the stock market was higher than usual, I would increase the sum of my stock market holdings. (Herd behavior)
9. I prefer to buy stocks on the days when the value of TA-100 Index increases. (Availability heuristic)
10. I prefer to sell stocks on the days when the value of TA-100 Index decreases. (Availability heuristic)

# Malaysian Real Estate Investment Trusts: A Performance and Comparative Analysis

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## Abstract

This study examines the investment performance of conventional and Islamic Real Estate Investment Trusts (REITs) listed in Malaysia over the 2005–10 time period. Analysis reveals that both conventional and Islamic REITs experienced negative monthly return during 2008 global financial crisis (GFC) period, and positive monthly return post GFC period. Compared to market indices, most REITs are under-performed before GFC. Divergent findings were reported during the GFC and post-GFC, depending on the measurement tools used. Based on Treynor and Sharpe measurements, most REITs under-performed the market portfolio in during and post GFC period. However, according to Jensen measurement, the REITs out-performed market indices during and post GFC period. Despite these seemingly divergent findings, this study can assist investors, regulatory body, fund managers and academics to make a better informed investment decision on Malaysia REITs. This study has provided interesting and important information and insights into the performance of Malaysia REITs.

**Keywords:** REITs, Performance measurements, Global financial crisis, Malaysia

## 1. Background of the Study

The source of income generation for Real Estate Investment Trusts (REITs) comes from the rental of commercial real-estate. Commercial properties are basically cyclical income-producing assets with inflation-hedging attributes that appear to provide long-term asset appreciation. Hence, REITs are deemed to be defensive stocks, consist of cyclical income-producing assets, though having some potential of asset appreciation (Graff, 2000). Do Malaysia Real Estate Investment Trusts (REITs) generate value for shareholders? How do investments in Malaysia REITs performed in comparison with market indices? How did Islamic REITs performed in comparison to conventional REITs? How was the performance of Malaysia REITs before, during, and after a financial crisis? The growing popularity of REITs investments makes these questions pertinent, and a study on the emerging market such as Malaysia would also prove beneficial for a globally diversified portfolio investor in terms of market timing and country selection.

REITs are not new to the world. In fact, REITs started in the United States in 1960 (Graff, 2001). In many other developed countries, REITs have been developed over decades and with steady fixed income, provides an alternative to fixed deposit investments. REITs Investors are typically long-term investors with moderate risk such as insurance companies, pension funds, unit trust funds and individual investors. As many investors may not be able to invest in a huge property portfolio, REITs gain strength from pool of funds gathered and invest into high profile and high value properties for better return. Table 1.1 shows the number of REITs in global market.

REIT investment in developing countries like Malaysia is proclaimed to be very attractive as the value of real estate in developing nations lags behind developed nations (JP, 2012). Table 1.1 indicates that a total of 97 REITs investments were listed in Asia (Ernst and Young, 2010). This study aims to study Malaysia REITs because it offers a competitive business environment (World Economic Forum, 2009) and was not as severely affected by the global financial crisis as most other Asian markets (Newell and Razali, 2009), as well as Malaysia being one of the most transparent property markets in Asia, only exceeded by Hong Kong and Singapore (Jones, 2008).

### 1.1 The development of Real Estate Investment Trust (REITs) in Malaysia

Amongst Asian countries, Malaysia was the earliest to publicly list property trust (Newell, Ting and Acheampong, 2002). The Central Bank of Malaysia, also known as Bank Negara approved the regulatory framework for Malaysia listed property trust in 1986 (Hamzah and Rozali, 2006); and developed specific Securities Commission guidelines for listed property trust funds in 1991, revising it further in 1995. In 1986, Malaysia started the property trust market, known as Property Trust Funds (PTFs), the predecessor of REITs (Newell, Ting and Acheampong, 2002). Since then, it has progressed to become a well-established REIT market in Malaysia, with fourteen REITs listed as of year 2010 (Security Commission of Malaysia, 2010).

In August 2006, Malaysia became the world's first developer of Islamic Real Estate Investment Trust, which is compliant with the principle of Shariah. The introduction of Islamic REITs was facilitated by guidelines issued by the Malaysia Securities Commission. These guidelines provided a new global benchmark for development of Islamic REITs, enhancing the important role of Malaysia to promote the growth and development of Islamic market in the International Financial Community. As an ethical investment vehicle, Islamic REITs were embraced by global Muslim investors (Ibrahim and Ong, 2008). By year 2010, Malaysia has established four Islamic REITs which are Al-Aqar KPJ REIT listed on Aug 2006, Al-Hadharah Boustead REIT listed on Feb 2007 and Axis REIT listed on Aug 2005. Axis REIT was converted to Islamic REIT in December 2008. Summary of REITs stock quote and listed on main board of Bursa Malaysia Securities Berhad is shown in Table 2.2.

REITs have been proven to be a popular and successful investment vehicle in the United States and Australia (Hamzah and Rozali, 2010). However, such does not seem to be the case in Malaysia. Investors seem to perceive Malaysia REITs unfavorably (Ong, *et al.*, 2011). There seems to be a lack of awareness of REITs amongst Malaysian demand, and a correspondingly lower demand. Consequentially, the participation rates of Malaysian investors on REITs are much lower than in other countries (Newell and Osmandi, 2009). Furthermore, the market capitalization of Malaysian real-estate lags behind many countries; even countries in Asia (refer to Figure 1.1). In addition to all these, Malaysia REITs have performed poorly since their inception in 1980s till year 2004 (Newell, Ting and Acheampong, 2002; Ting, 1999). This study seeks to provide answers to the performance of REITs and whether Islamic REITs performs better than conventional REITs.

### 1.2 Research Objective

The research objectives of this paper are:

1. To examine the performance of Malaysian REITs before, during and after the 2008 Global Financial Crisis
2. To investigate whether conventional real estate investment trust provides higher return than market benchmark, Kuala Lumpur Composite Index (KLCI).
3. To investigate whether Islamic real estate investment trust provides higher return than market benchmark, Emas Shariah Index.
4. To compare the performance of Malaysian Islamic REITs against the conventional REITs.

## 2. Previous Researches on REITs Performance

There have been limited empirical studies on the performance analysis of REITs and its predecessor, listed property trust in Malaysia. Kok and Khoo (1995) examined the performance of three listed property trusts, namely Amanah Harta Tanah PNB, First Malaysia Property Trust and Arab Malaysian First Property Trust for the period 1991 to 1995 by using Treynor, Sharpe and Jensen Index measurements. The results indicated listed property trusts are generally out-performed than market during bear markets, but performed poorly during bull markets.

Newell, Ting and Acheampong (2002) examined for the period March 1991 to March 2000 the performance of four listed property trusts in Malaysia, namely Maybank Property Trust Fund One, Amanah Harta Tanah PNB, First Malaysia Property Trust and Arab Malaysian First Property Trust. Annual returns are used to measure as returns in this study, standard deviation as proxy to risks and coefficient of variations as risk-adjusted performances. Kuala Lumpur Composite Index (KLCI), Kuala Lumpur Office Property Index (KLOPI), and Kuala Lumpur Properties Index (KLPI) are proxy to market index. The annual return of Amanah Harta Tanah PNB is higher than market return. whereas the standard deviation of Maybank Property Trust Fund One, Amanah Harta Tanah PNB, and First Malaysia Property Trust are higher than market risk. The coefficients of variation of each of the listed property trusts are under-performed the KLCI.

Abdullah and Wan Zahari (2008) investigated the performance of Malaysian listed property companies in the pre-crisis, during and post-crisis period using Adjusted Sharpe Index, Sharpe Index, Treynor Index, Adjusted Jensen Index and Jensen Index. The Kuala Lumpur Property Index (KLPI) and Kuala Lumpur Composite Index (KLCI)

were used as market benchmarks. Their results showed that the listed property companies significantly out-performed the market portfolio.

There is very limited research and literature have been studying regarding the Islamic REIT. Osmadi (2006) is specifically study the development of Islamic REITs. Ibrahim and Ong (2008) investigate the performance of operational Islamic-compliant REITs for both restricted and non-restricted scheme. The non-compliant REITs outperform compliant REITs for equally-weighted portfolio. However, the findings are inconsistent with the study of Alhenawi and Hassan (2011) examine the relative performance REITs for both restricted and non-restricted scheme. The results show that compliant REITs have out-performed non-compliant REITs and provide less volatile investment vehicle. Moreover, compliant REITs can gain more return for equally-weighted portfolio and reduce loss for value-weighted portfolio during financial crisis period.

Newell and Osmadi (2009) assessed the risk-adjusted performance, significance, and portfolio diversification benefit of Islamic and conventional REITs in Malaysia over the period of 2006 to 2008. The findings indicate that Islamic REITs provide portfolio diversification benefit and low risk level features compared to conventional REITs. Ong, *et al.* (2011) investigated the development and performance of Malaysia REITs by using Net Value approach (NAV). Malaysian REITs generally traded at a premium to NAV. Malaysian REITs are much better companies for transparency, disclosure, share liquidity, depth of management and corporate democracy.

This paper attempts to expand the existing research to investigate the performance of conventional REITs and Islamic REITs for the period 2005 to 2010. Unlike previous studies that tended to use only one measurement index (e.g., Kim *et al.*, 2002), this study employs a comprehensive set of performance measurements such as Treynor Index, Sharpe Index and Jensen Alpha Index. Using a comprehensive set of measurements such as Treynor Index, Sharpe Index and Jensen Alpha Index could enhance the validity of the results.

### 3. Data Collection Method

For this study, the data were collected from multiple resources such as Bank Negara Malaysia, Securities Commission, and DataStream. The four types of data used in this study are the FBM KLCI, FBM Emas Shariah Index, individual REITs price and 3-month Treasury bill rate (TBR). The monthly returns of KLCI and Emas Shariah Index serves as proxy for market benchmark. The market portfolio of REITs refers to all assets in the market. Three month treasury bills rates have been gathered from Bank Negara Malaysia used as the risk-free rate in this study. The data for conventional REITs were taken from August 2005 to December 2010, while the data for Islamic REITs will take from their inception in August 2006 until December 2010. The period of study will cover the full period introduction of all the REITs. The performance analysis of Malaysia REITs was divided into three sub periods to compare the performance before, during and after global financial crisis 2008.

#### 3.1 Sample Size

The Total population of Malaysia REITs consists of 14 publicly listed companies and all of them are included in this study (such as Al-Aqar KPJ, Al-Hadharah Boustead, AmFirst, Amanah Harta Tanah PNB, Amanahraya, Atrium, Axis, CapitaMall Malaysia Trust, Hektar, Quil Capita Trust, Starhill, Sunway, Tower, and UOA). In this study, the individual REIT prices were collected based on the closing price of all 14 listed companies in the last day of the each month.

### 4. Performance Measurement Methodology

The performance all REITs are measured by using three different performance measurement model included Sharpe, Treynor, and Jensen Alpha Index.

#### 4.1 Sharpe Index

Sharpe is a useful measurement of performance that excess return which actual return minus risk free rate return divided by standard deviation.

$$\text{Sharpe Ratio} = \frac{R_r - R_f}{\sigma_r}$$

Where:

$R_r$  = the observed average return on REIT

$R_f$  = the average return on 3 months Malaysian Treasury Bills

$\sigma_r$  = The standard deviation returns for REIT

#### 4.2 Treynor Index

Treynor is another measurement of performance that excess return which actual return minus risk free rate return divided by beta.

$$\text{Treynor Ratio} = \frac{R_r - R_f}{\beta_r}$$

Where:

$R_r$  = the observed average return on REIT

$R_f$  = the average return on 3 months Malaysian Treasury Bills

$\beta_r$  = The systematic risk of REIT relative to the market portfolio

The risk free rate will be represented as the Three months Malaysian Treasury Bills whereas beta ( $\beta$ ) will represent systematic risk.

#### 4.3 Jensen Alpha Index

The third measurement of performance is Jensen Alpha which determines the average return of asset portfolio predicted by Capital Asset Portfolio Model (CAPM), given market return ( $R_M$ ) and beta ( $\beta_p$ ).

$$\text{Jensen Ratio} = \alpha_p = R_r - [R_f + \beta_p (R_M - R_f)]$$

Where:

$\alpha_p$  = the Jensen's Alpha on REIT

$R_r$  = the average return on REIT

$R_f$  = the average return on 3 months Malaysian Treasury Bills

$\beta_r$  = The systematic risk of REIT relative to the market portfolio

### 5. Malaysian REITs Performance Analysis

#### 5.1 Malaysian REIT Performance Analysis for Entire Period

Table 5.1 presents the returns, risk and performance measures for the conventional REITs and Islamic REITs, over the period of study. The data suggests that Sunway gained the highest return (2.38%) by achieving lowest total risk (2.546%) and systematic risk (0.072%) as compared to market portfolio. By using the Sharpe and Jensen measurements, Sunway under-performed the market portfolio by -0.1841 and -0.0042 respectively. In terms of market capitalization, asset size, free float and average daily turnover volume, Sunway could be deemed as the largest Malaysia REIT. The benefits from the reputation and recognition of the Sunway brand name could provide support to Sunway REIT as a sound investment portfolio to investors.

The data in Table 5.1 also suggests that CapitaMalls Malaysia Trust was the second optimum investment portfolio for investors; it generated the second highest monthly return (1.55%) with lower total risk (3.825%) and systematic risk (0.419%). CapitaMalls Malaysia Trust experienced the highest value with Treynor, Sharpe and Jensen performance measurements as compared to the market portfolio. CapitaMalls Malaysia Trust was the only one really out-performed the market portfolio based on Jensen measure, with the positive values of 0.001. CapitaMalls Malaysia Trust is the largest Shopping Mall REIT in Malaysia and has the second highest market capitalization. The consistent attractive yield could have entice the support of investors to CapitaMalls Malaysia Trust.

However, the findings also reveal that Quill Capita Trust experienced negative return of -0.25%. Quill Capita Trust purchased assets during the Singapore financial downturn, resulting in Malaysia Quill Capita Trust experiencing losses. Meanwhile, Starhill also experienced the negative return of -0.26% which was slightly lower than Quill Capita Trust. The explanation for negative value could be due to Starhill ownership of a large number of undeveloped land.

Table 5.1 also exhibits the Islamic REITs performance measurements throughout the full study period. The results indicate that the average return for all Islamic REITs under-performed the market portfolio. The explanation to this result could be Islamic REITs in Malaysia are not well recognized by many investors as the only three Islamic REITs were listed on Bursa Malaysia. It can be consider as new type of investment. The comprising Shariah principle of Islamic REITs might lead to misunderstandings that Islamic REITs are meant for Muslim investors. Furthermore, the small numbers of Islamic REITs does not seem able to create sufficient buzz and interest of domestic and foreign investors.

Overall, the results reveal that Sunway and CapitalMalls Malaysia Trust were the most profitable conventional REIT relative to the market portfolio. Sunway and CapitalMall Malaysia Trust were listed after the global financial crisis. This fortuitous timing could result in investors' positive expectation of future growth prospects. Most conventional REITs under-performed the market portfolio and provided lower average monthly return and higher total risk than market portfolio. On the other hand, most of the conventional REITs have lower systematic risk than market portfolio. Based on the analysis of Treynor, Sharpe, and Jensen index, the results shows that all conventional REITs provide negative values, indicating the poor performances of overall conventional REITs.

### *5.2 Malaysian REITs Performance Analysis Pre-Global Financial Crisis*

Table 5.2 presents the returns, risk and performance measures for the conventional REITs from August 2005 to August 2007 and Islamic REITs from August 2006 to August 2007, before GFC period. The results indicate that the ranges of the average monthly return of all the REITs were very volatile. All REITs recorded positive average return, except for Starhill, which experienced negative return of -0.01%. A plausible reason for Starhill REIT's lackluster performance could be the perception of low dividends associated with the REIT.

The results indicate that Hektar generated the superior average return of 5.26%; it significantly over-performed the respective market return. A possible reason could be that Hektar successfully received investment from Frasers Centerpoint Trust, which secured Hektar with a total investment of 31.06%. Hektar was able to improve its performance to provide good returns to its investors. Further analysis using Sharpe, Treynor and Jensen measurements also indicate that Hektar greatly out-performed the market portfolio.

The results also reported that Tower and Quil Capita Trust experienced the attractive return relative to the market portfolio, respectively, 2.69 and 2.63 percent respectively. Further analysis with the Treynor, Sharpe, and Jensen measures reveals that both of these REITs also out-performed the market portfolio.

Table 5.2 also contains the Islamic REITs performance analysis before GFC period. Both Al-Aqar KPJ and Al-Hadharah Boustead under-performed the market in terms of average monthly return. A possible explanation for this result is that the Islamic REITs were established only two years prior to GFC, hence, it may not have generated sufficient goodwill and confidence to investors. Furthermore, Islamic REITs being new to the market then would have less uptake in the market. In addition, both these Islamic REITs had higher total risk than the market portfolio. Investors are unfamiliar with REITs will probably avoid taking additional risk premium.

Overall, all REITs offered volatile returns at a higher level of total risk compared to market portfolio. The analysis of monthly standard deviation shows that most conventional REITs provided higher risk or at most, slightly lower than market portfolio risk. Both CapitaMalls Malaysia Trust and Sunway REITs were not listed before the GFC; therefore they were not being analyzed for the pre-crisis period.

The results show that Hektar was the only conventional REITs generating positive value, which shows superior performance against the market portfolio based on Sharpe, Treynor and Jensen measurements. All of the Islamic REITs under-performed the market portfolio by providing lower return against the market portfolio with higher risks. The results show that the performances of all REITs generated negative value. The results indicate that the poor performances of all REITs except Hektar for the pre-GFC period under the Treynor, Sharpe, and Jensen measurements.

### *5.3 Malaysian REITs Performance Analysis during Global Financial Crisis*

Table 5.3 presents the returns, risk and performance measures for the conventional REITs and Islamic REITs from September 2007 to September 2008 during GFC period. The data suggests that majority of REITs reported the worst monthly average return and at higher level of risk performance except for Amanah Harta Tanah PNB and AmanahRaya. With the exception of these two REITs, all the other REITs as well as the market index, recorded negative returns during GFC period. Malaysia was badly affected by GFC. Investors tend to not invest during crisis period due to the lack of confidence in investments.

Amanah Harta Tanah PNB and AmanahRaya were able to generate positive return during GFC period, with 0.29% and 0.02% respectively. Further analysis of Treynor, Sharpe, and Jensen measurements shows that Amanah Harta Tanah PNB generated the highest value during GFC period. A plausible reason is that the establishment of Amanah Harta Tanah PNB was the first REITs to obtain the sponsor from Malaysian Government in year 2007. This could improve the performance of AmanahRaya. The Treynor and Jensen analysis also indicates that AmanahRaya out-performed the market portfolio.

The results also reveal that although Al-Aqar KPJ and Al-Hadharah Boustead generated negative monthly return, they managed to out-performed the market portfolio. Based on Treynor, Sharpe, and Jensen measurements,

Al-Hadharah Boustead also out-performed the market portfolio. However, Axis experienced worst monthly return than market return.

Overall, all REITs offered negative monthly return except Amanah Harta Tanah PNB and AmanahRaya and mostly accompanied by higher level of risk compared to market portfolio. Two conventional REITs (Amanah Harta Tanah PNB and AmanahRaya) were able to generate positive monthly return during GFC period. Both CapitaMalls Malaysia Trust and Sunway are not analyzed during the crisis period as they were only listed after the global financial crisis. In summary, the results show that all REITs provided inferior performances during GFC period using the Treynor, Sharpe, and Jensen measurements.

#### 5.4 Malaysian REITs Performance Analysis Post Global Financial Crisis

Table 5.4 presents the returns, risk and performance measures for the conventional REITs and Islamic REITs from October 2008 to December 2010 for post GFC period. The data suggest that all REITs reported positive monthly average return for post GFC period. Part of the explanation is that Asian REITs started to recover from the global financial crisis.

Sunway experienced the highest monthly average return (2.38%) with the lowest total risk (2.54%) and systematic risk (0.072%) as compared to the market portfolio. Further analysis shows that Sunway out-performed the market portfolio by using the Sharpe and Jensen measurements, -0.1841 and -0.0042 respectively. It can be argued that Sunway REIT is the largest REIT in Malaysia. The diversified portfolio of Sunway REIT encompasses real estate in hospitality, retail, and commerce sectors which gives significant benefit above pure-play REITs. The diverse of properties will benefit from diverse sources of income for both international and domestic investors. It can be said that Sunway was the most profitable conventional REIT with the highest return and lowest risk. Therefore, it is able to attract both international and domestic investors to invest in Sunway REITs.

The data also recorded that the second profitable conventional REIT obtained by CapitaMalls Malaysia Trust, which generated monthly average return (1.55%), and average total risk (3.825%). CapitaMalls Malaysia Trust experienced the highest value as compared to the market portfolio by using Treynor, Sharpe and Jensen performance measurements. Furthermore, the Jensen measurement indicates that CapitaMalls Malaysia Trust was the only REIT really out-performed the market portfolio with a positive value (0.0010).

The data also shows that Axis experienced with highest average monthly return (1.42%) but this was achieved by entailing the highest level of risk (8.302%) as against the market portfolio. meanwhile, Axis out-performed the market portfolio with both Treynor and Sharpe measurements, -0.0394 and -0.11 respectively. A plausible reason for this is Axis' acquisition of new properties and increasing of rental incomes.

Overall, the results suggest that Sunway and CapitaMalls Malaysia Trust were the best-performing real estate investments, providing high returns at lower level of risk for post GFC period, followed by Amanah Harta Tanah PNB, UOA and Atrium. Overall, the values of performance measurements for REITs showed improvement after GFC. Furthermore, increasing number of REITs out-performed the market portfolio based on Jensen measures. According to Global REIT report 2010, REITs signifies the initial recovery of the property market from global financial crisis. Around the world, REIT markets provided positive rates return in the year of 2009.

## 6. Conclusion

This study investigates the risk and return performance of Malaysian REITs relative to market portfolio. Do Malaysian REITs generate value for shareholders? How do investments in Malaysia REITs performed in comparison with market indices? How did Islamic REITs performed in comparison to conventional REITs? How was the performance of Malaysia REITs before, during, and after a financial crisis?

The stock and property market of Malaysia like elsewhere was badly affected during 2008 Global Financial Crises. The GFC was a result of the United States of America experiencing a financial crisis that was triggered by substantial defaults on subprime mortgage in 2008.

Malaysian REITs naturally experienced negative returns during this difficult period. The findings were also consistent with research results of Liow and Sim (2006), who reported that almost all Asian real estate markets provided negative returns over the period of 1997-2000. Similar result was reported by Kallberg *et al.* (2002), who recorded real estate return volatility during the crisis period. The results were supported by Liow and Adair's (2008) study, which concluded that Asian real estate companies reported inferior average monthly returns and experienced higher risk compared to Asian stocks.

Like their Asian counterparts, Malaysian REITs made substantial recovery post-GFC with positive monthly returns. Nevertheless, based on Treynor and Sharpe measurements, most Malaysian REITs under-performed the market



portfolio in pre, during, post GFC period. The Jensen measurement shows that REITs under-performed the market portfolio in the pre GFC but out-performed in during and post GFC period. The finding differs from Hamzah and Rozali's (2010) study that reported REITs experienced poorer performance in pre and post crisis period but generated better performance during the crisis based on adjusted Sharpe, Treynor and Adjusted Jensen Alpha. The results of this study also differs from Kok and Khoo's (1995) earlier study which concluded that listed property trusts are generally out-performed the market portfolio during bear market period and under-performed during bullish market period.

In general, the results also suggest that the higher level of risk experienced by majority of REITs may be due to the short time frame since the establishment of REITs creating concern among investors who are thinking about adding a property investment to their portfolio. Risk-adverse investors normally will not consider taking additional risk with unprofitable investments. The result is consistent with the study by Liow and Adair (2008). They found that all of the real estate market except for New Zealand, Australia, and US experienced higher risks than respective market index. Risk adverse investors and individual investor that knows nothing about investment will sell their REITs especially during financial crisis. As a conclusion, REITs cannot offer diversification benefits to investors when included in a share portfolio.

The above results show the inferior performance in REITs in the pre and during GFC period, based on the Treynor and Sharpe measurements. The findings also show significant improvement of REITs performance, based on the Jensen measurement. The results can be supported by the prior study by Newell (2003) who reported almost all the real estate markets were abruptly affected by Asian financial crisis 1997. The findings of Newell (2003) indicate that almost all the real estate consequently generated inferior performance than market index during downturn period. However, most of the real estate recovered from crisis period and presents significant improved risk-adjusted performance after downturn period.

#### 6.1 Limitations and Recommendations

The limitation of this study is a relatively shorter period of study for Malaysian REITs, as conventional REITs and Islamic REITs only started listing on Bursa Malaysia in August 2005 and August 2006 respectively. Furthermore, there is only four Islamic REITs listed on Bursa Malaysia. The short period of study with only 14 REITs might not be reliable for performance of Malaysia REITs in a long term period. Two REITs, namely CapitaMall Malaysia Trust and Sunway were not giving the empirical information before and during the global financial crisis period, as they were listed only in 2010.

Future research can be expanded to include another measure of performance such as Net Asset Value (Ong et al. 2011) to enhance the validity of the results. In addition, further research should concentrate on the performance analysis of Malaysian REITs for both local and international perspective to advice investors on whether they want to invest in locally or internationally. An exploratory study can be undertaken to better comprehend the performance of Malaysian REITs. The data can be collected through observation and interviews to examine the perception and attitudes of local and global investors towards Malaysian REITs. As the increasing number of REITs, the future research can give significant development and growth of real estate market in Malaysia.

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Table 1. Number of REITs by country

Country	2010	2009	2008
<b><u>Asia</u></b>			
Hong Kong	7	7	7
Japan	37	41	41
Malaysia	14	13	13
Singapore	20	20	20
South Korea	5	3	6
Taiwan	8	8	8
Thailand	6	6	6
<b>Total REITs in Asia</b>	<b>97</b>	<b>98</b>	<b>101</b>
<b><u>North America</u></b>			
Canada	32	30	33
US	172	142	171
<b>Total REITs in Americas</b>	<b>204</b>	<b>172</b>	<b>204</b>
<b><u>Europe</u></b>			
Belgium	14	15	14
Bulgaria	19	19	19
France	45	44	47
Germany	2	4	2
Greece	2	2	2
Italy	1	1	1
Netherlands	8	6	8
Turkey	13	13	13
UK	19	20	18
<b>Total REITs in Europe</b>	<b>123</b>	<b>124</b>	<b>124</b>
<b><u>Australasia</u></b>			
Australia	60	57	67
New Zealand	8	8	8
<b>Total REITs in Oceania</b>	<b>68</b>	<b>65</b>	<b>75</b>
<b><u>Middle East &amp; Africa</u></b>			
South Africa	5	5	5
<b>Total REITs in Middle East &amp; Africa</b>	<b>5</b>	<b>5</b>	<b>5</b>
<b>TOTAL GLOBAL REITs</b>	<b>497</b>	<b>464</b>	<b>509</b>

Sources: Compilation from Ernst and Young (2010), Macquarie Equities Research (2009)

Table 2. Summary of REITs Stock Quote and Listed on Main Board of Bursa Malaysia Securities Berhad

REITs	Stock Quote	Date Listed	Types of Property
<b>Conventional REITs</b>			
1. AmFirst	AMFIRST	21 December 2006	Office
2. Amanah Harta Tanah PNB *	AHP	25 March 1997	Office
3. Amanahraya	ARREIT	26 February 2007	Office, retail, industrial, hotel
4. Atrium	ATRIUM	2 April 2007	Industrial
5. CapitaMalls Malaysia Trust	CMMT	16 July 2010	
6. Hektar	HEKTAR	4 December 2006	Retail
7. Quil Capita Trust	QCAPITA	8 January 2007	Office
8. Starhill	STAREIT	16 December 2005	Hotel, retail, apartment
9. Sunway	SUNREIT	8 July 2010	
10. Tower	TWREIT	12 April 2006	Office
11. UOA	UOAREIT	30 December 2005	Office, retail
<b>Islamic REITs.</b>			
12. Al-Aqar KPJ	ALAQAR	10 August 2006	Healthcare
13. Al-Hadharah Boustead	BSDREIT	8 February 2007	Palm oil plantations
14. Axis **	AXREIT	3 August 2005	Office, industrial

Source: Ong, *et al.*, 2011; Newell and Osmadi, 2009

\*Established as Property Trust Funds (PTFs), being converted to REITs since August 2005

\*\* being reclassified as Islamic REITs since December 2008

Table 3. Performance analysis for Malaysia REITs: Aug 2005-Dec 2010 and Islamic REITs Aug 2006-Dec 2010

	Avg. Return (%)	Avg. Risk (%)	Beta	Treynor	Sharpe	Jensen
<b>Conventional REITs</b>						
Amanah Harta Tanah PNB	1.1100	5.7930	0.5190	-0.0447	-0.4001	-0.0127
Amanahraya	0.1800	4.4500	0.1390	-0.1930	-0.6030	-0.0238
AmFirst	0.6300	3.3440	0.3200	-0.0678	-0.6486	-0.0151
Atrium	0.2000	6.4500	0.3360	-0.0761	-0.3966	-0.0180
CapitaMalls Malaysia Trust	1.5500	3.8250	0.4190	-0.0042	-0.0461	0.0010
Hektar	0.7000	7.5200	0.3590	-0.0587	-0.2804	-0.0137
Quil Capita Trust	-0.2500	8.3980	0.7460	-0.0407	-0.3620	-0.0140
Starhill	-0.2600	3.6360	0.4390	-0.0719	-0.8683	-0.0230
Sunway	2.3800	2.5460	0.0720	-0.0651	-0.1841	-0.0042
Tower	0.5400	6.1540	0.6440	-0.0365	-0.3820	-0.0108
UOA	0.5500	5.2760	0.3460	-0.0677	-0.4442	-0.0167
<i>KLCI</i>	<i>0.8700</i>	<i>4.1880</i>	<i>0.4420</i>	<i>-0.0455</i>	<i>-0.4802</i>	<i>-0.0112</i>
<b>Islamic REITs</b>						
Al-Aqar KPJ	0.4500	4.4486	0.2180	-0.1099	-0.5387	-0.0190
Al-Hadharah Boustead	0.6100	4.8970	0.3760	-0.0575	-0.4413	-0.0135
Axis	0.8000	6.9840	0.2870	-0.0720	-0.2960	-0.0170
<i>Emas Shariah Index</i>	<i>0.9660</i>	<i>5.0952</i>	<i>0.2950</i>	<i>-0.0630</i>	<i>-0.3648</i>	<i>-0.0131</i>

Notes: Avg. Return = Average Monthly Return, Avg. Risk = Average Monthly Standard deviation

Table 4. Performance analysis for Malaysia REITs: Aug 2005-Aug 2007

	Avg. Return (%)	Avg. Risk (%)	Beta	Treynor	Sharpe	Jensen
<b>Conventional REITs</b>						
Amanah Harta Tanah PNB	1.0600	3.1960	0.6240	-0.0340	-0.6647	-0.0118
Amanahraya	0.6800	2.7510	0.1590	-0.1732	-1.0009	-0.0262
AmFirst	0.9700	3.0880	0.3340	-0.0739	-0.7991	-0.0231
Atrium	0.9800	8.5290	0.3780	-0.0654	-0.2897	-0.0187
Axis	2.2000	5.9910	0.3470	-0.0352	-0.2041	-0.1245
CapitaMall Malaysia Trust	-	-	-	-	-	-
Hektar	5.2600	9.3740	0.1000	0.1836	0.1959	0.0190
Quil Capita Trust	2.6300	14.5160	1.2770	-0.0063	-0.0556	0.0097
Starhill	-0.0100	4.3740	0.8380	-0.0399	-0.7641	-0.0236
Sunway	-	-	-	-	-	-
Tower	2.6900	7.9820	0.7040	-0.0106	-0.0935	-0.00004
UOA	0.8500	4.6160	0.4020	-0.0618	-0.5378	-0.0681
<i>KLCI</i>	<i>1.6800</i>	<i>3.1970</i>	<i>0.6020</i>	<i>-0.0403</i>	<i>-0.7595</i>	<i>-0.0208</i>
<b>Islamic REITs</b>						
Al-Aqar KPJ	0.0100	4.7110	0.2520	-0.1360	-0.7276	-0.0333
Al-Hadharah Boustead	3.1800	6.2660	0.3090	-0.0083	-0.0410	-0.0032
<i>Emas Shariah Index</i>	<i>4.2000</i>	<i>3.8740</i>	<i>0.3050</i>	<i>0.0255</i>	<i>0.2012</i>	<i>-0.0703</i>

Notes: Avg. Return = Average Monthly Return, Avg. Risk = Average Monthly Standard deviation

Table 5. Performance analysis for Malaysia REITs: Sept 2007-Sept 2008

	Avg. Return (%)	Avg. Risk (%)	Beta	Treynor	Sharpe	Jensen
<b>Conventional REITs</b>						
Amanah Harta Tanah PNB	0.2900	4.2330	0.4470	-0.0702	-0.7414	-0.0097
Amanahraya	0.0200	2.3160	0.3130	-0.1086	-1.4681	-0.0188
AmFirst	-0.6600	1.8900	0.2150	-0.1816	-2.0657	-0.0286
Atrium	-2.2100	4.0110	0.3590	-0.1568	-1.4037	-0.0389
CapitaMalls Malaysia Trust	-	-	-	-	-	-
Hektar	-2.6200	6.6410	0.5360	-0.1127	-0.9097	-0.0344
Quil Capita Trust	-3.0600	10.2160	0.4910	-0.1320	-0.6343	-0.0410
Starhill	-1.5200	2.2260	0.1320	-0.3468	-2.0565	-0.0430
Sunway	-	-	-	-	-	-
Tower	-1.6300	4.6980	0.6540	-0.0772	-1.0749	-0.0188
UOA	-1.7600	5.2840	0.1450	-0.3577	-0.9817	-0.0993
<i>KLCI</i>	<i>-1.4300</i>	<i>4.0000</i>	<i>0.3780</i>	<i>-0.1283</i>	<i>-1.2126</i>	<i>-0.0625</i>
<b>Islamic REITs</b>						
Al-Aqar KPJ	-0.4200	2.1640	0.1970	-0.1950	-1.7753	-0.0287
Al-Hadharah Boustead	-0.6900	4.9290	0.3960	-0.1039	-0.8351	-0.0216
Axis	-1.8800	3.9180	0.2510	-0.2115	-1.3551	-0.0719
<i>Emas Shariah Index</i>	<i>-1.5300</i>	<i>4.8510</i>	<i>0.2820</i>	<i>-0.1756</i>	<i>-1.0209</i>	<i>-0.0503</i>

Notes: Avg. Return = Average Monthly Return, Avg. Risk = Average Monthly Standard deviation

Table 6. Performance analysis for Malaysia REITs: Oct 2008-Dec 2010

	Avg. Return (%)	Avg. Risk (%)	Beta	Treynor	Sharpe	Jensen
<b>Conventional REITs</b>						
Amanah Harta Tanah PNB	1.5400	7.9510	0.4990	-0.0421	-0.2643	-0.0155
Amanahraya	0.1600	5.4260	0.0310	-0.7501	-0.4285	-0.0229
AmFirst	1.0800	3.8950	0.3810	-0.0330	-0.3225	-0.0083
Atrium	1.2500	6.9900	0.2830	-0.0386	-0.1561	-0.0078
CapitaMalls Malaysia Trust	1.5500	3.8250	0.4190	-0.0042	-0.0461	0.0010
Hektar	0.9500	6.8000	0.3160	-0.0438	-0.2036	-0.0103
Quil Capita Trust	0.4600	5.1980	0.4960	-0.0379	-0.3616	-0.0133
Starhill	0.1700	3.5970	0.3630	-0.0597	-0.6027	-0.0177
Sunway	2.3800	2.5460	0.0720	-0.0651	-0.1841	-0.0042
Tower	0.4000	5.3970	0.5560	-0.0349	-0.3599	-0.0133
UOA	1.4600	5.5550	0.3810	-0.0230	-0.1578	-0.0470
<i>KLCI</i>	<i>1.2300</i>	<i>4.7920</i>	<i>0.3690</i>	<i>-0.0301</i>	<i>-0.2315</i>	<i>-0.0305</i>
<b>Islamic REITs</b>						
Al-Aqar KPJ	1.0600	5.2110	0.1860	-0.0688	-0.2457	-0.0105
Al-Hadharah Boustead	0.7700	4.6030	0.3810	-0.0413	-0.3416	-0.0110
Axis	1.4200	8.3020	0.2320	-0.0394	-0.1100	-0.0377
<i>Emas Shariah Index</i>	<i>1.0900</i>	<i>5.0700</i>	<i>0.2690</i>	<i>-0.0464</i>	<i>-0.2462</i>	<i>-0.0247</i>

Notes: Avg. Return = Average Monthly Return, Avg. Risk = Average Monthly Standard deviation

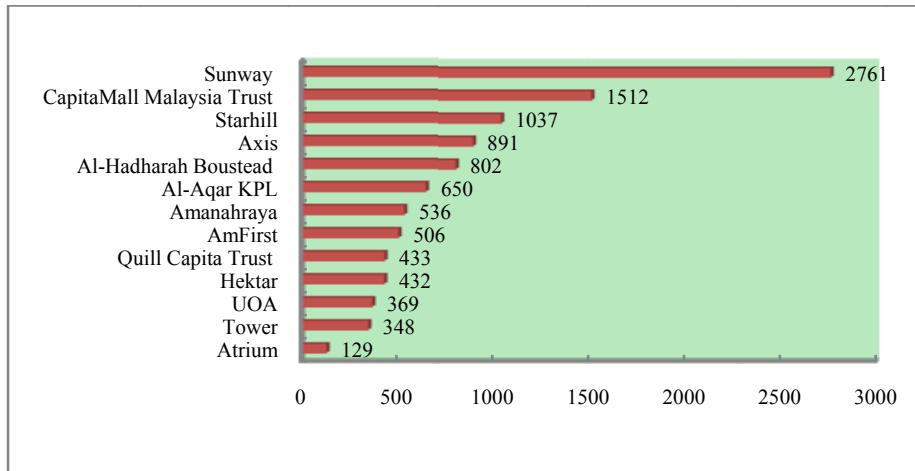


Figure 1. Market Capitalization in RM million as at 31 December 2010

# Surviving the Global Recession and the Demand for Auto Industry in The U.S. – A Case for Ford Motor Company

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## Abstract

The world economy has been severely affected by the global recession which started from the second quarter of 2007 triggered by the financial crisis. The auto industry in the U.S. faced the most severe difficulties which threatened its survival after the recession. In the U.S. especially the “Big 3” the General Motors, Ford, and Chrysler struggled to stay in the business. This paper analyzes the impact of recent downturn on U.S. auto industry in general, and the demand of Ford vehicles in particular. The study also discusses the past and present performance of Ford Motor Company in the light of changing economic conditions at home and abroad. The empirical study uses twenty years sales data to estimate a time-series demand model for Ford vehicles. The study found that the demand for automobiles in the U.S is positively related to non-farm employment and single family housing start and negatively related to gas price and vehicle price.

**Keywords:** Vehicle, Error-correction, Time-series, Ford, Autocorrelation

*JEL Code:* F0, F4

## 1. Introduction

Historically after every postwar recession automobile industry has been one of the major forces in the U.S. economic recovery. Some industry analysts believe that the automotive sector has experienced the same bubble as the housing sector and that it will never return to prosperity (Boudette and Shirouzu, 2008). The Great Recession that began during the middle of 2007 due to the collapse of subprime mortgage market ushered in the worst financial crisis in seventy five years. The U.S auto industry, because of its forward and backward linkages, consumer spending reached near death in 2009 when GM and Chrysler both took government bailouts and entered into bankruptcy. The auto sales hit the 30-year low and employed half as many people as it did in 2000 (the peak was in 2007 with 1 million) (Krisher et al. 2009).

However, recent industry reports suggest automakers are hiring again and the auto sales are rising. Americans bought 10.6 million cars and trucks in 2009, 11.8 million in 2010, and 13 million in 2011 (WardsAuto, 2011). Compared to June 2009, auto industry’s employment has increased by 12 percent by the end of 2011 although small but the employment creates a ripple effect on the economy. A study by the Center for Automotive Research (CAR, 2010) estimated that for every new auto manufacturing job creates nine other jobs from part manufacturing to restaurant employees. The CAR study found the impact of \$80 billion aid to GM, Chrysler, GMAC, and Chrysler Financial, saved 1.4 million jobs in 2009-10, prevented personal income loss of \$76.5 billion, and generated net gain for federal government in terms of changes in transfer payments, social security receipts, and personal income taxes \$28.6 billion. Many industry analysts wonder how Ford was able to overcome the recession while GM and Chrysler

went bankrupt. What factors contributed to Ford's survival in the aftermath of the global financial crisis and earn record profit last year deserve a closer look from the industry standpoint.

This paper analyzes Ford Motor Company's past and present performances in the light of changing economic conditions at home and abroad and its adaptability to customers' tastes and preferences that has positively affected its sales. The objective of this study is to estimate the demand for Ford vehicles in North America and the factors influence the demand. The study uses twenty-year time series data on several macro-economic variables and applied cointegration and error correction models to determine the demand for Ford motor company. The study found that the demand for automobiles in the U.S is positively related to non-farm employment and single family housing start and negatively related to gas price and vehicle price.

The organization of the paper is as follows: the next section discusses some of the recent studies in automobile demand analysis followed by the methodology used in this study. The fourth section discusses the sources of data and reports the model results followed by a section on summary and conclusions.

## 2. Recent Studies in Automobile Demand Analysis

Automobile sales in the U.S. dropped significantly in the last recession compared to recessions in 1982 and 2001 due to three 'rough waves' – high gasoline prices, the credit crunch, and the job losses (Chu and Su, 2010). Historically housing market and automobile industry contribute significantly to U.S. GDP growth as a result when recession hits these two sectors it causes the major fall in GDP. From its peak during the fourth quarter of 2007 to second quarter of 2009 the U.S. GDP, residential investment, and auto production decreased from \$13.3 trillion, \$525 billion, and \$402 billion to \$12.6 trillion, \$344 billion, and \$223 billion, respectively. During this period the fall in GDP was 5.14 percent while the fall in residential investment was 34 percent and the fall in auto production was 44 percent (Table 1; Figure 1).

Thompson and Merchant (2009) found that employment and GDP growth among states in the U.S. are directly linked to increased revenue of U.S. automakers than the Japanese automakers, except for Toyota. Although, the overall economic scenario has improved in the last quarter of 2010 in terms of auto sales (rose by 43 percent) and GDP, but the housing market went downhill in all these years including 2011. Most of the researchers believe it will take a long time for the U.S. economy to return to its 2007 peak economic activities. According to an industry report (Ward's Yearbook, 2010) the lowest total vehicle sales in 2009 recession (10.6 million seasonally adjusted annual rate) was the lowest since 1981 (when 9 million vehicles were sold), although U.S. population is 30 percent larger in 2009 (307 million) than in 1981 (230 million).

In an effort to estimate the long-term automobile demand and determine the fundamental factors that drive the cyclical fluctuations Chu and Su (2010) simulated three scenarios for auto industry: downside, baseline, and upside. The study concludes that the recovery for the auto industry is inevitable and with a significantly different demographics and transportation infrastructure, the auto industry in the U.S. is unlikely to repeat the Japanese scenario. Japan's peak auto sales in 1990 were 7.6 million, falling to 6 million at the end of the decade and sales fell further to 4.5 million in 2009.

In their baseline scenario the authors predict that the auto sales would return to 12 million in 2010, up from 10.6 million in 2009, and rising steadily to 16.6 million in 2015. Plache (2011) argues that the consumer demand for auto purchases depends on "3 C's" - cash (ability to pay), credit (ability to borrow), and confidence (motivation to buy). The study predicts that due to a large pent-up demand for automobiles during this recovery period auto sales may exceed all current and future projections.

Studies have found although the new vehicle sales are down during the last recession, the percentage of registered drivers in the U.S. remained stable over the last four decades even when the nation has experienced several oil shocks, recessions, and internet and technology revolutions. Although, the consumers are not buying the new vehicles the demand for used vehicles has gone up significantly and the price of used vehicles shows a sharp increase after the recession. Chu and Delgado (2009) explored the relationship between the demand for new vehicles and several other factors such as, the flow of new drivers into the market, changes in the average number of vehicles per driver, and the number of vehicles gets scrappage every year. The authors found that as Mexico progressively open the market for used car imports from USA from 2009 as per NAFTA regulation and fully liberalizing by 2019, the new vehicle sales in Mexico will reduce significantly and the new vehicle sales in the U.S will increase. The study estimates the loss of revenue to both auto makers and the Mexican government could reach as high as \$100 billion between 2009 and 2019. Due to non-availability of comparable sales data from competitive firms, the current study analyzes the factors determining the demand for Ford vehicles which is assumed to be the mirror image of the industry demand. A brief overview of the company, its products and services, and economic performance is provided below as a background for the analysis.



### 2.1 Brief Overview of the Company

The Ford Motor Company was founded by Henry Ford and has based their operations in Detroit, Michigan since 1903. Through the years, the Ford Motor Company has expanded and progressed in their business operations to become one of the largest automobile manufacturers in the World. Ford has broadly defined two business wings: vehicle sales and services and financial and credit services. As of recently, Ford produces and sells vehicles under the Ford, Mercury, Lincoln, and Volvo brand names even though they have sold Volvo and shut down the Mercury brand names. Ford's main competitors in the United States are General Motors, Chrysler, Toyota Motor Corporation, Honda Motor Company, and Nissan Motor Company. In addition, its main competitors in Europe are General Motors, Volkswagen, PSA Group, Renault Group, and Fiat. In the past few years, Ford Motor Company has faced many challenges and overcame them as opposed to its American competitor General Motors Corporation. Ford was able to obtain sufficient loans to survive the U.S. recession in the last few years without a government bailout as opposed to General Motors. The subsequent reputation boost brought new customers and investors to Ford. In 2010, Ford was finally able to surpass Toyota and became the number two seller in the U.S after General Motors. That same year Ford's sales grew by 15.2 percent regardless of selling Volvo and closing Mercury (New York Times, 2011).

Ford's market position was extremely strong compared to their competitors. In 2010 Ford's net income was 6.56 billion higher than those of its main competitors General Motors and Toyota Motor Corporation (whose net income figures are \$4.67 billion and \$5.93 billion, respectively). Its operating margin of 6.9 percent was also the highest among the three. Ford's market share of the auto market was 16.2 percent, the second largest among the Big Five (General Motors, Ford, Toyota, American Honda, and Chrysler), and only 1.9 percent lower than General Motors (see Figure 2). Last year Ford became the best-selling automaker in Canada after more than 50 years, its sales are also increasing in China and India by 32 and 168 percent, respectively (Ford Annual Report, 2010).

### 3. Methodology

It is recognized in the auto industry that the demand for new vehicles depends on a host of factors such as, macroeconomic variables, social, government regulations, and technology. Researchers in automobile demand analysis found a fairly consistent set of variables influence long-run demand for automobiles. It is hypothesized in this study that the demand for new vehicles is negatively related to vehicle prices and gasoline prices and positively related to new housing starts, household income, and employment. We recognize that the price of competing vehicles has a positive impact on the Ford vehicle sales hence, should be included in the demand equation. But due to non-availability of comparable data for the period under study the empirical study excludes this variable. It is observed from the historical sales data that automobile sales are significantly lower during the periods of recession hence, a variable representing the year of recession is included as an explanatory variable in the regression. Following Chu and Su (2010) this study used cointegration and error correction model for demand analysis. The cointegration model is defined as:

$$Sales = \alpha + \beta_1 V Price + \beta_2 G Price_{-1} + \beta_3 House_{-1} + \beta_4 Emp + \beta_5 Reces + \varepsilon \quad (1)$$

*Sales* = units of Ford vehicles sold in North America; *VPrice* = average price of Ford vehicles (\$); *GPrice (-1)* = average price of gasoline in the previous year (\$/gallon); *House (-1)* = units of single family housing start in the previous year; *Emp* = total non-farm employment (million); *Reces* = dummy variable (if recession year = 1; 0 otherwise)

One of the major problems in regression analysis using time-series data is that the residuals are often not distributed uniformly around the mean - implying sudden large differences between the expected (fitted) sales and the actual sales. In such circumstances a dynamic structure of the demand equation is estimated incorporating the error term (residual) from the original cointegrating model as one of the independent variables along with the lagged value of the dependent variable, and the first difference of all other independent variables. The error correction model is defined below in equation (2):

$$Sales = \alpha + \beta_1 Sales_{-1} + \beta_2 V Price(D) + \beta_3 G Price(D) + \beta_4 House(D) + \beta_5 Emp(D) + \beta_6 Reces + \varepsilon$$

"D" denotes difference in value of the variable between the current and the previous year.

### 4. The Data and Analysis of the Results

Annual data from 1990 to 2010 for units of vehicles sold by Ford came from Ford Motor's SEC filings and forms with the U.S. Securities and Exchange Commission (U.S. SEC, 2011). The data on average price of Ford vehicles are derived from the information on Ford's sales volume and revenue data from SEC filings for various years and Ford's 10-K reports. The historical data on average annual retail price for gasoline are obtained from the U.S. Energy and Information Administration (USEIA, 1961-2010). The historical data on annual non-farm employment

and GDP came from Bureau of Labor Statistics (BLS, 2011) and Bureau of Economic Analysis (BEA, 2011), respectively. The information on annual housing starts for single family is obtained from National Association of Home Builders (NAHB, 2011). Information on U.S. business cycle activities was collected from National Bureau of Economic Research (NBER, 2011). The descriptive statistics for the variables used in the study are reported in Table 2.

Initially, several macroeconomic variables such as, GDP, consumer credit flow, household income, and unemployment rate were tested for inclusion in the model but turned out insignificant hence, dropped out of the final model. Parameter estimates from the cointegration model (equation 1) are reported in Table 3. In terms of the explanatory power the model performs well and all independent variables have expected signs and are significant. However, low Durbin-Watson statistics suggests autocorrelation exists ( $DW < 2$ ), which is further evidenced when the residuals were plotted against the actual and the fitted values. The large spikes were observed for some years (Figure 3).

Next we estimated the error correction model (equation 2) and the results are reported in Table 4. Initially, the lagged values of the residuals from the cointegrating model ( $R_{-1}$ ) were included as an independent variable in the error correction model but the results did not improve and DW statistics remained below 2. Hence, we decided to run the model with current residuals instead of lagged residuals. All independent variables, except for the first difference of vehicle price have expected signs and are significant. Gasoline price has a significant structural negative impact and housing start and non-farm employment have a significant positive structural impact on new car sales. One of the possible reasons for the 'first difference in annual vehicle price' variable not significant is that when automakers aggressively cut vehicle prices consumers generally buy higher grade cars rather than buying more cars, for example, entry-luxury cars rather than mid-size cars (Chu and Su, 2010). The results from this model are consistent with Chu and Su (2010). Overall the explanatory power of the error correction model (Table 4) did improve ( $R^2 = 0.9453$ ) and the DW statistics is above 2. When residuals from this model are plotted (Figure 4) there were no signs of significant spikes.

Positive and significant coefficient on the residuals suggests the difference between the consumers' expectations about the future macroeconomic activities and the course of cyclical fluctuations in the current period would cause a significant positive impact on vehicle sales. The results from the cointegrating model (structural) and error correction model (cyclical) suggest that vehicle price has a significant structural impact (Table 3) but insignificant cyclical impact (Table 4) on Ford vehicle sales. The impact of gasoline prices, housing start, and non-farm employment are similar for both models. Negative signs on gasoline price and vehicle price suggest demand for new vehicles will decrease with the increase in value for these two variables. Intuitively, since the consumers generally spend a fixed amount of income on transportation, if the cost of acquiring and running a vehicle is either high at present or is expected to be high in the future, the demand for new vehicles will decrease.

## 5. Summary and Conclusions

This study investigates the impact of recent recession on the U.S. auto industry in general and the demand for Ford vehicles in particular. We found that the recession has greatly impacted the U.S. housing and auto industry, however from last quarter of 2009 auto sales are rising slowly and the industry is hiring more workers. The empirical evidence from this study shows that the recovery of sales for Ford vehicles in the future will depend on two set of factors: the macroeconomic factors such as, housing and employment; and cost factors such as, gasoline price and vehicle price. One of the drawbacks for this study is that the demand equation did not include the price of substitute vehicles (vehicles produced by competing firms) hence forecasting future demand based on current study would not be consistent and accurate. This study did not make any attempt to forecast future auto sales for Ford Motor Company based on our econometric model. However, the company expects that the overall auto sales will grow in 2012 due to economic recovery because, conventionally the auto market is expected to recover faster than the housing market since cars wear out sooner than houses.

With annual GDP growth expected to be 2.5 percent, current unemployment reaming at 8.5 percent, and gasoline price expected to be \$3.70 per gallon for 2012 Ford expects that the future demand will come from fuel efficient cars in the market. However, studies have found although the gasoline expenditure accounted for 5 percent of consumers' expenditure in 2007-09, a one-cent increase in gas price reduces consumption by 0.2 percent in terms of miles driven and not switching to more fuel efficient vehicles (Bento et al. 2009). Klier and Linn (2009) found that between 2002 and 2007 the half of the market share for U.S. automakers decreased due to an increase in gasoline prices. Ford has introduced new technologies to improve environmental friendly fuel efficient vehicles in the U.S. market. Ford Fiesta is evaluated as the most efficient subcompact car and Ford is currently in the process of

producing ten next generation fuel efficient cars such as, Hybrid and Plug-in Hybrid cars. Ford is also planning to produce five all new electric vehicles by 2012 (Ford Annual Report, 2010).

Figure 5 (a, b, c, and d) shows the annual fuel cost for running a Ford vehicle relative to its competitors' vehicles (car, pickup truck, SUV's, and overall). Figure 5(d) shows on average, Ford vehicles ranks 3<sup>rd</sup> (\$2, 966) for annual fuel cost (Honda being the lowest \$2,834, followed by Toyota \$2,861). Some industry analysts predict that future demand for automobile will greatly influenced by availability of new and stylized vehicles and auto transaction prices. With the rising inflation, average auto prices are expected to rise while vehicle incentives from auto manufacturers are expected to decrease. Plache (2011) found that for the industry as a whole the new vehicle prices increased by 5.7 percent and the average vehicle incentives decreased by 5.6 percent, the combination acted as a neutralizing effect on vehicle sales in the U.S. He believes that this trend will continue in the recovery phase in 2012 and beyond.

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Table 1. Housing and Automobile Industry Contribution to U.S. GDP 2007:Q4 – 2010:Q4 (In 2005 \$)

Quarterly Data	Auto Production	Residential	GDP (\$Bill)
	(\$Bill)	Investment(\$Bill)	
2007: Q4	401.799	525	13326
2008: Q1	393.106	483	13267
2008: Q2	352.855	463	13311
2008: Q3	332.948	443	13187
2008: Q4	268.086	415	12884
2009: Q1	224.236	368	12663
2009: Q2	223.098	344	12641
2009: Q3	279.250	360	12695
2009: Q4	288.378	342	12814
2010: Q1	314.972	331	12938
2010: Q2	312.851	350	13059
2010: Q3	330.807	323	13140
2010: Q4	320.787	326	13216

Source: Bureau of Economic Analysis (GDP data revised July30, 2011)

Table 2. Descriptive Statistics of the Variables Used in the Study (Average for 1990 - 2010, Obs = 21)

Variables	Mean	SD	Minimum	Maximum
Ford Vehicles Sold(Units in '000)	3,723	834.1	1,927	4,933
Average Price(Dollars)	18,705	3,261.4	12,784	23,555
Price of Gasoline(\$/gallon)	1.64	0.640	1.017	3.213
Single Family HomesStarts (Units in '000)	1,132	338	445	1,716
Total Non-farmEmployment (mill)	125.08	9.86	108.38	137.6
Recession (Yes = 1)	0.285	0.463	0.000	1.000

Table 3. Coefficient Estimates from the Cointegration (Structural) Model (Dependent variable = Units of Ford vehicles sold in North America)

Variables	Coefficients	t-statistics
Constant	-685.304	-0.353
Average vehicle price	-0.248*	-2.602
Price of gasoline (previous year)	-713.331*	-3.643
Housing start (previous year)	0.578*	2.172
Total Non-farm employment	76.861*	2.758
Recession (If yes = 1, otherwise 0)	-419.322*	-1.953
R-squared	0.8738	
F-statistics	20.78	
Durbin - Watson Statistics	1.22	

\*Indicates variable are significant at 5 percent or above level

Table 4. Coefficient Estimates from the Error Correction (Cyclical) Model (Dependent variable = Units of Ford vehicles sold in North America)

Variables	Coefficients	t-statistics
Constant	1252.16*	3.626
Units of vehicles sold (previous year)	0.629*	6.772
First difference in average vehicle price	0.016	0.248
First difference in price of gasoline	-115.029*	-3.365
First difference in units of housing start	1.248*	3.632
First difference in total Non-farm employment	110.591*	3.215
Residuals from Cointegration Model	0.477*	2.456
R-squared	0.9453	
F-statistics	40.35	
Durbin - Watson Statistics	2.07	

\*Indicates variable are significant at 5 percent or above level

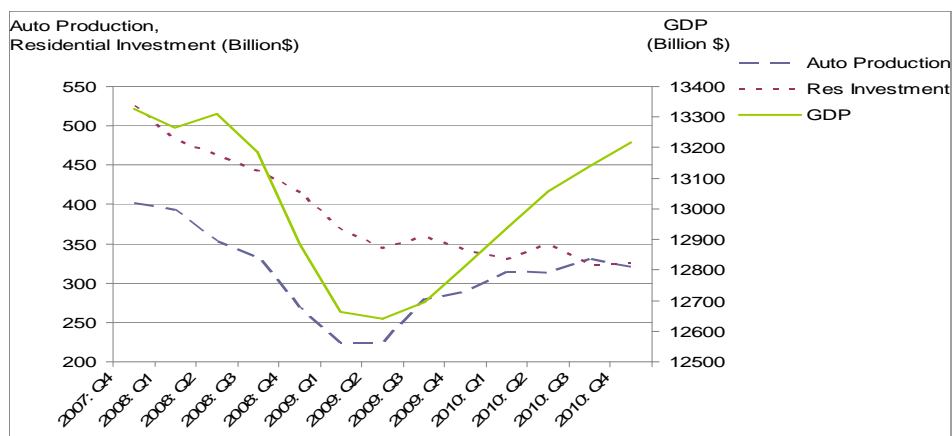


Figure 1. Housing and Automobile Industry Contribution to U.S. GDP

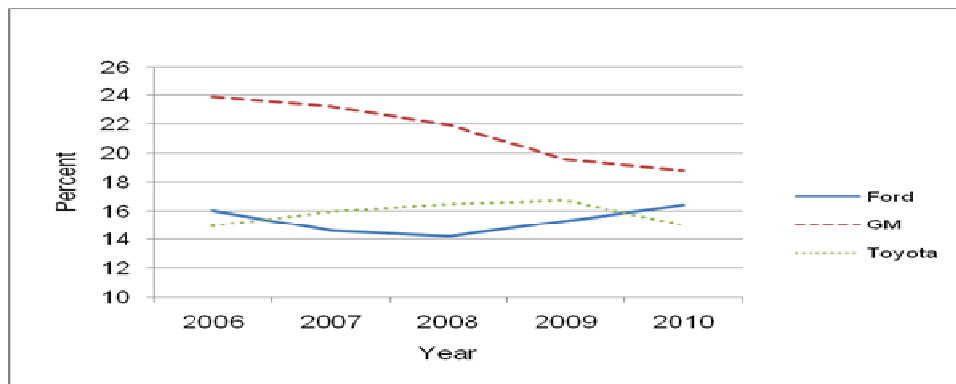


Figure 2. Big-3 Market Share in the U.S. (2006-10)

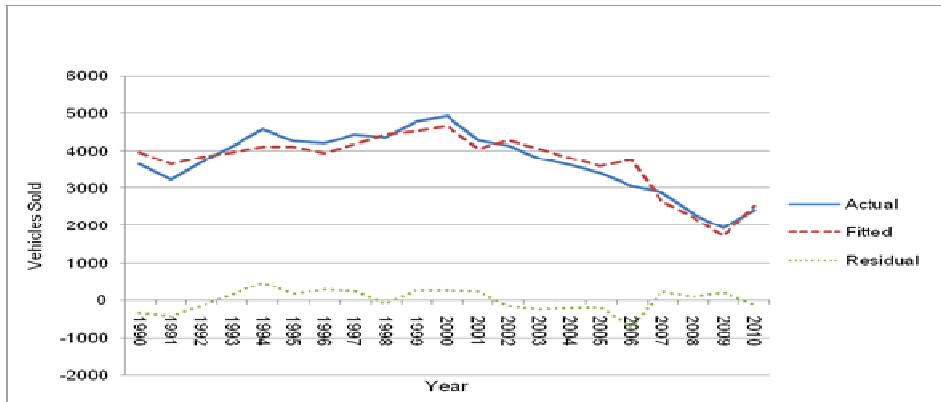


Figure 3. Actual, Fitted, and Residuals from the Cointegration Model

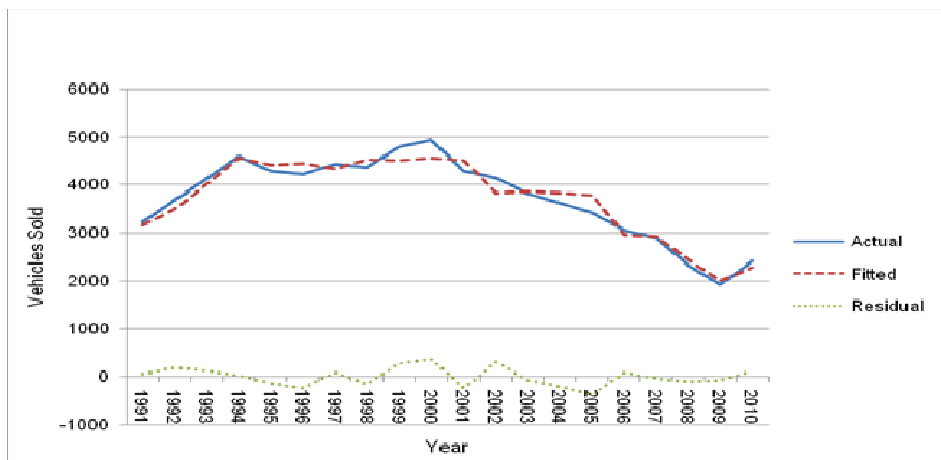
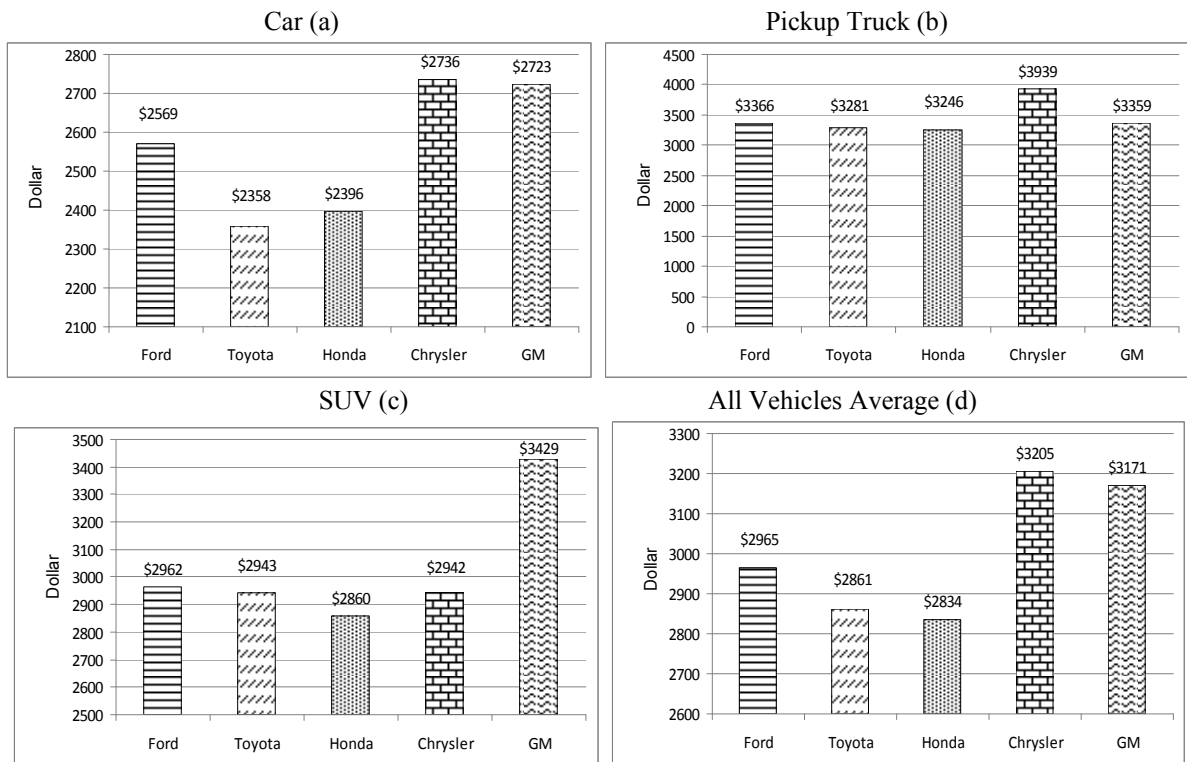


Figure 4. Actual, Fitted, and Residuals from the Error Correction Model



Source: <http://www.fueleconomy.gov/>

Figure 5. Average Annual Fuel Cost for Big-5 Automakers - 2011

# Financial Development and Economic Growth: Static and Dynamic Panel Data Analysis

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## Abstract

The relationship between financial development and economic growth has received a lot of attention in the economic literature in recent years. This study aims to revisit different econometric approaches used in panel data in relation of financial sector development and growth. In what follows, we extend our previous study by employing updated data and also exploring more questions related to the empirical link between financial development and growth. More specifically, we will investigate the issues relevant to static and dynamic panel data effect. We investigate the role of financial development (as measured by the credits to the private sector to GDP) in enhancing growth for different groups of countries. Estimations are conducted with a panel data of 70 countries over the period 1970-2009 using both LS (fixed effect) and GMM-Difference and GMM-System estimators for dynamic panel data. While the finding of a positive correlation between indicators of financial development and economic growth cannot settle this debate, advances in computational capacity and availability of large cross-country data sets with relatively large time dimensions have enabled researchers to rigorously explore the relationship between financial development and economic growth. Empirical results reinforce the idea that financial development promotes economic growth in all econometric approaches used in this paper.

**Keywords:** Financial development, Banks, Stock markets, Economic growth, GMM estimator

## 1. Introduction

The positive relation between financial development and economic growth was elaborated in a first study of Goldsmith (1969). Moreover, empirical studies have more importance in the 1990s, especially after King and Levine (1993a) work papers. These letters have studied more than the double of the sample used by Goldsmith for a period of 30 years that is 77 countries for the period 1960-1989 by adding other control factors which affect long-run growth. These variables stand to be the conditioning information to control for other factors associated with economic growth (e.g., income per capita, education, political stability, indicators of exchange rate, trade, fiscal, and monetary policy). They examined how the financial development can affect growth rate, productivity and capital accumulation. To measure financial development, King and Levine focused on financial deepening (DEPTH) which measures the size of financial intermediaries. It equals liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP. Both authors estimated strength of empirical relation between average of DEPTH during period 1960-1989 and averages of three indicators of economic growth during the same period. The three growth indicators were (1) the average rate of real per capita GDP growth, (2) the average rate of growth in the capital stock per person, and (3) total productivity growth. Analyses include the other factors of growth control represented by the matrix (X). They estimated the following regression:



$$G(i) = a + b.DEPTH + c.X + u$$

King and Levine's results mentioned that there is a strong positive relationship between the financial development indicator, DEPTH, and the three growth indicators G(i), long-run real per capita growth rates, capital accumulation and productivity growth. The coefficient of DEPTH implies that if depth ratio exceeds 0.2 (average rate of developing countries) to 0.6 (average rate of developed countries), growth rate will be improved by 1 %. This study also examined the role of initial level of financial DEPTH in expecting long-run growth rate, capital accumulation and productivity growth in 30 years. Their results indicate that financial depth in 1960 is a good predictor of subsequent rates of economic growth, physical capital accumulation, and economic efficiency improvements over the next 30 years. Their empirical specifications, particularly the financial development measures, were widely used with some modifications in the majority of recent studies. Indeed, King and Levine (1993a) shed the light on variables of bank transactions measures (the banking sector) to determine development level. However, this measure is not without flaws, an important weakness emerges when this financial development indicator measures only the size of financial intermediaries sector. It cannot represent the functioning of financial system while it does not give information about the best banks that exercise control of companies and supply management services of risks to customers. This idea can weaken confidence to perform results of King and Levine's studies and so to assert the link existing between financial development and economic growth. Furthermore, they recommended that the financial development plans the economic growth without running the forms of causality existing between both phenomena.

These shortcomings were remedied by Atje and Javanovic (1993), Levine and Zervos (1998) adding stock markets measures to the other indicators. Thus, they examined two financial system components as banks and capital markets. The introduction of these new measures supplies information on independent impact of stock markets on growth. These analyses influenced the debate regarding comparative importance of various financial sector segments. These authors introduced indicator of market capitalization which equals the value of listed shares divided by GDP. They noticed that initial level of stock market liquidity and initial level of banking development are positively correlated to future economic growth rates, capital accumulation and productivity growth during 18 years between 1976 and 1993. The control variables of economic growth used in this study are initial income, education, inflation, government spending, exchange premium and political stability. The banking development indicator was represented by credits to the private sector divided by GDP. This measure of banking development excludes both credit granted by government and central bank and credit assigned to the government and public enterprises. Levine and Zervos support their indicator of banking development is better than that used by King and Levine because the nongovernmental financial intermediaries which assign the credit to private companies, are going to improve efficiency of credit allocation and companies control. These results are compatible with models which underline that stock market liquidity facilitates long-run growth, (Levine (1991); Bencivenga (1995)). But this doesn't urge models which underline negative aspects of stock markets liquidity, (Bhide, 1993). Meantime, the results lend many supports of models which underline reports and connections between bank and market systems.

Levine has criticized this approach which simply introduce a list of national highly-rated in stock exchanges. This does not favor inevitably allocation resources. It is the ability to negotiate the feature of productive technologies of the economy which influences this allocation. Firstly, Levine and Zervos dealt with the question of causality. Secondly, authors included stock markets, however, they excluded other financial sector component to know bond markets and services supplied by non financial institutions, (Levine, 2008). To go beyond certain purely econometric problems, economists opted for using instrumental variables to solve the simultaneity bias running the relation between financial development and economic growth. The recent research introduces these variables to extract the exogenous component of financial development. The need for these variables is going to highly specific differences from countries depending on their financial development and not on growth. Levine (1998, 1999) and Levine, Loayza and Beck (2000) used the indicators of legal origins of countries elaborated by La Porta and al. (1998). These latter's have noticed that legal origins served enacting laws of those countries. This is going to protect external investor's rights and their application will underscore effectively financial development. In fact, authors have regarded that execution of corporate laws of such country is inspired from origins of Britain, France, Germany or Scandinavian's laws. Their explanation was that most of countries obtained their legal systems by occupation and colonization. These variables can be treated in an exogenous way. The used empirical model was presented by Levine (2008) as follows:

$$G(j) = a + b.F(i) + c.X + u \quad (1)$$

G (i): the growth rate of GDP per capita, F(i): financial development indicators and X: the exogenous variables of growth. The legal origin indicators are used as instrumental variables for the measures of financial development, F(i).

The validity of instrumental variables requires no correlation with error term by using test of Hansen (1982). These studies tried to examine the role of stock markets in enhancing economic growth. Results of Atje and Javanovic (1993) showed that stock markets have positive effects on economic activity. Later, these results were confirmed by studies of Demerguc-Kunt and Maksimovic (1998) and Levine and Zervos (1998). As well a considerable interest in the relative importance of the structures of financial systems; either banks or market; for economic growth. The results of cross-country of Levine (2002) indicate that although there is a strong connection between financial development and economic growth, there is no complete empirical support for both structures of markets. By exploiting data of firms (firm-level dated) for 40 countries, Demirguc-Kunt and Maksimovic (2002) showed that financial development helped to explain the growth of firms. However, firms don't tend to grow more quickly with both bank or market systems. Quite fully proofs of the literature, Ram (1999) showed that financial development and economic growth are negatively correlated. This study investigates samples from 95 countries. The correlation between financial development and economic growth in these countries is found negative and less important than insignificant. Similar results were obtained when analyses are executed for every individual country and for every sample grouped by level of growth rate. The major discoveries of cross-section analyses are summarized in Mckibbin's study (2007). The majority of studies seem clearly, conclude that financial development exercises a positive impact on economic growth.

To overcome problems associated with cross-section regressions growth, Levine, Loayza and Beck (2000) used the GMM method developed for panel data, (see Arellano and Bond, 1991; Arellano and Bover, 1995). By comparison to previous approaches, the panel approach has also both advantages and shortcomings. The following regression was adopted:

$$Y(i, t) = a.X_1(i, t - 1) + b.X_2(i, t) + C(i) + T(t) + U(i, t) \quad (2)$$

Where  $y$  represents the dependent variable,  $X_1$  represents a set of lagged explanatory variables and  $X_2$  a set of contemporaneous explanatory variables,  $C$  is an unobserved country-specific effect,  $T$  is a time-specific effect,  $U$  is the time-varying error term, and  $i$  and  $t$  represent country and (5-year) time period, respectively.

The first benefit from moving to a panel is the ability to exploit the time-series and cross-sectional variation in the data. Levine, Loayza and Beck have studied a panel of 77 countries for the period 1960-1995. This period was left in 7 years periods. They have confirmed their previous results in cross-section study. The evaluation of coefficients of financial development indicators is similar to those described previously. With panel data, we employ data averaged over five-year periods, yet the models we are using to interpret the data are typically models of steady-state growth. To the extent that five years does not adequately proxy for long-run relationships, the panel methods may imprecisely assess the finance growth link, (Levine, 2008). Beck and Levine (2002) have established their works on Rousseau and Wachtel (2000) papers. They used data in averages during the sub-periods of 5 years. They showed the existence of a positive link between financial development and economic growth. These studies suggested that exogenous component of financial development for both bank and stock market development has an economically impact on economic growth.

To recap, the econometric approach and both country sample and period essentially lie behind the differences of results found in author's papers in finance-growth relation.

## 2. Methodology

The used sample roughly consists of 70 developing and developed countries. The period of study is from 1970 to 2009. It is subdivided into 8 under 5-years periods. Every annual data is averaged on 5 years. This method has become popular in the majority of empirical works which are especially related to economic growth study. On the one hand, 5 years period allows remedying missing data and covering concerned period. On the other hand, it allows rolling panel data especially when study concerns a dynamic panel. We use all sample groups to validate the theoretical links of explanatory variables of growth rate by static and dynamic panel estimation. To investigate the relationship between growth and financial depth, we use the following model:

$$y_{i,t} = \alpha.y_{i,t-1} + \beta.x_{i,t} + u_i + \varepsilon_{i,t} \quad (3)$$

Indicators used in this model are generally retained in empirical literature of economic growth.  $y$  represents the Log of GDP per capita. In static model, this variable represents the economic growth rate. The vector  $x$  represents controls of economic growth such as the inflation rate, trade openness, education and government spending in percentage of GDP, civil liberties and political stability, (see the description of variables in appendix).  $u$  is an unobserved country-specific effect,  $\varepsilon$  is the time-varying error term,  $i$  and  $t$  index respectively country and time.

According to the implications of theoretical and empirical models of economic growth, an increase of opening and education lead to an increase of economic growth rate. Thus, the expected signs of these variables are positive.

Conversely, an increase of inflation leads to a decline of economic growth rate. Consequently, the expected sign of inflation rate is negative. We introduce the variable of civil freedom or political stability. An increase of civil freedom degree tends to be associated with an improved growth rate.

To estimate finance-growth relation, we shall use the generalized method of moments (GMM) which is developed for dynamic panel models by Holtz-Eakin and al. (1990), Arellano and Bond (1991) and Arellano and Bover (1995). The traditional regression of the growth model spells as follows:

$$y_{i,t} - y_{i,t-1} = \alpha \cdot y_{i,t-1} + \beta' \cdot x_{i,t} + u_i + \varepsilon_{i,t} \quad (4)$$

Where  $y$  is logarithm of real GDP per capita,  $x$  represents explanatory variables different from the delayed dependent variable,  $u$  is a non observed specific country effect,  $\varepsilon_{i,t}$  is error term and  $(i, t)$  represent respectively country and time. We also include dummies variables to represent the specific time effect. Arellano and Bond (1991) propose to differentiate the equation (4):

$$(y_{i,t} - y_{i,t-1}) - (y_{i,t-1} - y_{i,t-2}) = \alpha \cdot (y_{i,t-1} - y_{i,t-2}) + \beta' \cdot (x_{i,t} - x_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \quad (5)$$

Although the difference eliminates the specific country effect, it introduces a new way by construction of new error term, which is correlated to dependent variable delayed. According to the suppositions that (a) the error term ( $\varepsilon$ ) is not serially correlated, and (b) the explanatory variables ( $X$ ) are weakly exogenous, Arellano and Bond propose the following moment conditions:

$$E[y_{i,t-s}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T \quad (6)$$

$$E[x_{i,t-s}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T \quad (7)$$

By using these conditions of moment, Arellano and Bond (1991) proposed a two step GMM estimator. In the first stage, the terms of error are assumed to be independent and homoscedastic through countries and time. In the second stage, residuals obtained in the first stage are used to build a coherent estimation of variance-covariance matrix, so relaxing suppositions of independence and homoscedasticity. The two step estimator is so asymptotically more efficient than that obtained in the first step. It is the estimator used by Rousseau and Wachtel (2000) with annual data to examine the relation between stock markets, banks and economic growth. There are, however, abstract and statistical defects with this estimator in difference. Conceptually, we would also like to study relation between financial sector development and economic growth through countries which is eliminated in estimation in difference. Statistically, Alonso-Borrego, Arellano (1999) and Blundell and Bond (1998) showed that in case of persistent explanatory variables, delayed levels are weak instruments for difference equation regression. Asymptotically, there will have an increase of the variance of coefficients. In short samples, simulations of Monte Carlo showed that weaknesses of instruments can produce biased coefficients. To reduce the potential of the way and the indistinctness associated with the GMM difference estimator, Arellano and Bover, (1995); and Blundell and Bond, (1998) suggested using a GMM system estimator which combines difference regression with level regression. Instruments for difference regression are even as above. Instruments for level regression are the delays of corresponding variables differentiated. These are instruments suited under the additional suppositions below: although it can have a correlation between the levels of the variables of the right side and the specific effect country in the equation (2) there, there is no correlation between the differences of these variables and the specific effect. Given that the delayed levels are used as instruments in difference regression, only the most recent difference is used as an instrument in level regression. The use of delays of additional differences would succeed in the conditions of moment superfluous, (Arellano and Bover, 1995). So, additional conditions of moment for level regression are:

$$E[(y_{i,t-s} - y_{i,t-s-1})(u_i + \varepsilon_{i,t})] = 0 \text{ for } s = 1 \quad (8)$$

$$E[(x_{i,t-s} - x_{i,t-s-1})(u_i + \varepsilon_{i,t})] = 0 \text{ for } s = 1 \quad (9)$$

Hence, we use the moment conditions presented in equations (6) to (9) and employ the system panel estimator to generate consistent and efficient parameter estimates. The consistency of the GMM estimator depends on the validity of the assumption that the error terms do not exhibit serial correlation and on the validity of the instruments. To address these issues we use two specification tests suggested by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). The first is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. The second test examines the hypothesis that the error term  $\varepsilon_{i,t}$  is not serially correlated. We test whether the differenced error term is second-order serially correlated (by construction, the differenced error term is probably first-order serially correlated even if the original error term is not). Failure to reject the null hypotheses of both tests gives support to our model.

### 3. Results and Discussions

This section describes the indicators of stock market and bank development, the conditioning information set, and provides both OLS and GMM regressions results of stock markets, banks, and economic growth. Three techniques of estimations were used to revisit the various econometric approaches which studied the link between the financial development and the economic growth as described equations before. These methods are OLS (Fixed effect), the generalized method of moments in difference (GMM-Difference, Arellano and Bond, 1991) and in system (GMM-System, Blundell and Bond, 1995). Our results will be based on the last one which was the object of recent applications concerning the theme. In the first place, we made estimations by the LS method. This last one allows checking the problem of heterogeneity of countries. The test which is associated with is the one of Hausman which allows choosing specific fixed or random effects. As shown table1, in the majority of regressions the test appreciates the relevance of fixed effects ( $p < 5\%$ ).

The GMM estimations in first difference and in system allow taking into account the problem of endogeneity of variables. This problem emerges especially when study concerns relation between financial development and economic growth regarding the existence of causality with double meaning between financial development and growth. The GMM-System estimator treats combination of both difference and level equations. Instruments used for the difference equation are the delayed values of variables in levels. Moreover, variables are instrumented by their first differences in level equation. This system of equations is estimated simultaneously by GMM. The simulations of Monte Carlo made by Blundell and Bond (1997) showed that system estimator is the most efficient. The tests used for over-identification are Sargan test which will be later replaced by Hansen test and test of second serial correlation of Arellano and Bond. In most regressions, results of these tests confirmed our expectations. Statistics of Hansen test allowed acceptance of validity of instruments. For serial correlation test, results validate the hypothesis of absence of second serial correlation of residuals. In all regressions, standard deviations of coefficients are corrected by White method in order to check heteroscedasticity problem.

Table (1) shows results for LS panel regressions. Tables (2) and (3) provide respectively, GMM-difference and GMM-system panel regressions. Financial development measures introduced in regressions are domestic credit to the private sector, bank credit divided by bank deposit, liquid liabilities (M3), financial system assets divided by GDP and market capitalization. These financial measures, as well as the other control variables, proxy for the steady state level of GDP. We notice that estimations of columns 1 to 5, concern the use of the civil liberty indicator. However, columns 6 to 10, introduce political stability taking the place of civil liberty indicator. This is due to the strong correlation between the two indicators.

#### 3.1 Analysis of the Static Panel Data Estimations

Fixed effect estimation, in table.1, displays results when all financial measures are used as proxies for financial development. These latter's, except credit by deposit ratio, when significant, have a positive sign in all regressions, confirming a long-run positive relationship between financial development and growth as predicted in the majority of theoretical models. This is also consistent with the argument that well-developed domestic financial sectors in countries contribute significantly to an increase economic growth. For example, a 1% increase in the ratio of credit to private sector implies an increase in growth for 0.02%. The results are consistent with previous studies, which find a positive relationship between measures of financial development and growth (see Levine, 2005).

#### 3.2 Analysis of the Dynamic Panel Data Estimations

The dynamic panel data is valid if the estimator is consistent. We used the criterion of Windmeijer (2005) small sample correction to have consistent stand errors. As shown in Table.2 and Table.3, the two equations present consistent estimates, with no serial correlation for the GMM estimators. Specially, in Table.3 the specification Sargan test shows that there are no problems with the validity of the instruments used for both equations. The instruments are used respectively to Roodman's program, (2006).

As shown Table 3, our results relating to the financial development indicators:

- i) Private credit (CREDIT): the expected sign is positive, which is confirmed by the estimations;
- ii) Liquid liabilities (M3/GDP): the expected sign is positive, and the coefficient of the variable significantly confirms this;
- iii) Market capitalization: the expected sign is positive, and the coefficients of these variables are positive;
- iv) Financial system assets to GDP: the results significantly confirm the expected sign which is positive;
- v) Credit by deposit ratio coefficient is positively linked to growth and significant.

We conclude that whatever econometric method or indicator used, financial development exercises a positive and significant effect on the economic growth.

#### 4. Conclusions

Our research's results validate theory suggestions. Thus, effective financial institutions and markets that help overcome market frictions, introduced by information asymmetries and transaction costs, can foster economic growth through several channels. Specifically, they help (i) ease the exchange of goods and services by providing payment services, (ii) mobilize and pool savings from a large number of investors, (iii) acquire and process information about enterprises and possible investment projects, thus allocating society's savings to its most productive use, (iv) monitor investments and exert corporate governance, and (v) diversify and reduce liquidity and inter-temporal risk.

Empirically, this paper continuously emphasized that all methods have their problems but that one problem plaguing the entire study of finance and growth pertains to the proxies for financial development. Study of finance-growth relationship is important to all countries because the development of domestic financial sector is significant in affecting the pattern of economic growth by promoting economic growth through efficient allocation of resources.

While a wide array of cross-country techniques has been applied to the finance and growth field, some techniques have not been used yet, such as identification through heterogeneity in structural shocks (Rigobon, 2003). Next, it is easy to predict that there will be further advances both in GMM techniques that better control for country heterogeneity and in techniques to assess the finance and growth relationship at different frequencies. As before, the finance and growth literature will benefit in the coming years from methodological advances in neighboring fields, especially in growth econometrics. Merging VAR and cross-country techniques are two literatures promise further methodological insights.

In conclusion, the empirical results of the later decades have provided a strongly positive relationship between financial development and economic growth. However, the choice of financial development measures, causality direction of finance and growth, econometric problems arise and the channels in linking both financial development and economic growth need to be more ameliorated to answer questions related to the finance growth nexus issues. There are challenging tasks for researchers with wide ranges of interest in the theory, measurement and techniques used.

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#### *Countries list*

##### Developed countries:

Austria, Belgium, France, Germany, Italy, Netherlands, the United Kingdom, Ireland, Spain, Finland, Denmark, Greece, Portugal, Sweden, Norway, the USA, Canada, Australia, New-Zélande, Japan.

##### Developing countries:

South Africa, Mexico, Argentina, Brazil, Chile, Colombia, Venezuela, Peru, Singapore, Thailand, Philippine, Indonesia, Malaysia, R. Korea, Egypt, Pakistan, Turkey, Morocco. Algeria, Bangladesh, Benin, Bolivia, Botswana, Burkina Faso, Burundi, Cameroon, Costa Rica, Côte d'Ivoire, Ecuador, El Salvador, Gabon, Ghana, Guatemala, Haiti, Honduras, Jamaica, Kenya, Maurice, Nicaragua, Niger, Nigeria, Panama, Papouasie-New-Guinia, Paraguay, Syria, Senegal, Sri Lanka, Togo, Tunisia, Uruguay.

Table 1. Financial Development and economic Growth: Static Panel Estimation, Fixed Effect vs. Random Effect, over the period 1970 to 2009

Growth rate	Fixed Effects (OLS)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Initial GDP	-0.0396*** (-18.30)	-0.0064*** (-6.641)	-0.016*** (-4.222)	-0.014*** (-6.326)	-0.012*** (-6.649)	-0.039*** (-18.68)	-0.05*** (-15.54)	-0.016*** (-4.079)	-0.013*** (-6.060)	-0.013*** (-5.586)
Trade openness	0.00332 (0.353)	0.00312** (2.232)	0.0157** (2.470)	0.0226*** (3.779)	0.0279*** (3.799)	0.00301 (0.325)	0.00473 (0.779)	0.0147** (2.332)	0.0217*** (3.561)	0.0223*** (3.595)
Education	-0.00272 (-0.276)	0.0109*** (2.942)	-0.00597 (-0.365)	-0.00684 (-0.658)	-0.00514 (-0.523)	-0.00254 (-0.261)	0.00203 (0.208)	-0.00397 (-0.245)	-0.00650 (-0.628)	-0.00378 (-0.370)
Inflation	-0.0109 (-1.370)	-0.0194*** (-4.014)	-0.0107** (-1.979)	-0.019*** (-5.322)	-0.001*** (-3.564)	-0.0109 (-1.383)	-0.0099* (-1.751)	-0.0112** (-2.079)	-0.019*** (-5.509)	-0.022*** (-5.374)
Government consumption	-0.0470 (-1.219)	-0.0401** (-2.465)	-0.0683 (-1.307)	-0.0491 (-1.152)	-0.093*** (-2.897)	-0.0481 (-1.256)	-0.0780* (-1.769)	-0.0675 (-1.298)	-0.0519 (-1.196)	-0.0672 (-1.538)
Civil freedom	0.00535 (0.911)	0.0109*** (3.988)	0.0179** (2.474)	0.0144*** (3.035)	0.0165** (2.375)					
Polical stability						0.0275*** (2.707)	0.00638 (0.622)	0.0248*** (2.907)	0.0191*** (3.013)	0.0198*** (3.146)
Private credit/GDP	0.0280*** (2.761)					0.00678 (1.128)				
M3/GDP		0.00434** (2.532)					0.0101* (1.958)			
Market capitalisation/GDP			0.00408** (2.286)					0.00388** (2.178)		
Financial system assets/GDP				0.0206** (2.128)					0.0213** (2.183)	
Credit/deposit					0.00472 (1.462)					0.00480 (1.168)
Constant	0.387*** (19.22)	0.0814*** (8.773)	0.184*** (4.454)	0.134*** (5.377)	0.107*** (7.382)	0.385*** (19.35)	0.502*** (15.47)	0.176*** (4.251)	0.128*** (4.910)	0.140*** (5.427)
Observations	543	543	292	543	544	543	475	292	543	543
R-squared	0.555	0.1246	0.135	0.175	0.128	0.555	0.1266	0.144	0.176	0.169
Nombre de pays	68	68	57	68	68	68	68	57	68	68
Hausman Test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Notes: t-stat in parentheses.

\* p&lt;0.1; \*\* p&lt;0.05; \*\*\* p&lt;0.01 indicate significance at the 10%, 5% and 1% level in the first-stage regression respectively.



Table 2. Financial Development and economic Growth: Dynamic Panel Estimation, GMM-Difference, over the period 1970 to 2009:

Dependant Variable : LogGDP	<i>GMM en Différence</i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial GDP	-0.039*** (-18.30)	-0.006*** (-6.641)	-0.016*** (-4.222)	-0.014*** (-6.326)	-0.012*** (-6.649)	-0.039*** (-18.68)	-0.051*** (-15.54)	-0.0160*** (-4.079)
Trade openness	0.137*** (9.053)	0.0769*** (5.642)	-0.0119 (-0.773)	0.0609*** (3.585)	0.135*** (9.197)	0.0769*** (5.496)	-0.00518 (-0.293)	0.0601*** (3.720)
Education	0.0784*** (3.955)	0.0435* (1.863)	0.171*** (3.923)	-0.0613*** (-3.215)	0.0833*** (3.823)	0.0475** (2.198)	0.172*** (4.011)	-0.0582*** (-3.061)
Inflation	-0.0785*** (-8.011)	-0.0780*** (-6.429)	-0.0813*** (-7.430)	-0.0610*** (-6.126)	-0.0750*** (-7.914)	-0.0797*** (-7.342)	-0.0799*** (-7.062)	-0.0591*** (-6.022)
Government consumption	-0.914*** (-8.495)	-1.053*** (-10.04)	-1.025*** (-6.180)	-0.706*** (-4.758)	-0.941*** (-8.607)	-1.051*** (-9.019)	-1.020*** (-6.374)	-0.677*** (-4.461)
Civil freedom	0.0699*** (4.921)	0.0570*** (3.417)	0.00393 (0.326)	-0.000836 (-0.0636)				
Political stability					0.0575*** (3.788)	0.0406*** (2.940)	-0.0245* (-1.680)	-0.0192 (-1.032)
Private credit/PIB	0.216*** (10.23)				0.209*** (11.72)			
M3/PIB		0.536*** (14.48)				0.507*** (12.00)		
Market Capitalisation/GDP			0.276*** (48.91)				0.261*** (43.87)	
Financial system Assets/PIB				0.465*** (10.26)				0.458*** (9.221)
Constant	2.749*** (58.47)	2.816*** (63.77)	2.875*** (27.33)	2.139*** (26.36)	2.749*** (53.12)	2.798*** (66.65)	2.847*** (29.56)	2.144*** (27.57)
Observations	407	407	235	407	407	407	235	407
Countries	68	68	56	68	68	68	56	68
Sargan Test <sup>b</sup>	0.1182	0.1145	0.1568	0.1014	0.1363	0.1187	0.1399	0.0978
AR(2) <sup>a</sup>	0.9482	0.7566	0.6593	0.7867	0.9630	0.7559	0.6800	0.7522

Notes: t-stat in parentheses.

The regressions also include dummy variables for the different time periods that are not reported.

\* p<0.1; \*\* p<0.05; \*\*\* p<0.01 indicate significance at the 10%, 5% and 1% level in the first-stage regression respectively.

a The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

b The null hypothesis is that the instruments used are not correlated with the residuals.

Table 3. Financial Development and economic Growth: Dynamic Panel Estimation, GMM-System, over the period 1970 to 2009:

Dependant Variable :	GMM- System									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LogGDP										
initial GDP	-0.293** *	-0.2363***	-0.1498** *	-0.217***	-0.220***	-0.283***	-0.236***	-0.163***	-0.214 ***	-0.216***
	(-44.12)	(-34.07)	(-28.64)	(-62.36)	(-44.90)	(-56.50)	(-55.04)	(-28.08)	(-44.67)	(-45.9)
Trade openness	0.141** *	0.202***	-0.125***	0.281***	0.263***	0.139***	0.195***	-0.117***	0.265***	0.247***
	(6.57)	(10.24)	(-5.609)	(10.72)	(13.81)	(6.960)	(12.06)	(-5.497)	(12.30)	(14.37)
Education	0.241** *	0.0291	0.103**	0.145***	0.271***	0.230***	0.0357*	0.120***	0.151***	0.252***
	(10.70)	(1.370)	(2.567)	(8.192)	(11.30)	(11.58)	(1.871)	(3.446)	(8.692)	(15.65)
Inflation	-0.007** *	-0.00780** *	-0.0153** *	-0.00766** *	-0.00860** *	-0.00653** *	-0.00809** *	-0.0167*** *	-0.00747** *	-0.00881* **
	(-9.65)	(-8.136)	(-7.382)	(-12.32)	(-15.92)	(-9.549)	(-11.21)	(-11.12)	(-11.44)	(-19.86)
Gouvernement Consumption	-0.915** *	-1.181***	-1.820***	-1.307***	-1.251***	-0.959***	-1.239***	-1.823***	-1.288***	-1.226***
	(-14.92)	(-12.02)	(-18.61)	(-14.28)	(-12.43)	(-17.81)	(-12.45)	(-17.96)	(-12.50)	(-11.30)
Civil freedom	0.147** *	0.113***	0.0403** *	0.0947***	0.131***					
	(13.11)	(8.101)	(6.238)	(8.297)	(8.254)					
Political stability						0.179*** (14.83)	0.209*** (16.53)	0.107*** (9.183)	0.176*** (12.49)	0.244*** (14.62)
Private sector credit/GDP	0.406** *					0.385***				
	(22.31)					(23.59)				
M3/PIB		0.272*** (9.198)					0.276*** (11.92)			
Market Capitalisation/G DP			0.133*** (29.33)					0.154*** (49.42)		
Financial system assets/GDP				0.102*** (3.336)					0.0938*** (4.745)	
Credit/Deposit					0.132*** (8.964)					0.140*** (10.99)
Constant	2.231** *	2.049***	1.740***	1.806***	1.644***	2.172***	2.021***	1.799***	1.757***	1.586***
	(46.13)	(46.56)	(22.33)	(41.55)	(38.51)	(60.70)	(57.89)	(22.64)	(34.64)	(36.01)
Observations	490	490	298	490	490	483	483	293	483	483
Countries	70	70	58	70	70	69	69	57	69	69
Sargan Test <sup>b</sup>	0.1229	0.1220	0.1535	0.0776	0.0776	0.1271	0.1517	0.214	0.1312	0.1084
AR(2) <sup>a</sup>	0.2046	0.3119	0.5838	0.3514	0.3581	0.1617	0.1816	0.607	0.2728	0.2328
								0		

Notes: t-stat in parentheses.

The regressions also include dummy variables for the different time periods that are not reported.

\* p<0.1; \*\* p<0.05; \*\*\* p<0.01 indicate significance at the 10%, 5% and 1% level in the first-stage regression respectively.

a The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

b The null hypothesis is that the instruments used are not correlated with the residuals.

# Financial Development and Economic Growth in the UAE: Empirical Assessment Using ARDL Approach to Co-integration

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## Abstract

This paper empirically examines the relationship between financial development and economic growth in a small open economy of United Arab Emirates (UAE). Using time series data from 1974 to 2008, the study employs the autoregressive distributed lag (ARDL) approach to co-integration. The analysis is carried out using two indicators to measure the level of financial development. The first indicator is the financial depth or size of the financial intermediaries sector as measured by the monetization ratio (M2/GDP). The second indicator is the ratio of the credit provided to private sector by commercial banks as a percentage of the GDP (financial intermediation ratio). The results show a negative and statistically significant relationship between financial development, as measured by M2/GDP, and economic growth. The results also suggest a bi-directional causality between the two variables. Overall, the evidence supports neither the demand-following nor the supply-leading hypotheses for UAE.

**Keywords:** UAE, Financial development, Economic growth, ARDL, Co-integration

## 1. Introduction

Theoretically, financial development and economic growth are intimately related. That is to say, a well-developed financial system performs several critical functions to enhance the efficiency of intermediation by reducing information, transaction, and monitoring costs. More specifically, modern financial system promotes investment by identifying and funding good business opportunities, mobilizes savings, monitoring the performance of managers, enables the trading, hedging and diversification of risks, and facilitates the exchange of goods and services (Creane et al., 2004).

Economically, the above-mentioned functions will result not only in a more efficient allocation of resources but also a more rapid accumulation of physical and human capital and faster technological progress, all of which are expected to positively nourish economic growth.

Having said this, however, historically, a subject that relates financial development to economic growth was not so novel (Rousseau, 2003). In fact, it had taken a pretty good shape since the work of Bagehot (1873) before

Schumpeter (1912) took a lead in showing that financial development promotes growth. However, Lucas (1988) opines that the importance of financial system in energizing economic growth is over-stressed. Apart from Schumpeter and Lucas, the third most influential study on the subject is by Robinson (1952). She asserts that “where enterprise leads, finance follows”, which is at variance with the finding of the two above-cited authors.

Due to its importance from both researchers and policymakers’ perspectives, the relationship between financial development and economic growth has been examined extensively. However, in the context of the high-income oil exporting economies of the Gulf Cooperation Council (GCC), in particular the United Arab Emirates (UAE), studies seemed to be somewhat scanty. Therefore, the primary objective of the present study is to fill this gap in the literature by providing evidence on the relationship between financial development and economic growth in one of the fast-growing emerging economy. The paper also aims to offer some policy implications for the decision-makers in UAE. In the most recent survey of the literature, Choong and Chan (2011, p. 2025) concluded that “it is of interest to all countries to gain insight into the finance-growth relationship” (Note 1).

This paper investigates empirically the long-run relationship and short-run dynamic linkages between financial development and economic growth in the UAE during the period 1974- 2008. The study employs the autoregressive distributed lag (ARDL) approach to co-integration. The analysis is carried out using two indicators to measure the level of financial developments. The first indicator is the financial depth or size of the financial intermediaries sector and it is measured by broad money M2 as percentage of GDP. The second indicator is the ratio of the credit provided to private sector by commercial banks as a percentage of GDP. We included three control variables in our analysis. These variables are inflation rate (INF), trade openness (TO) and government expenditures (GOV).

To the best of our knowledge, this is the first study to utilize the ARDL approach for testing the finance –growth nexus in UAE. Most recent studies have indicated that ARDL approach is more preferable to other conventional approaches. The results show a statistically significant negative impact of financial development on economic growth.

The remainder of the paper proceeds as follows. Section 2 elaborates the theoretical background and previous research. Section 3 describes the data and methodology. The results are reported in Section 4. Section 5 concludes as well as provides policy implications of the paper. The final section outlines the potential limitations of this study.

## **2. Theoretical Background and Previous Research: A Brief Overview**

The writings on the relationship between financial development and economic growth can be traced from the pioneering work of Schumpeter (1912), then Robinson (1952), McKinnon (1973), Shaw (1973), and, more recently, Lucas (1988), among others. To date, however, the relationship between financial development and economic growth is still a subject of great disagreement and controversy among researchers. This in turn has produced an immense academic literature, both theoretical and empirical. As a result, there exist a large number of works offering extensive survey of literature of this subject (see, for instance, Levine, 1997, 2004, Tsuru, 2000, Eschenbach, 2004, Demirgüç-Kunt and Levine, 2008, Acaravci, OzturkandAcaravci, 2009 and Choong and Chan, 2011). With a view to conserve space, we will only present a brief overview of the theoretical and empirical literature on finance-growth nexus in order to gain a better understanding of the issue.

The economic literature on the link between financial development and economic growth can be generally categorized into four different arguments. These are supply-leading (finance-led growth), demand-following (growth-led finance), feedback (bidirectional causality) and independent hypotheses (see, for example, Al-Yousif, 2002 and Majid, 2007). The first hypothesis, supply-leading, suggests that a well-functioning and well-developed financial intermediaries provides efficient allocation of resources through channeling the limited resources from surplus units to deficit units which in turn accelerate economic growth. “Financial development involves improvements in the (i) production of ex ante information about possible investments, (ii) monitoring of investments and implementation of corporate governance, (iii) trading, diversification, and management of risk, (iv) mobilization and pooling of savings, and (v) exchange of goods and services. Each of these financial functions may influence savings and investment decisions and hence economic growth” (Levine, 2004, p.6). Several prominent economists support the supply-leading hypothesis including Bagehot (1873), Schumpeter (1912), McKinnon (1973), Shaw (1973), Greenwood and Jovanovic (1990), and King and Levine (1993), among others.

On the other hand, the second hypothesis, demand-following, assumes that economic growth causes financial development i.e. “growth-led finance”. In other words, as Robinson (1952) put it “where enterprise leads finance follows” (p. 86). From this perspective, the expansion in the real sector of the economy creates demand for new financial instruments and thereby the financial sector effectively responds to this demand. That is, economic growth leads to financial development. In addition to Robinson (1952), Gurley and Shaw (1967), Goldsmith (1969), Jung (1986) and Ireland (1994), for instance, support this hypothesis.

The third argument on the finance-growth nexus is the feedback or “bidirectional causality” hypothesis. This view maintains that financial development and economic growth causes each other, that is, there is a two-way causality between financial development and economic growth. From this perspective, a better functioning financial sector can spur economic growth through enhancing technological changes and introducing innovative products and service, which in turn increases the demand for new financial services. As the financial intermediaries respond to these demands, these changes will propel economic growth (Majid, 2007). This hypothesis has received support from numerous theoretical and empirical studies including Patrick (1966), Demetriades and Hussein (1996), Luintel and Khan (1999), Greenwood and Smith (1997), Al-Yousif (2002) and Calderón and Liu (2003), among others.

Apart from the above-mentioned hypotheses, the fourth view suggests that the relationship between financial development and economic growth is not important. This “independent” hypothesis, which was originally proposed by Robert Lucas (Nobel Laureate in economics) in 1988, argues that financial development and economic growth are not causally related. According to Lucas (1988, p.6) “economists badly overstress the role of financial factors in economic growth”. Furthermore, in his influential survey of development economics, Nicholas Stern (1989) does not discuss the role of finance in the economic growth process. Stern also did not include it in his list of “omitted topics” that are worthy for future consideration (see also, Meier and Seers, 1984). More recently, Ram (1999, p.172) concluded that “...the predominant correlation between financial development and economic growth is negligible or weakly negative”.

In fact, judging from the way economists across the Atlantic treating the topic, neither theoretical nor empirical consensus has yet been achieved. As Rousseau and Wachtel (2005, p.2) have aptly summarized: “while American authors (e.g., Levine and ourselves) often exhibit unbounded enthusiasm about the strength of the relationship, Europeans (Arestis, Demetriades and Temple, among others) are much more cautious and give more emphasis to the variability of the effects and the lack of robustness in some studies”. From the cited works on finance-growth nexus, there is ample evidence to suggest that a model of economic development that is based on “one-size fits all” is almost non-existent.

As stated earlier, the literature on finance-growth relationship is vast and it is beyond the scope of this paper to present another review of the literature. However, we will present few studies that are either related to UAE context or employed the same methodology used in the present study (i.e., ARDL approach).

As far as the UAE economy is concerned, to the best of our knowledge, there is only one study that is fully devoted to examine the relationship between financial development and economic growth in the UAE. Using time series data from 1973 to 2003, Mosesov and Sahawneh (2005) examined the finance-growth nexus in UAE. The study employed standard OLS regression and used three variables to measure financial development, namely broad money to GDP (M2), credit to private sector to GDP (PSC) and domestic assets of resident banks to GDP (BDA). The paper also controlled for other variables that are believed to influence economic growth in the UAE, namely labor force growth, gross investment as percentage of GDP and oil prices. Inconsistent with their expectation, the coefficient on M2 is found to be negative and statistically significant at the 5% level in their Regression 1 (without oil prices) and negative but not statistically different from zero in Regression 2 (with oil prices). The coefficients on the second financial development variable (PSC) are also found to be negative but not statistically significant. Similarly, the coefficients on the third financial development variable (BDA) are not statistically significant but positive. Mosesov and Sahawneh concluded that no positive evidence to suggest that financial development had influence the economic growth in the UAE. The control variables used in their study, however, are found to be positively and significantly related to economic growth in the UAE.

The above-mentioned study conducted by Mosesov and Sahawneh (2005) suffers from a serious methodological problem as it employed the standard OLS regressions. Such estimation method produces biased and incorrect estimates of the parameter coefficients and cannot capture the long-run dynamic relationship between financial development and economic growth. The drawback in Mosesov and Sahawneh’s (2005) work has motivated the current study to overcome the limitations of their study by employing the appropriate econometric technique i.e., ARDL approach to co-integration in order to examine the finance-growth nexus in the UAE.

Meanwhile, as far as the methodology is concerned, Mohamed (2008) examined the short and long run relationship between financial development and economic growth in Sudan, one of the Middle East and North Africa (MENA) countries. Covering the period from 1970 to 2004, the study employed the ARDL modeling approach to co-integration. Specifically, he used two proxies for financial development. That is, the ratio of M3 to GDP (M3Y) and the credit provided by the commercial banks to private sector as a percentage of GDP (CBS). The result showed that financial development variables negatively affect real GDP. The coefficient on M3Y is found to be negative and statistically significant at the 1% level and the coefficient on CBS is also negative but insignificant. Mohamed

attributed his finding to the inefficient allocation of resources by banks, the absence of proper investment climate, and to the poor quality of credit disposal of the banking sector in Sudan

Another study utilizes ARDL model of co-integration is conducted by Majid (2007). The study examined the short and long-run dynamics between financial development, inflation and economic growth during the post 1997 financial crisis in Thailand. The paper found a long-run equilibrium between economic growth, finance depth, inflation and share of investment. The study also documented that the common sources of economic progress/regress in Thailand is price stability and financial development. Specifically, this implies that in promoting the growth of economy, it is very important for the government to preserve price stability by maintaining a lower rate of inflation and enhancing the financial sectors both banking and stock market.

Seetanah (2008) used the ARDL model to investigate the dynamic empirical link between financial development and economic performance in a small island state of Mauritius. The results showed that financial development have been contributing to the output level of the economy in both the short and the long run. Using similar econometric approach, Kargbo and Adamu (2009) have arrived at the same conclusion for the case of Sierra Leone. The next section will elaborate on the data and the econometric modeling.

### 3. Data, Model Specification and Methodology

#### 3.1 Data

The current study is based on time series data covering the period from 1974 to 2008. The data are obtained from the country tables published by the International Financial Statistics (IFS) and the International Monetary Fund, World Economic Outlook Database.

#### 3.2 Model Specification

The economic literature often suggests the following model of finance-growth nexus:

$$Y = f(FD, CV) \quad (1)$$

where  $Y$  is the economic growth measured by the real gross domestic product (GDP) per capita growth (see Levine 1997), which is a function of  $FD$  (set of financial development indicators) and  $CV$  (other control variables believed to be linked to economic growth).

The financial development can be defined as “improvement in quantity, quality and efficiency of financial intermediary services (Calderón and Liu, 2003, p. 326). To measure the financial system development ( $FD$ ), the literature has identified several indicators. Following Calderón and Liu (2003) and Al-Malkawi and Abdullah (2011), this paper will employ two proxies for financial development. The first proxy is the monetization ratio, or broad money supply ( $M2$ ) to GDP (Note 2). We will refer to this proxy as  $M2$ . This measure has frequently been used by earlier research (see, for example, King and Levine, 1993, Levine, 1997, Gillman and Harris, 2004, Kemal, Abdul Qayyum and Hanif, 2007, and Odhiambo, 2008). This variable measures the financial depth or size of the financial intermediaries sector. It has been argued that the larger the size of the financial system the stronger it can contribute to economic activities by mobilizing savings and channeling them towards productive economic activities, and hence growth (see Levine, 1997). Based on the aforesaid discussion and consistent with previous research the  $M2$  is expected to have positive relationship with economic growth.

The second proxy for financial development is the financial intermediation ratio, credit provided by financial intermediaries to the private sector as a percentage of GDP (Note 3). We will refer to this variable as  $DC$ . This proxy has been widely suggested in the literature (see, King and Levine, 1993, Levine, 1997, Andersen, 2003, and Kemal, Abdul Qayyum and Hanif, 2007, among others). This measure indicates the extent to which funds are channelled into private sector by financial intermediaries. This measure “is better than other measures of financial development used in the literature” and also “more directly linked to investment and growth” (Calderón and Liu, 2003, p. 326) (Note 4). Accordingly, and consistent with prior research, we expect the impact of the variable  $DC$  on economic growth to be positive.

As stated earlier, the purpose of this paper is to examine the relationship between financial development and economic growth. However, the standard literature has also identified other factors associated with economic growth, which is denoted here as  $CV$  in Equation 1. Therefore, we included three control variables in our analysis. These variables are inflation rate ( $INF$ ), trade openness ( $TO$ ) calculated as import plus export as a ratio of GDP, and government expenditures ( $GOV$ ).

#### 3.3 Methodology

##### 3.3.1 ARDL Bound Testing Approach

This study utilizes the newly proposed autoregressive distributed lag (ARDL) approach, developed and introduced by Pesaran and Shin (1995 and 1998), Pesaran et al. (1996), Pesaran (1997) and Pesaran et al. (2001). More of the recent

studies indicate that ARDL approach is more preferable in estimating the co-integration relation to other methods like Engle and Granger (1987), Johansen (1988) and Gregory Hansen (1996). The ARDL approach to co-integration is a more reliable method than other conventional co-integration approaches and it is applicable irrespective of whether the underlying regressors are purely  $I(0)$ , purely  $I(1)$  or mutually co-integrated. Unlike most of the conventional co-integration procedures, which are valid for large sample size, the ARDL approach is more robust and performs well for small sample sizes. By using the ARDL approach, one can estimate the long-run and the short-run components of the model simultaneously.

The existence of an error-correction term among a number of co-integrated variables implies that changes in the dependent variable are a function of both the level of disequilibrium in the co-integration relationship (represented by the ECM) and the changes in other explanatory variables. This tells us that any deviation from the long-run equilibrium will feed back into the changes in the dependent variable in order to force the movement towards the long-run equilibrium (Masih and Masih, 2002, p. 69).

To analyze the relationship between economic growth and financial development in UAE, an individual model for each financial development indicator will be employed based on the following two general models

$$GDP_t = a_0 + a_1 t_t + a_2 DC_t + a_3 GOV_t + a_4 TO_t + a_5 INF_t + \varepsilon_t \quad (2)$$

$$GDP_t = a_0 + a_1 t_t + a_2 M2_t + a_3 GOV_t + a_4 TO_t + a_5 INF_t + \varepsilon_t \quad (3)$$

In the first model (Equation 2), economic growth is represented by real GDP growth as a dependent variable, while the independent variables are domestic credit to private sector as a percentage of GDP (DC) (financial intermediation ratio),  $GOV_t$  is a measure of government expenditure as a percentage of GDP,  $TO_t$  is a measure for trade openness as a percentage of GDP,  $INF_t$  is a measure of inflation,  $t_t$  is the time trend, and  $\varepsilon_t$  is an error term. In the second model (Equation 3), with  $M2_t$  (i.e., M2 as a percentage of GDP) being the only exception, other variables remained unchanged.

Based on the above general models, the error correction representation of the ARDL model can be presented as follows:

Model 1: Economic growth and financial intermediation ratio (DC)

$$\begin{aligned} \Delta GDP_t = & a_0 + \sum_{i=1}^n a_1 \Delta GDP_{t-i} + \sum_{i=1}^n a_2 \Delta \ln DC_{t-i} + \sum_{i=1}^n a_3 \Delta \ln GOV_{t-i} \\ & + \sum_{i=1}^n a_4 \Delta \ln TO_{t-i} + \sum_{i=1}^n a_5 \ln INF_{t-i} + \lambda_1 GDP_{t-1} + \lambda_2 \ln DC_{t-1} + \lambda_3 \ln GOV_{t-1} \\ & + \lambda_4 \ln TO_{t-1} + \lambda_5 \ln INF_{t-1} + \beta t + \varepsilon_t \end{aligned} \quad (4)$$

Model 2: Economic growth and monetization ratio (M2)

$$\begin{aligned} \Delta GDP_t = & \delta_0 + \sum_{i=1}^n \delta_1 \Delta GDP_{t-i} + \sum_{i=1}^n \delta_2 \Delta \ln M2_{t-i} + \sum_{i=1}^n \delta_3 \Delta \ln GOV_{t-i} \\ & + \sum_{i=1}^n \delta_4 \Delta \ln TO_{t-i} + \sum_{i=1}^n \delta_5 \ln INF_{t-i} + \alpha_1 GDP_{t-1} + \alpha_2 \ln M2_{t-1} + \alpha_3 \ln GOV_{t-1} \\ & + \alpha_4 \ln TO_{t-1} + \alpha_5 \ln INF_{t-1} + \beta t + \varepsilon_t \end{aligned} \quad (5)$$

In the first model (Equation 4), the null hypothesis of “non-existence of the long-run relationship” defined by  $(H_0 : \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0)$  and it is tested against the alternative hypothesis  $(H_1 : \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq 0)$ . In the second model (Equation 5), the null hypothesis of “non-existence of the long-run relationship” is defined by  $(H_1 : \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 0)$  and it is tested against the alternative hypothesis  $(H_1 : \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq 0)$ . These hypotheses are examined using the standard F-statistics. Two sets of asymptotic critical values are provided by Pesaran et al. (2001). The first set assumes that all variables are  $I(0)$  while the second category assumes that all variables are  $I(1)$ . If the computed F-statistics is greater than the upper bound critical value, then we reject the null hypothesis of no co-integration and conclude that there exists steady state equilibrium between the variables. If the computed F-statistics is less than the lower bound critical value, then the null hypothesis of no co-integration cannot be rejected. If the computed F-statistics falls within the lower

and upper bound critical values, then the result is inconclusive. In this case, following Kremers, Ericsson and Dolado (1992) the error correction term will be a useful way of establishing co-integration. The second step is to estimate the long-run coefficients of the same equation and the associated ARDL error coercion models. In order to determine the optimal lag-length incorporated into the model and select the ARDL model to be estimated, the study employs the Akaike Information Criteria (AIC).

### 3.3.2 Vector Error Correction Model (VECM) Framework

The following step is to construct a standard Granger causality test. The Granger causality approach says that Y is said to be granger-caused by X if X helps in predicting the value of Y. In other words, the lagged values of X are statistically significant. The null hypothesis  $H_0$  tested is that X does not granger-cause Y and Y does not granger-cause X. The test will be augmented with a lagged error correction term when variables are co-integrated, and then estimated within a Vector Error Correction Model (VECM). This procedure is more attractive than the standard VAR because it permits temporary causality to emerge from firstly, the sum of the lagged differences of the explanatory differenced variable, and secondly, the coefficient of the error-correction term.

The conducting of this test helps to explore the short and long-run dynamic relationships between economic growth represented by the percentage of GDP per capita growth, and the financial development represented by the monetization ratio (M2) and the financial intermediation ratio (DC). Based on the theoretical background, if two variables, i.e.  $y_t$ ,  $x_t$ , are co-integrated with each other, then the error correction term is required in testing Granger causality. At the same time, neglecting the error correction term (ECT) when testing for causality among co-integrated variables leads to serious biases due to filtering out low-frequency (long-run) information. The VECM is given by

$$\Delta Y_t = a_0 + \pi y_{t-1} + a_1 \Delta y_{t-1} + a_2 \Delta y_{t-2} + \dots + a_{p-1} \Delta y_{t-p+1} + \varepsilon_t \quad (6)$$

where  $\Delta$  is a difference operator,  $y_t$  a column- $n$  vector of endogenous variables,  $a_1, \dots, a_{p-1}$  are  $(n \times n)$  matrices of coefficients, and  $\varepsilon_t$  is a vector of normally and independently distributed error terms.

## 4. Results and Discussion

The results of the ARDL bound test are shown in Table 1. The calculated F-statistics for model 1 is less than the lower bound critical value. Based on this result the null hypothesis cannot be rejected, which suggests that there is no cointegration when using financial intermediation ratio (DC) as a financial indicator for economic growth. Based on this result the second step to estimate the long-run coefficients of the same equation and the associated ARDL error coercion models cannot be continued.

For ease of reference, we report the calculated F-statistics for the model 2, and it is 4.812, which is significant at 95% level. This result provides evidence for the existence of long-run relationship among economic growth represented by the real GDP, the financial development represented by monetization ration (M2), and also government expenditure, trade openness and inflation. This indicates that these variables have a long-run equilibrium, thereby having the tendency to move together in the long-run.

In the second stage, we estimate the long-run coefficients of the selected ARDL model using the variable (M2) as a financial indicator. The overall goodness of fit of the estimated equation, as shown in Table 2, is extremely high with  $R^2 = 0.99$ ; the F-statistic measuring the joint significance of all regressors is statistically significant ( $p$ -value = .000). Meanwhile, the diagnostic tests of the model show no serial correlation and no heteroscedasticity. The AIC lag specification is ARDL (1, 1, 0, 0, 1), where the numbers represent the lags for the variables which are listed in the same order. The long-run coefficient estimates are reported in Table 2.

The results show that the financial development indicator, as measured by M2 to GDP, has a significant negative impact on economic growth in the case of UAE. Similarly, the control variables namely, government expenditure, trade openness and inflation are found to have significant negative impact on economic growth (Note 5).

Although the result of the negative relationship between the financial development and economic growth reported in this study is inconsistent with general evidence in the empirical literature, it is not surprising in the case of UAE. A possible explanation for that, over our study period (1979-2008), the UAE financial system was still in the transition phase and needs to reach a certain level of development before it will be able to promote economic growth. In addition, as Al-Yousif (2002, p.147) suggested, this negative relationship between the two variables (i.e. monetization ratio and economic growth) can be attributed to the act of "business cycle rather than a representation of a long-run relationship. Also, according to him "due to the fact financial intermediaries operating in a weak regulatory environment combined with the expectation that government will bail out failing banks". This explanation is quite plausible for GCC countries in general and for the UAE in particular.



Furthermore, the result obtained in this paper is consistent with Mosesov and Sahawneh (2005) who reported negative and significant relationship between financial development as measured by M2/GDP and economic growth in the UAE. In an earlier study, Ram (1999) did not support the view that financial development promotes economic growth. Using data for 95 individual countries including UAE, Ram found negligible or weakly negative correlation between financial development and economic growth. The coefficient of correlation between M2/GDP and GDP is found to be negative for UAE, but insignificant. Also, Gillman and Harris (2004) obtained negative and significant coefficient on M2/GDP for 13 transition countries. More recently, Mohamed (2008) reported similar result for Sudan.

Following the exploration of the long-run association between economic growth, monetization ratio (M2), with control variables namely; government expenditure, trade openness and inflation, we proceed to perform multivariate Granger-Causality test based on VECM. The core value of this test is to reveal the direction of causation among variables. Table 3 reports the results of causation among all variables. The results show that there are significant negative short-run dynamic bidirectional causations between the financial indicator (M2) and economic growth represented by GDP per capita growth.

The coefficient of the estimated error correction model (ECM) of the selected ARDL (when real GDP is considered as dependent variable) has the correct negative sign, which is highly significant at 1%. This confirms the existence of long-run relationship between the two variables. Beside that it represents the speed of adjustment to restore equilibrium in the dynamic model following disturbance. The coefficient of the ECM is -0.2625, suggesting that a deviation from the long-run equilibrium following a short-run shock is corrected by about 26% in less than a year.

## 5. Conclusions and Policy Implications

This paper empirically examines the relationship between financial development and economic growth in a small open economy of United Arab Emirates (UAE). Using time series data from 1974 to 2008, the study employs autoregressive distributed lag (ARDL) approach to co-integration. The analysis carried out using two indicators to measure the level of financial development. The first indicator is the financial depth or size of the financial intermediaries sector as measured by the monetization ratio (M2/GDP). The second indicator is the ratio of the credit provided to private sector by commercial banks as a percentage of the GDP (financial intermediation ratio). We included three control variables in our analysis. These variables are inflation rate (INF), trade openness (TO) and government expenditures (GOV).

To the best of our knowledge, this is the first study to utilize the ARDL approach for testing the finance –growth nexus in the UAE. Most recent studies have indicated that ARDL approach is more preferable to other conventional approaches.

The results show a negative and statistically significant relationship between financial development, as measured by M2/GDP, and economic growth. The results also suggest a bi-directional causality between the two variables. A possible explanation for that, over our study period (1979-2008), the UAE financial system was still in the transition phase and needs to reach a certain level of development before it will be able to promote economic growth. Moreover, as Al-Yousif (2002, p.147) suggested, this negative relationship between the two variables (i.e. monetization ratio and economic growth) can be attributed to the act of “business cycle rather than a representation of a long-run relationship. He also argued that it could be, “due to the fact financial intermediaries operating in a weak regulatory environment combined with the expectation that government will bail out failing banks”. This explanation is quite plausible for GCC countries in general and for the UAE in particular. Over all, the evidence supports neither the demand-following nor the supply-leading hypotheses for UAE.

In responding to such inconclusive result between financial intermediaries and economic growth, a policy that is geared towards an extensive liberalization of the business and financial services is thought wise considering. This is being the case as UAE is getting more matured in terms of politics and economics, and is more exposed to unpredictable and robust world economy. While responsibility for promoting the liberalization of banking and financial services rested with the UAE Central Bank, the Ministry of International Trade and Industry, and Ministry of Finance are expected to promote other services and incentives, which in one way or the other is supportive of what is done by the Central Bank.

## 6. Limitations of the Study

The study is based on the data set that is constructed from the publications of the IFS and IMF. The reliability and accuracy of that data will therefore, affect the robustness of the results of the present study. All efforts have been made to ensure the accuracy of the data, but this potential data problem remains.

Another limitation is related to the various proxy variables used. Although the proxy variables used in this study were defended empirically and theoretically, they remain proxies and may not perfectly represent the theoretical propositions. Once again, the proxy variable issue is a problem common to all empirical testing in finance-growth nexus, and more generally.

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### Notes

Note 1. Ram (1999) suggested that the future research on the finance-growth nexus should focus on individual-country studies.

Note 2. Money and quasi money (M2) comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This definition of money supply is frequently called M2; it corresponds to lines 34 and 35 in the International Monetary Fund's (IMF) International Financial Statistics (IFS).

Note 3. Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises.

Note 4. Levine, Loayza and Beck (2000) also favored this measure of financial development.

Note 5. Al-Malkawi and Abdullah (2011) found negative and significant relationship between government expenditure and inflation and economic growth for a sample of MENA countries including UAE.

Table 1. F-statistics for Testing the Existence of a Long-run Relationship

	Equation	The Calculated F-statistics
Model 1	F(GDP/GOV, TO, INF, DC)	1.9174
Model 2	F(GDP/GOV, TO, INF, M2)	4.812**

Note: The relevant critical value bounds are obtained from Pesaran, Shin and Smith (2001). Table CII (iii) Case III: Unrestricted intercept and unrestricted trend, the number of regressors is 4. These values are 3.13 – 4.04 at 90%, 3.41 – 4.36 at 95% and 3.96 – 4.96 at 99% significance level. \*\* denotes that the F-statistic falls above the 95% upper bound.

Table 2. Estimated long-run coefficients based on ARDL model selected by AIC (1, 1, 0, 0,1)

Dependent variable is LGDP

Regressors	Long-run coefficient	T-Ratio [Prob]
Intercept	34.1962***	12.8690[0.000]
t	0.0747***	6.6710[0.000]
LM2	-0.8173***	-4.5838[0.000]
LGOV	-.81142***	-2.4540[0.021]
LTO	-0.8891***	-2.2750[0.032]
INF	-0.1648***	-2.2801[0.031]
Adj- $R^2$ = 0.99		
F- statistics = 475.5503 [0.000]		
D-W = 1.978		
LM = 0.00535[0.942]		

Note: \*, \*\* and \*\*\* denote statistical significance at 10%, 5% and 1% levels, respectively. -  $R^2$  denotes adjusted R- squared, D-W denotes Durbin-Watson test for autocorrelation, LM denotes Langrange Multiplier.

Table 3. Granger Causality results based on VECM.

*Financial indicator: Money and quasi money as a percentage of GDP (M2).*

Dependent Variables	Independent Variables		
	$\Delta$ GDP	$\Delta$ M2	ECM (-1)
$\Delta$ GDP	-	-0.5277*** [-6.3354]	-0.2625*** [-3.2761]
$\Delta$ M2	-1.1132*** [-6.8587]	-	-0.3759*** [-5.3025]

Note: \*, \*\* and \*\*\* denote statistical significance at 10%, 5% and 1% levels, respectively. Figures in squared parentheses represent t-statistics.

# Bankruptcy Prediction Using Memetic Algorithm with Fuzzy Approach: Empirical Evidence from Iran

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## Abstract

Several corporate failures have recently occurred, many have suffered from serious losses and most notably public confidence has deteriorated. In order to facilitate investor's decision making regarding potential investment opportunities, this paper seeks to demonstrate that it is model specific constraints that limits the usefulness of accounting information, not the nature of variables per se. Thus we develop a Hybrid model which is an adaptive Memetic Algorithm combined with fuzzy approach that generates and optimizes a set of if-then rules for bankruptcy prediction. Data are derived from Tehran Stock Exchange (TSE) data bank, adopting 18 variables all of which are accounting ones, between 2001 and 2009. Four out of five models used in this survey have either accomplished high degree of accuracy or low level of type I error; however experimental results show that in terms of both average accuracy in prediction and occurrence of type I and II errors, fuzzy memetic performs better than GA, MLP, C4.5 and LDA in comparison.

**Keywords:** Bankruptcy prediction, Memetic algorithm, Fuzzy learning, Accounting variables, Cross validation, Article 141 of commercial codes of Iran

## 1. Introduction and Literature Review

Numerous studies have been performed regarding bankruptcy prediction and its importance is becoming more vital due to recent failures, financial distress and most importantly its effect on various stakeholders such as stockholders, managers, creditors, potential investors and regulatory institutions. Warner(1977) indicates that the direct costs associated with bankruptcy (such as court costs, lawyer costs, and accountant fees) may be around 4% of the firm value, and that both direct and indirect costs (such as lost sales, lost profits, higher cost of credit, inability to issue new securities, and lost investment opportunities) may be around 28. Therefore, it is important to detect potential

insolvency at its early stages. (Premachandra et al, 2011). Aziz and Dar (2006) have cited the methodologies and findings of previous studies through a comprehensive literature review. Three main categories in predicting corporate failure include statistical models, artificial intelligence expert system models (AIES) and theoretical models (Aziz & Dar, Ibid). The initial models were parametric ones where subsequent research introduced non-parametric models as well as methods for improving their parameters (Davalos et al, 2009). Statistical bankruptcy classification methods include Univariate and Multivariate analysis (Altman, 1968). The insight of both practitioners and researchers, originating with the papers of Beaver and Altman, was that firms with certain financial structures have a greater probability of default and eventual bankruptcy than other types of firms (Martin et al, 2011). Primary multivariate methods include cluster analysis, factor analysis, MDA, multidimensional scaling, logit analysis (Ohlson, 1980), probit analysis (Zmijewski, 1984), Fischer's LDA (Fisher, 1936), Altman's Z score, and logit-probit (Zhang et al, 1999).

Non-parametric statistical models are based on machine learning techniques such as Artificial Neural Networks (ANN); thereafter rule induction techniques have been introduced to improve the limitations and performance of the earlier models. However, they are not consistent in outperforming the "classical statistical" models (Davalos et al, Ibid). Until 1980's discriminant analysis was the dominant method in failure prediction (Back et al, 1996). Since the early 1990's, neural networks, and Multi-Layer Perceptron neural networks in particular, have been widely used to design bankruptcy prediction models. These neural networks make it possible to get around the statistical constraints of discriminant analysis, the main technique used to design such models since Altman (du Jardin, 2010). Neural networks perform classification tasks in a way intended to emulate brain processes (Aziz & Dar, Ibid). There are generally three layers in neural network, the first layer—input layer, the second—hidden layer and the third layer—output layer (Martin et al, Ibid). Later on Genetic algorithms (GA) developed which have played an important role in conducting bankruptcy models, Based on the idea of genetic inheritance and Darwinian Theory of natural evolution (survival of the fittest genes), GA works as a stochastic search technique to find an optimal solution to a given problem from a large number of solutions. Varetto was the first person who introduced a bankruptcy classification model based on a genetic algorithm. Using GA we can choose the financial ratio set dynamically by considering features such suitability of bankruptcy model for an industry, Number of ratios used for prediction, suitability of classification model, all of which can increase the accuracy of the prediction. Neural network is preferred for non-linear data with learning capacity, while its lack of explanatory power due to rational of the decision being made is a black box (Martin et al, Ibid). Fuzzy Neural Network adds rules to Neural Network which could overcome the black box issue although learning capacity is reduced. It is anticipated that Genetic Fuzzy Neural Network improves the learning efficiency. These multi-classifier models can enhance bankruptcy classification by combining the strengths of the different models.

There are two types of multi-classifier models, one, typically called hybrid, involves an optimized model focused on manipulating the parameters for a classifier model that generates a classification. A second type of multi-classifier model combines the output of several classifiers into a single classifier; known as Ensemble, which performs better than single classifiers but is more time consuming to develop since the contribution of each classifier needs to be determined and in some cases, different combinations need to be examined. Bagging is a commonly used method for aggregating classifiers into an ensemble (Davalos et al, Ibid). Inductive learning on the other hand can improve the performance of bankruptcy models (Tsai, 2008). Rule induction generates a model in human terms in the form of if-then rules. Decision tree algorithms and Genetic algorithms have also been successfully applied to rule induction logic. Of course, in terms of increasing accuracy in prediction, several factors are involved, such as the nature of variables, their number and relevance.

The reliability of bankruptcy classification models developed using only financial ratios is in question since there is doubt about the validity and reliability of the accounting information used for the ratios (Agarwal, Taffler, 2008). The main difficulty in choosing a set of predictors is the large number of variables that could be used. Analyzing nearly 200 scientific papers dealing with corporate failure prediction published in the last 50 years, Philippe du Jardin found that more than 500 different ratios were used in the final models (du Jardin, Ibid). In addition, the relevance of particular ratios depends on changes in the environment (Tsai, Ibid). Thus, classifier models have included other information such as firm population characteristics, macro-economic factors, and market variables (Shumway, 2001). Ohlson (Ibid) suggested trying all the possible and viable combinations of variables and models to find an optimal set of variables, albeit this approach is computationally not feasible (Varetto, 1999).

## 2. Research Hypotheses

In order to evaluate the accuracy power and occurrence of type I error regarding bankruptcy predictions, independent sample t-test is used between FM and GA, MPL, C4.5 and LDA predictions, thus four hypotheses are proposed:

H1: Fuzzy Memetic achieves higher average accuracy and lower type I error comparing to Genetic Algorithm in bankruptcy prediction.

H2: Fuzzy Memetic achieves higher average accuracy and lower type I error comparing to MLP in bankruptcy prediction.

H3: Fuzzy Memetic achieves higher average accuracy and lower type I error comparing to C4.5 in bankruptcy prediction.

H4: Fuzzy Memetic achieves higher average accuracy and lower type I error comparing to LDA in bankruptcy prediction.

### 3. Research Methodology

Memetic algorithms just like genetic algorithms are rule-based models in bankruptcy prediction field. The model presented in this paper is a hybrid one, developed by Memetic algorithm with fuzzy approach. Regarding accuracy and occurrence of type I error this paper seeks model comparison among Genetic Algorithm (GA), Multi-Layer Perceptron (MLP), Linear Discriminant Analysis (LDA), C4.5 (Decision Tree) along with the presented model of this paper, FM (Fuzzy Memetic).

The data used in this survey are derived from Tehran stock exchange data bank for the period between 2001 and 2009. For classifying bankrupt from non-bankrupt firms, we used Article 141 of commercial codes of Iran which states: "had the cumulative losses of a firm reaches at least half of the firm's legal capital, the board is responsible for holding an extraordinary general meeting of shareholders, deciding between liquidation and survival". Data from prior year (one year to actual bankruptcy) is used in bankruptcy prediction. Table 1 presents the number of total companies, consisting of bankrupts and non-bankrupts in the mentioned period. We randomly selected 45 bankrupted and 45 non-bankrupted firms from various industries; the next step was to divide the samples into training and test groups with the same proportion.

#### 3.1 Descriptive Statistics

Table 2 presents 18 variables selected for this analysis along with central and dispersion parameters, their standard deviation, and the result of independent sample's t-test in order to compare the means of the sample groups. The result of t-test shows that there are significant differences in two groups and those ratios such as liquidity (CA/CL), leverage (TL/TA) and profitability (ROA, NI/NR, OR/TA) are appropriate measures for classifying bankrupt from non-bankrupt.

#### 3.2 Learning of Memetic Algorithm with Fuzzy Approach

Memetic Algorithms (MAs) are a class of stochastic global search heuristics in which Evolutionary Algorithms-based approaches are combined with problem-specific solvers. The hybridization is meant to either accelerate the discovery of good solutions, for which evolution alone would take too long to discover, or to reach solutions that would otherwise be unreachable by evolution or a local method alone. It is assumed that the evolutionary search provides for a wide exploration of the search space while the local search can somehow zoom-in on the basin of attraction of promising solutions (Krasnogor, 2006). When integrating local search with evolutionary search we are faced with the dilemma of what to do with the improved solution that is produced by the local search. To wit, suppose that individual  $i$  belongs to the population  $p$  in generation  $t$  and that the fitness of  $i$  is  $f(i)$ . Furthermore, suppose that the local search produces a new individual  $i'$  with  $f(i') < f(i)$  for a minimization problem. The designer of the algorithm must now choose between two alternative options. Either (option 1) he/she replaces  $i$  with  $i'$ , in which case  $P = P - \{i\} + \{i'\}$  and the genetic information in  $i$  is lost and replaced with that of  $i'$ , or (option 2) the genetic information of  $i$  is kept but its fitness should alter:  $f(i) = f(i')$ . The first option is commonly known as Lamarckian learning while the second option is referred to as Baldwinian Learning (Baldwin, 1896). The fuzzy memetic (FM) model proposed in this research is based on Lamarckian approach with modest changes. While in Lamarckian learning algorithms all the genetic information of  $i$  is replaced with  $i'$ , we substitute those attributes of  $i$  with that of  $i'$  according to improvements made by these changes in the final fitness function. The logic behind this is due to fuzzy perspective executed in this article. The superiority level of each individual in population comparing to another one is uncertain. In Lamarckian approach the level of superiority is neglected and those with lower advantages even by modest percentages are wholly substituted, which reduces the leaning capacity of the memetic algorithm.

Molga (2005) has used several benchmark functions for optimization needs; hence we chose three most popular of them, namely Ackley, Griewank and Rastrigin functions to compare our model with Genetic Algorithm (GA) and Standard Memetic Algorithm (MA). For assessing the efficiency of proposed model, three statistical measures were used. First, the Mean which is achieved via continuously running the algorithm 30 times, second the variance of results used in computing the Mean and finally Best Results of each algorithm. Each operation was performed in



similar condition and each on 210 seconds. Most notably is the Variance of the model which shows great stability, and its low risk toward bankruptcy prediction. The results are presented in tables 3, 4 and 5. As it is shown in each function, FM algorithm achieves the lowest amount; however, the best results are randomly obtained, thus to reliably compare the algorithms, it's appropriate to use the Means of each algorithm. On the other hand variance which represents Stability of results in continuous operations and its related risk is a vital element in bankruptcy prediction models. Regarding the results of three benchmark functions for optimization, we expect that proposed algorithm would achieve the lowest variance and highest accuracy.

Despite of usage of any model in bankruptcy prediction, crisp logic which divides firms to bankrupt and non-bankrupt along with ignoring deviation (distance) from bankruptcy frontier reduces accuracy level in prediction. On the other hand, fuzzy logic can define a grade quality and that enables us to differentiate between bulks of variables. With having article 141 of commercial codes of Iran in mind, we used a fuzzy approach toward the coverage ratio of accumulated losses to legal capital. However due to non-existence of such trade law in other countries, researchers can perform their surveys based on other assumptions.

### 3.3 Model Presentation

The model presented in this paper provides an if-then rule; each rule is associated with a chromosome consisting of N genes. Each gene has four fields:

$$Ci ( gene1( X1, Le, V1, Q1) , gene2( X2, Le2, V2, Q2), \dots, geneN( Xn, Len, Vn, Qn) )$$

*Xi: variable, Lei: logical equation, Vi: value, Qi: quality*

Logical equation is simply “<” or “>” related to cut-off point, value is the cut-off point determined by the rule and Qi is the quality of the variable in the final fitness. To this end, we used this element for improvement of the next generation in population. If a variable deteriorates the final accuracy of the final rule, its changes should be greater than those variables which are acting accordingly due to final accuracy. Qi is derived from the total misclassification resulted from mentioned variable to the total predictions (in this paper total prediction equals 40). On one side mutation changes inappropriate variables with a random rate, while this rate can be lower, equal or greater than Qi. On the other hand, we defined a rule in the model which performs a comparison between the random rate and Qi, if  $Qi > \text{random rate}$ , then the Qi is the preferred rate for due changes in variables in next generation. While one of the aims of this paper is to reduce the type I error, we shall shift our focus from type II error to type I error. Thus, we multiplied Qi of the variables which caused type II error by 0.5.

For any prediction extracted by rules, there can be four different outcomes,

- *True positive (tp) - the rule predicts that the firm is non-bankrupt and it is not.*
- *False positive (fp) – the rule predicts that the firm is non-bankrupt but it is. (Type I error)*
- *True negative (tn) - the rule predicts that the firm is bankrupt and it is;*
- *False negative (fn) - the rule predicts that that the firm is bankrupt but it is not. (Type II error)*

Due to any prediction generated by the rules, rewards and penalties was prescribed. For determining the amount of these rewards and penalties, we assigned scores to the firms. This assignment is based on the distance of firms from bankruptcy frontier. Due to article 141 of commercial codes of Iran which states, had the cumulative losses of a firm reaches at least halve of the firms legal capital, the firm is a valid case of bankruptcy. Thus by computing coverage ratio (retained earnings/legal capital) of firms, a valid measure for score assignment is made.

$$Si = |\text{Max coverage ratio}| - |\text{coverage ratio } i| \quad (1)$$

In above equation, Si is the score assigned to firm i, Max coverage ratio is the highest ratio in each two categories (bankrupt and non-bankrupt). The pitfall of most models in bankruptcy prediction is usually caused by those samples which are close to bankruptcy frontier, resulting in misclassification of firms, however those far above or below from frontier do not impose any errors. The logic behind this equation is that by identifying firms which are close to bankruptcy frontier (their absolute value of coverage ratio are small), the assigned scores are higher and for those with higher coverage ratio, assigned scores are lower, clearly because their identification are a lot easier. The score coefficients of any prediction are as follow:

- *true positive (tp) = +Si*
- *false positive (fp) (Type I error) = -1.5 Si*
- *true negative (tn) = + Si*
- *false negative (fn) (Type II error) = -Si*

Altman (1968) states that the cost of type I error can be 30 to 60 times as much as the cost of type II error, thus to account for this difference, we assigned  $1.5 \cdot S_i$  penalty to rules which caused type I error. In this way, those rules which have the lowest type I error are considered the optimized ones. Davalos (2009) has reached the lowest type I error, however along with lowest accuracy whereas using fuzzy approach and assigning scores through mentioned logic, enhanced accuracy is expected.

### 3.4 Fitness Function

Carvalho (2002) used the function below to compute fitness,

$$\text{Accuracy} = (\text{tp} + \text{tn}) / N(\text{size of population}) \quad (2)$$

In this paper, we rewrite this equation using scores;

$$\text{Accuracy} = [ \sum \text{si}(\text{tp}) + \sum \text{si}(\text{tn}) + \sum \text{si}(\text{fn}) + \sum \text{si}(\text{fp}) ] / \sum \text{si}(\text{when all prediction would be true}) \quad (3)$$

Our goal in this function is to increase accuracy, which can be reached via maximizing the numerator. Thus,

$$\text{Fitness} = \sum S_i \quad (4)$$

Clearly occurrence of errors would result in lower accuracy, however there is a difference between type I and II error and their impact on accuracy.

### 3.5 Model Validation

This paper has used 5-fold cross validation in order to gauge the generalizability of proposed algorithm, and in the meantime it enables us to compare the performance of two or more different algorithms and to find out the best algorithm for the available data. Cross-Validation is a statistical method of evaluating and comparing learning algorithms by dividing data into two segments: one used to learn or train a model and the other used to validate the model. In typical cross-validation, the training and validation sets must cross-over in successive rounds in a way that each data point has a chance of being validated against. The basic form of cross-validation is k-fold. Other forms of cross-validation are special cases of k-fold or involve repeated rounds of k-fold cross-validation. Kohavi (1995) also obtained desirable results for 10-fold cross-validation with empirical decision trees (C4.5). Values of K small as 5 or even 2 may work even better if you analyze several different random k-way splits of the data to reduce the variability of the cross-validation estimate.

## 4. Empirical Result

The cross-validated prediction results are presented for each model separately. To study the consequences of different model selection approaches we have applied corresponding statistical method to test the predictive ability of constructed models. In this study, we used 5 fold cross validation method for all models, in our algorithm, each fold generates 6 rules, resulting total 30 rules and then we applied these rules to all available data which are derived from one year prior to bankruptcy .

FM generates the highest accuracy (94.1%) with relatively small standard deviation (0.7%) which implies its low risk regarding bankruptcy prediction. GA ranks second from both accuracy (92.5%) and standard deviation (1.80%) perspective. MLP has lower accuracy (86.4%) comparing to two mentioned methods, but its standard deviation of accuracy is close to LDA (8.83%). Decision Tree (C4.5) has relatively lower accuracy (87.7%) along with higher standard deviation (8.2%). LDA has reached sounded predictive ability (89.6%) despite the fact that its standard deviation of accuracy is higher than FM and GA (8.84%). Type I error is 7%, 10.1% and 10.4% for FM, MLP and GA respectively. However FM's remarking low standard deviation of type I error (0.13%) demonstrates its strong stability in numerous operations, as was expected in benchmark function results. MLP and LDA have much higher deviation regarding type I error, 8.92% and 10.1% respectively. The result from independent sample t-test which is depicted in table 7 shows there is significant discrepancy between average accuracy and type I error of FM and other four models predictions, hence all research hypotheses are accepted.

Hwang (2007) has considered the sum of both error rates (type I and type II) to be important, since type II error can also deteriorate model reliability, and it can further impose opportunity cost to investors, here, type II error for FM is 4.7%, a relatively low rate, however this rate for MLP and LDA is as high as 17.03%, 10.7% respectively. We examined five different classifiers using cross validation. The model presented in this paper is able to classify bankrupt firms from non-bankrupts better than mentioned models, jointed with high degree of stability, higher accuracy and relatively low type I error and II.

## 5. Conclusion

The failure prediction research has suffered from lack of any unified theory since the 1930's when first empirical studies on this subject were published. (Back et al, Ibid). In this paper we proposed a Fuzzy memetic algorithm which

belongs to Hybrid model family. The primary goal of this model was to improve bankruptcy prediction accuracy rate while attempting to reduce occurrence of type I error, not ignoring the consequences of type II error since it can impose opportunity cost to investors. Grice and Ingram (2001) reported that Altman's Z-score model declined when applied to various industries. The samples of this paper are a mixture of different industries and variables used are obtained from firm's financial statements. To achieve the optimal prediction rule, 5 fold cross validation was used while extracting 6 rules from each fold. The empirical results show that the anticipated high degree of accuracy is a valid case. However this research has some constraints in practice since determining a benchmark in order to segregate bankrupt firms from non-bankrupt ones is related to Article 141 of commercial codes of Iran. Thus, applicability of the hypothesized coverage ratio is somehow related to each bankruptcy code in each country. However, it is demonstrated that different model results are somehow caused by its specific constraints, not the very nature of the variables.

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Table 1. Number of bankrupt and non-bankrupt firms

Year	Firms	Bankrupt Firms	Non-bankrupt firms
2001	313	12	301
2002	335	10	325
2003	393	5	388
2004	406	14	392
2005	416	18	398
2006	424	7	417
2007	426	6	420
2008	428	9	419
2009	429	13	416
Firm/Year	3570	94	3476

Table 2. Descriptive statistics and t-test data

Row	Variable	Definition	Min	Max	Mean	Std.dev	T-test
1	C/NS	Cash over net sale	0.003	0.528	0.053	0.070	0.257
2	C/TA	Cash over total assets	0.001	0.889	0.044	0.096	0.851
3	C/CL	Cash over current liabilities	0.002	1.097	0.071	0.135	0.288
4	CA/CL	Current assets over current liabilities	0.007	2.3	1.061	0.381	0.028
5	C/TL	Cash over total liability	0.002	1.011	0.094	0.208	0.042
6	TL/TA	Total liabilities over total assets	0.029	0.945	0.709	0.194	0.00
7	NI/TL	Net income over total liabilities	-0.168	2.472	0.212	0.370	0.00
8	ROS	Net income over net sale	-0.604	1.116	0.138	0.264	0.00
9	ROE	Return on equity	-0.65	3.81	0.331	0.643	0.00
10	ROA	Return on assets	-0.134	0.581	0.091	0.138	0.00
11	NS/TA	Net sale over total assets	0.099	2.613	0.841	0.419	0.074
12	NI/FA	Net income over fix assets	-0.222	59.688	1.948	8.350	0.05
13	OI/TA	Operating income over total assets	-0.141	0.654	0.112	0.141	0.00
14	RE/TA	Retained earnings over total assets	-0.139	0.428	0.070	0.124	0.00
15	EBIT/TA	Earnings before interest and taxes over total assets	-0.054	0.663	0.136	0.139	0.00
16	NS/OE	Net sale over owners' equity	0.368	30.12	4.559	4.109	0.145
17	CA/NS	Current assets over net sale	0.005	7.952	1.101	1.153	0.854
18	Growth	Sale growth in the past 3 years	-0.833	4.498	0.506	0.777	0.177

Table 3. Minimizing 100-dimensional Ackley function

algorithm	Mean	variance	Best result
GA	2.8790e+000	1.9370e-002	2.6665e+000
MA	5.0886e-001	5.9523e-003	3.8527e-001
FM	1.7914e-003	2.2273e-006	4.3375e-005

Table 4. Minimizing 100-dimensional Griewank function

Algorithm	Mean	variance	Best result
GA	2.4330e+000	9.3362e-002	1.9475e+000
MA	9.9118e-001	3.6275e-003	8.2449e-001
FM	6.8825e-004	2.1434e-006	5.9892e-008

Table 5. Minimizing 100-dimensional Rastrigin function

algorithm	Mean	variance	Best result
GA	2.9685e+001	1.3718e+001	2.3188e+001
MA	1.5130e+000	1.0415e-001	8.8490e-001
FM	9.3813e-005	2.0153e-008	1.0623e-010

GA: Genetic Algorithm, MA: Memetic Algorithm, FM: fuzzy Memetic

N: number of dimensions (variables)

Table 6. Cross validation results

Model	Ave accuracy	Type I error	Type II Error	St.dev Accuracy	St.dev Type I
FM	94.1%	7%	4.7%	0.7%	0.13%
GA	92.5%	10.4%	4.80%	1.80%	4.90%
MLP	86.4%	10.1%	17.03%	8.83%	8.92%
C4.5	87.7%	15.5%	8.8%	4.3%	8.2%
LDA	89.6%	11.1%	10.7%	8.84%	10.1%

Table 7. Independent-Sample T-test Results

H1	Ave accuracy	Error Type I	H2	Ave accuracy	Error Type I
FM	94.10%	7%	FM	94.10%	7%
GA	92.50%	10.40%	MLP	86.40%	10.10%
T-test statistics	3.986	3.456	T-test statistics	4.774	2.101
Sig.(2-tailed)	0.000	0.001	Sig.(2-tailed)	0.000	0.048
H3	Ave accuracy	Error Type I	H4	Ave accuracy	Error Type I
FM	94.10%	7%	FM	94.10%	7%
C4.5	87.70%	15.50%	LDA	89.60%	11.10%
T-test statistics	4.01	0.31	T-test statistics	2.744	2.23
Sig.(2-tailed)	0.000	0.025	Sig.(2-tailed)	0.001	0.033

# Multidimensional Analysis for Agricultural Producers' Health Care in Cameroon

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## Abstract

This research evaluates farmers' demand for health care in Cameroon by measuring the degree of access to public health care and estimating health care demand factors'. The methodology involves Lorenz curves' construction, the use of Multiple Correspondence Analysis and the construction of health care's demand model. The database used to produce the results is the Third Cameroonian Household Survey conducted by the National Institute of Statistics. First results indicate that the poorest farmers have less access to public health structures than farmers who are better off. Then, the cost of consultation determines the choice of medical sector for farmers. Farmers who are better off cover less distance to attain medical services than those who are poor. To solve this problem of health care's difficult access for poorest farmers, policymakers should stimulate demand by costs' discriminatory policies in order to give more opportunities to these farmers to get access to public health care.

**Keywords:** Multidimensional analysis, Health care

## 1. Introduction

Health is a basic need. This explains the constant intervention and involvement of public authorities in the field of health. The health sector in most African countries has, since the last decade, a lack of more and more resources. The causes of this under-funding are likely exogenous and endogenous. The external causes are the result of the decrease in general revenues. Endogenous causes include mainly poor policy choices in resources' allocation and structural and managerial weaknesses. In almost all African states, known as the Bamako Initiative (note 1) has sometimes provoked strong reactions since its launching in 1987, particularly with regard to the possible economic exclusion of some people due to pricing and introduction of costs recovery from care users.

In developing countries, most people under the poverty line live in rural areas (World Bank, 1997). Malnutrition and health problems directly affect the ability to work, even in countries that have achieved a high level of economic development. These problems create a vicious circle of low productivity, low wages, malnutrition, diseases, and low work capacities. The World Health Organization (1999) argues that reducing the burden of the disease is its first priority, while a World Bank's (1997) report emphasizes the urgent need for cooperation with countries to reduce the impact of poverty on populations' conditions in terms of health and nutrition, and protect it from the effects of depletion of diseases, malnutrition and high fertility. The agricultural sector is particularly affected because the work remains largely manual or semi-mechanized and thus, closely related to physical capacities. The outdoor work exposes farmers to weather, cold, heat and sun. These factors can cause many problems which, if they don't get strictly into professional diseases' category will lead to absentee, lower productivity and reduce the body's resistance to diseases. Farmers are rarely protected by a system of recording and declaration and are not entitled to social

security benefits unless they adhere to it voluntarily by paying their own contributions. Small health centers and field hospitals in Cameroon, can't offer the same services as the major hospitals of the cities for that attract and retain difficulty their hard staff (Forastieri, 2000). As a result, health status in rural areas is worse than urban centers. Some farm workers live in extremely primitive conditions, in areas where roads are missing or unsuited, making transportation difficult. To meet this challenge, it's appropriate to adopt a multidimensional approach to better understand the obstacles and defects that undermine the consumption of health care for farmers in Cameroon. The multidimensional approach permit to address more broadly but not exhaustive the problem that is to broaden the scope of research. Therefore, the objectives of this work are firstly, to proceed to factorial analysis of health care, secondly, to assess access to health care and finally, to assess health care demand determinants' for farmers in Cameroon's rural sector.

## 2. Literature Review

In Africa, implementation of health reforms' analysis in recent decades all point to the same conclusion: the fair aspect of public health policy has been neglected, and the primary concerns of the actors focused on the effectiveness of organization to set up (Gilson, 2000; Standing, 2002). Experiences in connection with the implementation of public policies in West Africa (Ridde, 2005), particularly in Burkina Faso (Nitiéma and al., 2003; Haddad and al., 2004; Ridde and al., 2005), produce the same results. Thus, understanding the concept of equity, according to the viewpoint of stakeholders, is essential (Ridde, 2006). "In the analysis of efficiency or equity, in the reflection focused on the fight against poverty, the role of values is, of course, preeminent" (Sen, 2000). On the same continent, others have found that indeed the equity in the health care system has become a secondary goal giving priority to financial viability, effectiveness and efficiency (Leighton, 1996). However, equity is a polysemous term and is a concept whose content depends on both the epistemological position of the researcher and the social environment of actors studied (Peter, 2001; Braveman and Gruskin, 2003; Oliver and Mossialos, 2004). To understand the value placed on equity by the Cameroonian and commitment offering, it is essential to know the range of their conceptual definitions.

The concept of health as a very ordinary fully justifies that the distribution of health care is the result of free trade made in a market. Two arguments can be raised, one better suited to the analysis of Nozick (1988), the other to Hayek (1994) ones. Both combine to reject any public redistribution in health care. The market is the only procedure that guarantees respect for individual freedom. Everyone is entirely free to purchase care according to his preferences that is, according to the importance he attaches to his health, according to his attitude towards risk, etc (note 2). The second argument for care access in respect of market's laws relates to the effectiveness of this procedure. Set individual decisions leads to optimal resources' allocation. The Moderate liberalism has the particularity of accepting state's intervention. So the market remains the general rule for acquiring essential goods, partial support may be granted to individual beneficiaries for certain goods. In the contractarian theory of Buchanan (1986), the unjust inequalities are the inequalities of birth: the contractors of the constitutional contract would agree to consider that it's not fair that some people are disadvantaged when they start in life. Unlike at libertarians, the egalitarians admit that the good "health" has a particular value. They also go beyond the moderate Liberals by recognizing a guardian character, therefore justifying more extensive interventions. A first definition of equal access is provided by Le Grand (1982): two individuals have equal access to a good when they have to pay the same "price" for it. By price, we mean not only the monetary price which is in charge of the patient, but also more broadly the price in terms of distance and time. A second definition of equal access is provided by Olsen and Rogers (1991): two individuals have equal access to a good if and only if they can consume the same amount of this good.

Also, despite the speeches of recent decades, the poorest still lack access to health services. Primary health care affordable and accessible for all are essential for human development and a basic duty and of key importance for achieving the Millennium Development Goals (MDGs). A common problem in many Sub-Saharan African countries since the late 1980s is extreme poverty. According to World Bank's (2000) assessment, from 217.2 million people living with less than \$ 1 a day in sub-Saharan Africa in 1987, it rose to 290.9 million in 1998 that is an increase of 34 % in 12 years. During this period, in South Asia, it increased from 474.4 to 522 million that is an increase of 10%. In East Asia and Pacific region, poverty has declined more. The number of people living with less than \$ 1 a day felt from 452.4 million in 1990 to 265.1 million in 1996. In fact, for the UNDP (2001), the sub-Saharan Africa is lagging behind others: not only the income and human poverty remains considerable, but also, the adults' literacy rate there is still only 60 percent and life expectancy at birth stand on 48.8 years. Thus, sub-Saharan African countries are in their majority, countries with lowest Human Development Index (HDI); those who have medium HDI come at the end of list of these category countries.

Cameroon is among the countries with medium Human Development Index, with a HDI of 0.500, since the 1990s. The strong poverty reduction recorded during the period 1996-2001 has been replaced by a quasi-stability of income

poverty between 2001 and 2007. The stability of the observed poverty at the national level masks a striking contrast between areas of residence. In urban areas, in fact, the poverty rate which was 17.9% in 2001 declined by 5.7 points over the period 2001- 2007, when he was quite up by 3 points in the rural areas, and stand at 55.0% in 2007 (INS, 2008). The worsening of the situation observed in rural areas is partly explained by the fact that the earned income didn't increased at a sufficient rate to enable farmers to maintain their purchasing power. Indeed, the purchase price to producers has not evolved to enable farmers to maintain their living standards. Moreover, this is due to low yields and difficulties in selling their products at remunerative prices. The attention to equity dimension of health care is particularly important in Cameroon, due to widespread poverty. However, the economic transition process, heavily dependent on resource endowments, cash crops and food crops, livestock exports, and strong current of emigration to neighboring countries and hampered by a multitude of constraints, there is a very low level of human development and poverty sustainably.

### 3. Methodology

Here, we are going to first of all to dwell at length on data's' source before elaborating the methodology itself.

#### 3.1 Data Source

The data used in this research are those from the Third Cameroonian Household Survey (ECAM III) which was conducted by the National Institute of Statistics (INS) in 2007. This is the most recent database on households in Cameroon. It provides a range of variables necessary to carry out this work because it covers the whole Cameroon and also, provides information on households' situation by sector and by place of residence. We have to underline that in this study, we are interested by agricultural households in rural sector that is households which heads of family activity is agriculture. It's also important to notice that the study stand on agricultural households and not on agricultural industries. The total size of investigated farm heads household is 4 275.

#### 3.2 Construction of Health Care Access Indicator

Multidimensional analysis techniques also known as factor analysis are used to construct an indicator which weighting contained in the functional form of the indicator are less arbitrary. The main advantage of this method stand on the fact that it eliminates the assigning scores arbitrary nature. Thus, it leaves little room for subjectivity. This approach is called inertia approach because it comes from the static mechanics. It uses Multiple Correspondence Analysis (MCA) techniques in the case of individuals array characterized mainly by qualitative variables. The basic idea is to summarize the information provided by these qualitative indicators in just one composite index. In this work it is proposed to use a third variant of analysis factor, namely the MCA as suggested and presented by Asselin (2009). Two reasons for this choice: i) this method is more suitable to the nature of our data including a set of categorical variables presented below in the appendix and representing the different modalities that can take the primary indicators that reflect households' living conditions, ii) several studies on the measurement of living standards in Africa have been performed using this method: Ayadi and al. (2005) for Tunisia; Ki and al. (2005) for Senegal, Foko and al. (2007) for Cameroon. Analyses will be performed with the SPAD software. The variables are summarized in Table 4 in annex.

#### 3.3 Measurement of Equity in Public Health Care Access

Public spending goal is in general to provide opportunities to the most disadvantaged groups and improve their social and economic position. It is important to know whether these expenditures are more or less directed towards these groups. It's to solve this problem that the well-being economic literature proposed two main approaches: the first focuses on the need to measure individual preferences for the goods in question based on microeconomic theory (Glewwe and Patrinos, 1998). This approach, however, requires too much data and implies a precise knowledge of individuals and households' demand functions; the second approach is the analysis of the impact of earnings (Demery and al., 1995). This method combines the analysis of requirements and expenditures required for the production of public services with information on accessing these services in order to deduce how the gains are distributed among individuals or households. It's based on the idea that households which get access to a public health center benefit from a subsidy to compensate for their lack of resources. It is also based on the assumption that the distribution of spending between socioeconomic groups depend on:

- The allocation of resources to and within the sector concerned, that is the average spending per user of the service;
- The level of access for different groups of household structures and services available to them that is access rates per socioeconomic group.

Concerning access to care, it's suitable to describe the inequality by the rate of care access, their cost, measured by personal care spending or health spending. Equality will be said perfect if the cumulative frequencies' curve merges



with the first bisector ones. The inequality is proven if the cumulative frequencies' curve is faraway from the first bisector.

### 3.4 Specification of Health Care Demand Equation

The dependent variable HCD (health care demand) takes the following procedure: 1.00 = public sector, 2.00 = formal private sector and 3.00 = informal sector. The public sector includes: first class hospital, provincial hospital, district hospital, the medical center sub-division and the integrated health center. While the formal private sector includes: pharmacy, clinic / medical office and ICG / NGO health. Finally, the informal sector includes: traditional healers, informal vendors and other. The equation of health care demand is then presented as follows:

$$HCD_i = \alpha_0 + \alpha_1 headsex_i + \alpha_2 headage_i + \alpha_3 edulevel_i + \alpha_4 cost_i + \varepsilon_i \quad (1)$$

Where *headsex<sub>i</sub>*: producer head household's sex, *headage<sub>i</sub>*: its age; *edulevel<sub>i</sub>*: level of education and *cost<sub>i</sub>*: the cost of consultation.  $\varepsilon_i$  is the error term and  $\alpha_i$  ( $i = 0, 1, 2, 3, 4$ ) parameters to be estimated. The dependent variable is qualitative and having more than two unordered terms, equation [1] can be estimated only by the unordered multinomial logit. The multinomial logit model is a direct generalization of the logit model that can be used to treat any situation with three or more unordered qualitative responses. More detailed treatments are presented in the synthesis articles; see especially Greene (1990), among others.

## 4. Empirical Results

The results of the MCA are contained in Figure 1 in annex. These results indicate that farmers who are better off of the fifth quintile of the spending are located in the first quadrant. They are consulted in provincial hospitals usually located in the major regions of Cameroon. They bear the higher costs of consulting and choose the public, private, confessional and parapublic sectors for their need of consultation. These producers put forwards as reasons for choosing these areas of consultation: service quality and proximity. They are consulted by the doctor, health staff and the nurse. In addition, they cover the least distance to attain integrated health centers (IHC), district hospitals (DH) and pharmacies (PH). They therefore have the highest annual health spending. The main reasons for the consultation sector's choice are: The family decision and relationships. They are some of the visually impaired and speech disabilities. Some producers say that they have done the HIV's test and others accept to do it. Education levels of these producers are: higher level, secondary second cycle and secondary first cycle.

Agricultural producers have-nots of the second quadrant are consulted by the traditional healers and informal vendors of drugs. Customs and beliefs are the main reasons for the choice of the consultation sector. They have a low cost of consultation, but their health spending is higher. These producers suffer from malaria, diarrhea and respiratory diseases. Some of these producers are handicapped. Among the handicaps, we have the hearing impairment, motor, mental and other disabilities not specified. They cover quite long distance to attain district hospitals and pharmacies. Even though farmers of the third quadrant seem not to be concerned by the care demand during investigations because according to them, they don't know if they have been sick, they are however faraway from health services and pharmacies and therefore have the lowest health costs. They have never done the HIV test. While in the fourth quadrant, the producers say they are not sick and as result, answer don't know (DK) if they are suffering from malaria, respiratory diseases, diarrheal disease, get tested for HIV / AIDS and don't know the distances from their homes to health centers and pharmacies. However, in view of the graph, it's difficult to locate the men and women. But men are much more localized in the third quadrant of producers not knowing their health status while women belong more to the second quadrant of producers who reported having been ill and consulted.

Figure 2 in annex shows the percentage of access to care in public health facilities. The farmers have more access to health facilities integrated and the district hospitals. These public health facilities are those located in rural areas of Cameroon. While the medical center sub-division is in the heads of departments. In addition, hospitals of first class and provincial hospitals are respectively installed in towns especially, in the two major cities of Cameroon (Douala and Yaounde). It's therefore easy to understand why the poor farmers can't easily afford the care in these others public health centers.

The Lorenz curve in Figure 3 in annex shows that cumulative frequencies curve of health spending is below the total expenditures one: the proportion of this expenditure in total expenditure is low. In this perspective, the inequality in health spending is chronic, because the concentration area, the area between 0 and 1, different curves and the 45 degrees straight line is great. The poorest farmers have a very insignificant level of health spending compared to the richest ones. It's important to underline that health expenditures include curative care expenditures, preventive care expenditures and others spending that contribute to improve health state. It's therefore possible to easily understand why the poorest farmers allocate just a bit of their spending to health demand. But in general, farmers in rural areas don't devote enough of their income to health care consumption. However, the yield curve of public health care

access shows that access is inequitable between different social classes. Even though the area between the first bisector and the rates curve is small, farmers of the poorest households have however less access than farmers in the richest ones.

Figure 4 in annex shows the percentages of care demand in different areas of consultation. It appears that the public sector is the most area frequented by the farmers followed by the informal sector.

According to Table 1 in annex, in average, patients pay 4 050 CFAF for consultation. The standard deviation of consultation cost is high, indicating a wide dispersion around the mean costs. At a minimum, some patients don't bear any consultation cost while others spend up to 99 999 CFAF. The head of household's education level is a categorical variable: minimum 1.00 = not schooled, 2.00 = primary, 3.00 = secondary 1st cycle, 4.00 = secondary 2nd cycle and the maximum 5.00 = higher level. Also, the variable sex of producer is divided into: 1.00 = male, 2.00 = feminine. At a minimum, the producers have 15 years and at a maximum 99 years. However, the average age of household heads is 46 years.

The tests of likelihood ratios contained in Table 2 in annex show that all variables require a special analysis because they are all significant at 1%.

The results in Table 3 in annex show that in the public sector, the consultation cost's parameter is significantly different to zero at the 1%. It's therefore a significant variable in public sector care's demand. Because its parameter is zero, we then look at the odds ratio using the formula  $[\text{Exp}(B) - 1] * 100$ . It follows that a producer has a zero chance of being consulted in the public sector and a 100% probability of being consulted in the informal sector further to the increased of one unit of consultation's cost. The existence of informal sector is a palliative for the costs of seeking care. The poorest people will take an informal route treatment. Given not only the theoretical hypothesis put on the determinants of care's demand, but also on lessons learned by others applications in developing countries (Bitran and Mcinnes, 1986; Mwabu and al., 1993). It's first opportune to take into account economic factors that influence the key decision of an effective resort to patients' care. The age variable has a parameter significantly different to zero at the 1%. By applying the above formula, a farmer has a 1.7% higher chance of being consulted in the public sector than in the informal sector if his age increases by one year. The age of the parents, as well as that of the individual patient may have a positive effect on households' decision of using health care. This is an approached variable of experience accumulation in health care (Barcat, 1998). The effect will be negative if the age is an indicator of senility, adults tiredness or obsolescence, inefficiency of the techniques learned (Bishai, 1996). The "not schooled" variable has a coefficient significantly different to zero at 1%. A not schooled farmer has a probability of 90.8% lower to be consulted in the public sector compared to a farmer of higher level. Furthermore, the parameter of the modality "primary" is significantly different to zero at 5%. Thus, a primary level farmer offers a 78% probability less than the higher level farmer one for being consulted in a public sector. In addition, the modality "secondary first cycle" shows a coefficient significantly different to zero at 10%. Thus, the probability for a farmer with secondary first cycle level to be consulted in the public sector is 72.3% less than a farmer with higher level one. In other words, not schooled farmers or primary and secondary levels ones are more likely to be consulted in the informal sector than the higher level farmers. Regarding the influence of education of the person responsible for the household, Schultz (1984) states that education has a direct impact on the acquisition of knowledge in health and hygiene domains. The gender variable has a coefficient significantly different to zero at 1%. Thus, being male farmer offers 36.6% less chance to get access to public health care than being a female farmer.

In the formal private sector, the nullity of the cost consultation parameter indicates that an additional unit of consultation cost leads to a null chance of demanding for health care in the private sector, in the benefit of the informal sector. GoM's (2000a, 2000b) studies show that the demand for care in the formal sector highly depends on the household's living standards. The parameter of farmer's age variable indicates a positive effect in the health care demand in private sector. An additional year gives the opportunity to a farmer for being consulted in the private sector than in the informal sector. In the same logic, the negative signs of the parameters of each category of education level show a negative effect on care's demand in private sector. In other words, a not schooled farmer presents less chance to choose private sector for his consultation needs than a higher level farmer. Moreover, farmers with higher level have more chance to choose private health facilities than lower educational level ones. Kenkel (1994) shows that individuals with low incomes have also more often a low level of education. Anyway, people say they have renounced to care about financial reasons (Bocognano and al., 1999). Also, being male farmer decreases its ability for being consulted in private sector in benefit of informal sector.

## 5. Conclusion

The objective of this research was to assess the degree of accessibility and demand for health care of rural farmers in Cameroon. To achieve this goal, firstly, we quantified the equity of access to public health care. Secondly, we

estimated the equation of health care demand. In addition, the Lorenz curves construction allowed us to classify farmers by living standards and degree of accessibility to public health care. While the multinomial logit method was used to estimate the equation demand in health care. The most convincing results were as follows:

The poorest farmers allocate just a bit of their spending on health care acquisition. One's notices that access to public health care services is unfavorable for the poorest farmers. Thus, only 6% of poorest farmers access to public health care against 14% for the richest ones. Proximity is the main reason for the choice of the public sector, but the consultation cost remains a concern for farmers. However, the cost of consultation appears to be the main reason for the choice of informal sector. Thus, in order for the public sector to attract farmers from informal sector, government should revise its policy of consultation costs fixing. In this perspective, it should adopt a discriminatory policy of consultation costs for the poorest farmers. This policy should be sustained by a policy of "bringing nearer" most distant farmers public health services.

Moreover, consultation cost is the main factor that negatively influences health care demand in the formal sectors. Thus, the additional unit of consultation cost involves farmers in the informal sector for their health needs. As consequence, a farmer has a null chance of being consulted in the public and formal private sector and a 100% probability of being consulted in the informal sector further to the increased in unit of consultation cost. However, a not schooled farmer has a less 90.8% probability for being consulted in the public sector than a higher level farmer. In the same way, a not schooled farmer presents less chance to choose the formal private sector for its consultation needs than a higher level farmer. This last result confirms the importance of education in health care application. The most educated farmers have probably been informed of the need for being consulted in the formal sectors. It was also agreed that most educated farmers have the highest levels of income necessary to guarantee their health care needs in formal sectors. In this regard, the Government should put in its social policy, education as a priority despite of the many constraints the state is facing.

The Cameroon, having reached the completion point of the initiative for heavily indebted poor countries benefit a greater scope for its economic policy in general and social policy in particular so, it's imperative to put access to health care at the forefront of its concerns. To achieve this, economic and structural changes must be driven, especially in the development of the medical sector not only because health strengthens the productive capacities and thus, raises the income, but also because Cameroon pursues the objectives of Millennium Development Goals which first objective is to halve extreme poverty and hunger by 2015. Improve agricultural performance in this context requires that we give more attention to programs which goal is to increase agricultural productivity and competitiveness. Such programs need to remove obstacles from health care access in the formal sectors, build complementarities between formal and informal medical sectors and continue the reform of the institutions necessary for medical sector's emergence. These goals are long-run fundamentals in the medical development in Cameroon.

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### Notes

Note 1. Every individual makes a choice between these needs and defines its basket price based on various goods and the value that these preferences attribute them, and, ultimately, according to its budget constraint.

Note 2. Which backbone is primary health care.

Table 1. The exogenous variables in the demand for health care

Exogenous variables	Valid N	Mean	Standard deviation	Minimum	Maximum
Sex of the producer	4 275	1.28	.450	1.00	2.00
Age of the producer	4 275	45.96	15.794	15	99
Cost of consultation	1 787	4 049.58	18 375.344	0	99 999
Educational level of the producer	4 275	1.9413	.95184	1.00	5.00

Source: Results from the study.

Note: Valid N is the number of valid observations. With 1 USD = 500 CFAF.

Table 2. Tests of likelihood ratios of the demand for health care

Effect	-2 log-likelihood of reduced model	Chi-square	degrees of freedom	Significance
Constant	2 627.081 <sup>(a)</sup>	.000	0	.
Cost of consultation	2 653.634	26.552	2	.000
Age	2 647.490	20.408	2	.000
Educational level	2 712.660	85.579	8	.000
Sex	2 645.665	18.584	2	.000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect of the final model. The hypothesis is zero if all the parameters of this effect are zero. (a) This reduced model is equivalent to the final model because omitting of effect does not increase the degrees of freedom.

Source: Results from the study.

Table 3. Parameter estimates of the demand for health care

Consultation sector <sup>(a)</sup>		B	Erreur std.	Wald	Degrees freedom	Signif.	Exp (B)
Public	Constant	2.024	.768	6.955	1	.008	
	Cost of consultation	.000	.000	10.486	1	.001	1.000
	Age	.017	.004	19.660	1	.000	1.017
	Not schooling	-2.388	.747	10.224	1	.001	.092
	Primary	-1.512	.745	4.116	1	.042	.220
	Secondary 1 <sup>st</sup> cycle	-1.285	.754	2.903	1	.088	.277
	Secondary 2 <sup>nd</sup> cycle	-.917	.779	1.383	1	.240	.400
	Higher	0 <sup>(b)</sup>	.	.	0	.	.
	Masculine	-.456	.123	13.742	1	.000	.634
Feminine	0 <sup>(b)</sup>	.	.	0	.	.	
Private	Constant	1.290	.857	2.268	1	.132	
	Consultation cost	.000	.000	6.525	1	.011	1.000
	Age	.015	.006	5.635	1	.018	1.015
	Not schooling	-3.290	.815	16.299	1	.000	.037
	Primary	-2.362	.806	8.585	1	.003	.094
	Secondary 1 <sup>st</sup> cycle	-2.321	.828	7.852	1	.005	.098
	Secondary 2 <sup>nd</sup> cycle	-1.695	.865	3.839	1	.050	.184
	Higher	0 <sup>(b)</sup>	.	.	0	.	.
	Masculine	-.686	.192	12.714	1	.000	.503
Feminine	0 <sup>(b)</sup>	.	.	0	.	.	

Source: Results from the study.

Note: The reference modality is: 3.00 = informal sector. (b) This parameter is reset to zero because it is redundant. Number of observations: 1 784.

Table 4. List of attributes of the MCA

<i>Sex of producer</i>	<i>Is the victim of a handicap</i>	<i>Main handicap</i>	<i>Ill during the last two weeks</i>	<i>Had a consultation for this disease</i>
Masculine	Yes handicapped	Visual handicap	Yes was sick	Yes was consulted
Feminine	Not	Hearing impairment	Not been sick	No was not consulted
<i>At present attains at malaria</i>	<i>Appreciation of its current health</i>	Mental disability	Don't know if was sick	<i>Currently achieved by a diarrheal illness</i>
Yes attains malaria	Good	Motor disability	<i>Tranche of age</i>	Yes achieved
Not	Good enough	Deaf-mute	Under 30	Not
Don't know if achieved of malaria	passable	Other handicaps	30-39 years	Don't Know if achieved
	Bad		40-49 years	diarrhea
			50 years and	
<i>Person who has consulted for the disease</i>	<i>Consultation sector</i>	<i>Main reason for choice the consultation sector</i>	<i>Type of structure chosen for the consultation</i>	<i>Accept do / repeat test for HIV / AIDS</i>
Pharmacist	Parapublic	Acceptable cost	First class hospital	Yes accepted
Doctor	Private secular	Proximity	Provincial hospital	does not accept
Health personnel	Private confessional	Family decision	District hospital	DK if accept
Traditional practitioner		Custom / belief	Medical Center	Undeclared
Seller informal	<i>Currently achieved by a respiratory illness</i>	Quality of service	sub-division	<i>Level of education of producer</i>
Other	Yes achieved of respiratory disease	Relationship	Integrated Health Centre	Not schooling
<i>HIV testing done</i>	Not	Other	Pharmacy	Primary
Yes tested for HIV / AIDS	DK if achieved respiratory disease	<i>Quintile of per capita expenditure</i>	Clinical / medical office	Secondary 1st cycle
Not tested for HIV / AIDS		Poorest	School nurse	secondary 2nd cycle
DK if tested for HIV / S		Second class	Home / visit of the doctor	Higher
Undeclared		Third class	To go to traditional practitioner	
		Fourth Class	ICG / NGO Health	
		Richest	The seller informal	
			Other	
<i>Cost of consultation</i>	<i>Distance district hospital (DH)</i>	<i>Distance Integrated Health Centre (IHC)</i>	<i>Distance from the pharmacy (PH)</i>	<i>annual health expenditure</i>
Cost of 000-600	Less than 500m	Less than 500m	PH less than 500m	Health expenditure
Cost of 650-2 000	Distance 1-4km	Distance 1-4km	Distance PH 1-4km	0-19 967
Cost of 2 300-4 700	Distance 5-10km	5-10km distance	Distance PH 5-10km	Health expenditure
Cost of 5 000-10 000	Distance 11-15km	Distance 11-15km	Distance 11-15km	20 000 – 79 987.66
Cost of 10 100-99 997	Distance 16-19km	Distance 16-19km	Distance 16-19km	Health expenditure
Cost DK	DK Distance DH	DK Distance IHC	Distance 20-30km	80 000 – 159 900.99
			Distance 32-40km	Health expenditure
			Distance 42-70km	160 000-595 200
			Distance 72-90km	Health expenditure
			Distance PH DK	600 000 – 3 797 477.14

Source: Results from the study.





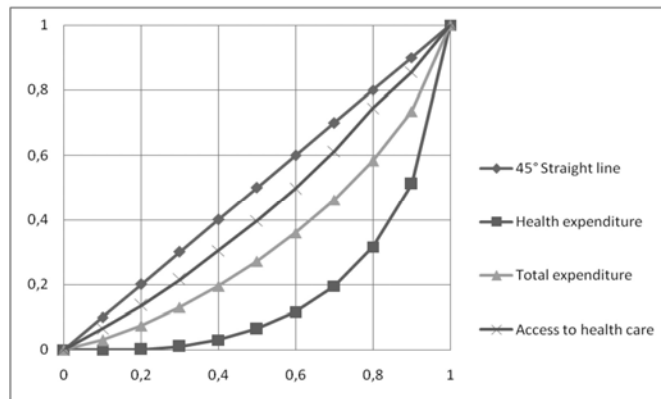


Figure 3. Lorenz curve of cumulative frequencies  
Source: Results from the study.

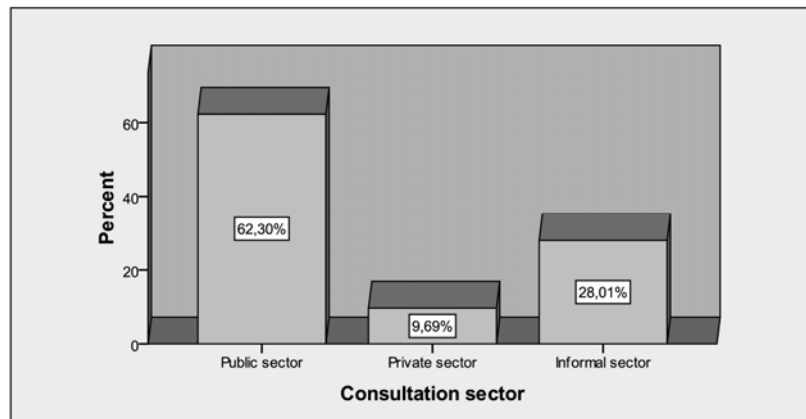


Figure 4. Statistics dependent variable's modalities  
Source: Results from the study.

# The Usefulness of an Accounting Information System for Effective Organizational Performance

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## Abstract

The aim of this study is to investigate usefulness of accounting information system (AIS) for effective organizational performance. AIS is the whole of the related components that are working together to collect, store and disseminate data for the purpose of planning, control, coordination, analysis and decision making. Therefore, impact of AIS on elements of organizational performance such as: performance management and financial performance is examined. The results of this study show that although AIS is very useful and have effect on organizational performance to listed companies in Dubai financial market (DFM) but, there is no relationship between AIS and performance management.

**Keywords:** Accounting information system, Financial performance, Performance management, Organizational performance

## 1. Introduction

Accounting Information Systems (AIS) are a tool which, when incorporated into the field of Information and Technology systems (IT), are designed to help in the management and control of topics related to organization's economic-financial area. But the stunning advance in technology has opened up the possibility of generating and using accounting information from a strategic viewpoint (El Louadi, 1998). Accounting Information System (AIS) is vital to all organizations (Borthick and Clark, 1990; Curtis, 1995; Rahman *et al.*, 1988; Wilkinson, 1993; Wilkinson *et al.*, 2000) and perhaps, each organization either profit or non profit-oriented need to maintain the AISs (Wilkinson, 2000: 3-4). On the other hand, an AIS is the whole of the related components that are put together to collect information, raw data or ordinary data and transform them into financial data for the purpose of reporting them to decision makers (Mahdi Salehi, vahab rostami and Abdolkarim Mogadam, 2010). To better understand the term 'Accounting Information System', the three words constitute AIS would be elaborated separately. Firstly, literature documented that *accounting* could be identified into three components, namely information system, "language of business" and source of financial information (Wilkinson, 1993: 6-7). Secondly, *information* is a valuable data processing that provides a basis for making decisions, taking action and fulfilling legal obligation. Finally, *system* is an integrated entity, where the framework is focused on a set of objectives (Bhatt, 2001; Thomas and Kleiner, 1995).

Accounting literature argues that strategic success is considered an outcome of Accounting Information System's (AIS) design (Langfield-Smith, 1997). Several, studies have analyzed the role of AIS in strategic management, examining the attributes of AIS under different strategic priorities (Ittner and Larcker, 1997; Bouwens and Abernethy, 2000). It has also been analyzing the effect on performance of the interaction between certain types of strategies and different design of AIS (e.g. different techniques and information). The appropriate design of AIS supports business strategies in ways that increasing the organizational performance (Chenhall, 2003). Increasing AIS investment will be the leverage for achieving a stronger, more flexible corporate culture to face persistent changes in the environment. Innovation is the incentive with which a virtuous circle will be put in place, leading to better firm performance and a reduction in the financial and organizational obstacles, while making it possible to access capital markets. AIS are systems used to record the financial transactions of a business or organization. This system combines the methodologies, controls and accounting techniques with the technology of the IT industry to track transactions provide internal reporting data, external reporting data, financial statements, and trend analysis capabilities to affect on organizational performance (Elena Urquia Grande, Raquel Perez Estebanez and Clara Munoz Colomina, 2010).

In managing an organization and implementing an internal control system the role of accounting information system (AIS) is crucial. An important question in the field of accounting and management decision-making concerns the fit of AIS with organizational requirements for information communication and control (Nicolaou, 2000). Benefits of accounting information system can be evaluated by its impacts on improvement of decision-making process, quality of accounting information, performance evaluation, internal controls and facilitating company's transactions (H. Sajady, M. Dastgir and Hashem Nejad, 2008). Therefore, regarding the above five characteristics, the effectiveness of AIS is highly important for all the organization performance. According to Adrian Downes and Nick Barclay (2008) performance management is a quick maturing business discipline. Therefore, performance management has a key role to play in improving the overall value of an organization. Control efficacy of financial information reliability has affected operating performance (Ming-Hsien Yang, Wen-Shiu Lin and Tian-Lih Koo, 2011).

Prior researches have shown that accounting information system adoption does increased firm's performance, profitability and operations efficiency in Malaysia, Spain, Finland, Pakistan and Iran (S. Kharuddin, Z. Ashhari and Nassir, 2010; E. Grande, R. Estebanez and C. Colomina, 2010; Gullkvist, B., 2002; R. Kouser, A. Awan, G. Rana and F. Shahzad, 2011; H. Sajady, M. Dastgir and H. Hashem Nejad, 2008). In United Arab Emirates (UAE) information society and the new computer tools have allowed the companies to make better use of their accounting system in their relations with suppliers and customers. In the same way the development of the AIS and electronic banking allows the companies to save a lot of time in their transaction ([www.ameinfo.com](http://www.ameinfo.com)). Thus, the present study attempts to provide some clarification of the relationship between AIS design, organizational strategy and performance especially on financial performance and performance management.

This study has focused on 74 firms operating till the first quarter of 2011 as per listed companies at Dubai Financial Market (DFM) in Dubai, UAE ([www.dfm.ae](http://www.dfm.ae)). In accordance with several authors, it is of great interest to analyze the usefulness of AIS on financial performance like economic and financial profitability indicators (Return on Assets (ROA) and Return on Equity (ROE)) of firms.

The structure of this article is as follows: Section 2 reviews the relevant literature and develops hypotheses about relationships between AIS, organizational strategy and performance. Section 3 describes the empirical methodology. Section 4 present results from the statistical analyses of hypotheses. Finally, section 5 presents the discussion and conclusion of this study, provides the limitations of the current study, and points out some directions for further research.

## 2. Literature Review

The main advantages of an optimal use of AIS in an organization are: better adaptation to a changing environment, better management of arm's length transactions and a high degree of competitiveness. There is also a boost to the dynamic nature of firms with a greater flow of information between different staff levels and the possibility of new business on the network and improved external relationships for the firm, mainly with foreign customers accessed through the firm's web (Elena Urquia Grande, Raquel Perez Estebanez and Clara Munoz Colomina, 2010).

For the first time in 1966, the American Institute of Certified Public Accountants (AICPA) stated that: "Accounting actually is information system and if we be more precise, accounting is the practice of general theories of information in the field of effective economic activities and consists of a major part of the information which is presented in the quantitative form".

In the above definition, accounting is a part of a general information system of an economic entity. Boochholdt (1999) defines accounting information systems as systems that operate functions of data gathering, processing, categorizing and reporting financial events with the aim of providing relevant information for the purpose of score keeping, attention directing and decision-making.

Recently several studies have asserted that AIS plays a proactive role in the strategy management, acting as a mechanism that enables organizational strategy (Chenhall, 2003; Gerdin and Greve, 2004). Strategy has been examined using different typologies, such as Porter (1985) or Miles and Snow (1978). The latter has been extensively used in management literature (Zajac and Pearce, 1990). In the present study it is assumed that the organizational performance is a function of the financial performance, performance management and the AIS. Fitness will exist in the combination of strategy and AIS that contribute to financial performance.

### 2.1 AIS and Financial Performance

The AIS design can be defined in terms of the information characteristics that it provides (Chenhall and Morris, 1986; Gul, 1991). Chenhall and Morris (1986) described AIS according to the perceived usefulness of four information attributes, namely scope, timeliness, level of aggregation, and integration. Scope refers to the measures being used and to the extension of AIS in time and space. Then information could focus on future vs. historical

events or external vs. internal events. Also the information could be quantified in monetary or non-monetary terms. Timeliness refers to the frequency, speed of reporting and the orientation of the information (e.g. short or long run). Aggregation refers to the way data is aggregated in time periods, functions or in accordance with decision models. Finally, integration refers to the need of providing information to reflect the interaction and coordination effects of several functions in the organization. These four attributes have been analyzed for comparing AIS and organizational strategies and performance (Gerdin and Greve, 2004). Only recently have studies begun to examine whether organizations systematically vary the AIS design to support their chosen strategy, recognizing that AIS have the potential to facilitate strategy management and enhance organizational performance (Gerdin and Greve, 2004).

Appropriate review between designing of AIS and performance of commercial units by analyzing strategies explains that high performance of commercial units depends on a wide range of accounting information systems (Boulianne, 2007). So many studies begun to examine whether organizations systematically vary the AIS design to support their chosen strategy, recognizing that AIS have the potential to facilitate strategy management and enhance organizational performance (Gerdin and Greve, 2004).

Existing literature offers scant evidence of the relationship between these AIS and financial performance; though it is important to highlight the study made by Elena Urquia Grande, Raquel Perez Estebanez and Clara Munoz Colomina (2010) which discovered a positive association between AIS design and organizational strategy and performance. The successful implementation of AIS could save shareholder's money and time. The information value generated by AIS to shareholders and stakeholders in making investment decisions (Zulkarnain Muhamad Sori, 2009).

Financial managers need the financial and accounting data provided by AIS to evaluate the firm's past performance and to map future plans. Therefore, the organizational performance is measured in terms of ROA (Return on Assets) and ROE (Return on Equity) these ratios are financial performance measuring ratios (Sadia Majeed, 2011).

Return on equity is a key to provides useful information about the performance of debt in the capital structure that the general manager must try to influence in order to improve financial performance (Alan Miller, Michael Boehlje and and Craig Dobbins, 2001).

If AIS design can be linked to financial performance and financial performance is linked to organizational performance, then we can argue that AIS design can be expected to have positive effects on organizational performance through ROA and ROE. However, other researchers such as Ismael Younis Abu-Jarad, Davoud Nikbin and Nor Aini Yusof (2010) supported the use of Return on Assets (ROA), Return on Equity (ROE) as the most common measures of organizational performance. Therefore, we formulate the following hypotheses.

H<sub>1</sub>: Use of an accounting information system (AIS) will lead to have better economic and financial performance.

H<sub>2</sub>: There is a positive relationship between financial performance and organizational performance.

H<sub>3</sub>: There is a positive relationship between AIS and organizational performance.

## *2.2 AIS and Performance Management*

Existing literature offers scant evidence of the relationship between AIS and performance management. Accounting information systems are considered as important organizational mechanisms that are critical for effectiveness of decision management and control in organizations (H. Sajady, M. Dastgir and H. Hashem Nejad, 2008). Accounting Information System (AIS) as one of the most critical systems in the organization has also changed its way of capturing, processing, storing and distributing information. Nowadays, more and more digital and on-line information is utilized in the accounting information systems (Huang, Lee and Wang 1999, Clikeman 1999).

Performance management (PM) includes activities that ensure that goals are consistently being met in an effective and efficient manner. Performance management can focus on the performance of an organization (<http://en.wikipedia.org>). Accounting systems affect behavior and performance management and have affects across departments, organizations, and even countries (Noellette Conway, 2009).

Management is engaged with different types of activities which require good quality and reliable information. Quality information is one of the competitive advantages for an organization. In an accounting information system, the quality of the information provided is imperative to the success of the systems (Hongjiang Xu, 2010). Quality of information generated from AIS is very important for management (Essex and Magal, 1998). Business organizations often use accounting information systems to provide support for management decisions. Support usually includes financial analysis from company accountants. Analysis is often taken for the company's accounting information

system. Using business technology, this system can process copious amounts of documents electronically for owners and managers (Osmond Vitez, 2011).

Management compares information about current performance to budgets, forecasts, prior periods, or other benchmarks to measure the extent to which goals and objectives are being achieved and to identify unexpected results or unusual conditions that require follow-up. In the same way that managers are primarily responsible for identifying the financial and compliance risks for their operations, they also have line responsibility for designing, implementing and monitoring their internal control system (www.ucop.edu). Internal controls typically center around the company's accounting information system, which is the primary function for moving financial information through a company. Therefore, internal controls help managers to monitor and measure the effectiveness of their accounting operations on performance (Osmond Vitez, 2010).

Performance management has a key role to play in improving the overall value of an organization (Armstrong and Baron, 1998). Accounting systems are often the most important formal sources of information in industrial organizations. They are designed to provide all levels of management with timely and reasonably accurate information to effect on performance management and help them make decisions which are in agreement with their organization's goals (Anthony G, 2006). Organizational performance is one of the most important constructs in management research (Pierre J. Richard, Timothy M. Devinney and George S. Yip, 2008).

Thus, the relationship between AIS and organizational performance would be moderated by the performance management. According to the pervious argument we analyze the contingency fit between AIS, performance management and organizational performance using accounting data, decision making and internal control process. Therefore, we formulate the following hypotheses:

H<sub>4</sub>: There is a positive relation between AIS and performance management acting through accounting data, decision making and internal control process.

H<sub>5</sub>: there is positive relation between performance management and organizational performance.

The Fig.1 is developed on the basis of theoretical framework as mentioned above (appendix A).

### 3. Research Methodology

According to Jassim Al Shamsi (2007) the federal government of United Arab Emirates, led by the Ministry of Finance and Industry, has been introducing a number of initiatives aimed at modernizing public resources management and improving the efficiency and effectiveness of federal government spending in forty ministries and autonomous agencies. The initiatives include strengthening the strategic budgeting process and introducing performance based budgeting across the federal government, modernizing the accounting and information system used government financial management and improving efficiency in cash management. Therefore, data were collected through questionnaire from 74 firms as per listed companies at Dubai Financial Market (DFM) which is subset of one of the forty ministries and autonomous agencies that led by the federal government of United Arab Emirates (www.dfm.ae).

#### 3.1 Measures

The questions were on the five point Likert-type questions, with a choice of strongly agree to strongly disagree. Further the questionnaire consisted of 2 sections. The first section focused on demographics of the target audience. The second section covers main questions. The questionnaire consisted of twenty one questions, which were carefully designed to collect relevant data (See Appendix A). These companies are distributed along fifteen industries. Our sample has been randomly selected using sampling with no replacement process.

#### 3.2 Data Collection

The method of data collection is a crucial aspect in any research because imprecision in the methods of data collections would adversely affect the result of the study and hence provide the result that are invalid. There are many types of data; the major types are primary and secondary data.

Totally 271 questions sent to concern responses were listed as the accountants, financial managers and direct managers of the firms sampled. A reminder was sent and non-respondents were followed up with two additional mailings. During the first questionnaire launching, 154 questionnaires were completed and returned. In the second and third mailings, a total of 82 more completed questionnaires were returned. Altogether 236 questionnaires were available for data analysis.

## 4. Empirical Results the Studies

### 4.1 Description the Demographic Profile of the Sample

In order to analyze the data, which was collected through questionnaires different statistical tools, were used. For that purpose, the information gathered was analyzed using the SPSS software version 17.0. According to the results of the demographic questionnaire, the following summary information about the profile of the sample is presented.

In terms of education, 16.1 percent of the samples were PhD, 38.1 percent were Masters and 45.8 percent were Bachelors (see Table 1). To conclude, majority of participants in this study had bachelor degrees. In terms of experience, 25.8 percent of the responses had less than 4 years, 51.3 percent had between 5 to 9 years and 22.9 percent had more than 10 years experience (see Table 2).

Refer to Tables 1 and 2 which show the respondents' demographic information there was significant difference for education and experience.

### 4.2 Measurement Variables and Testing Hypotheses

Construct validity is typically evaluated by looking at the patterns of correlations of the scale in question with a variety of other measures. Validity is measured in two contexts – first is content validity and second is construct validity. Content validity of our survey was established from the existing literature and adopting constructs validated by other researchers. Reliability analysis is the ability by which the same results can be obtained if I repeat the measure on the same object and under same conditions (Maria Teresa, Nadia Auriat, 2005). The statistical tool used for measuring reliability based on internal consistency is Cronbach's alpha. The Alpha Value greater than 0.6 it shows that the questionnaire is reliable (Fornell and Lacker, 1981). As shown in Table 3, our composite reliability values ranged from 0.610 to 0.712 which is showing above acceptable levels.

Apart from validity assessment of the measurement model, we performed a check for multicollinearity among the variables. A correlations' matrix was used for determining the relationship among all the variables. As Table 4 displays, the highest correlation 0.662 existed between AIS and financial performance and the lowest correlation 0.252 existed between financial performance and performance management. In total, these correlations indicate that multicollinearity.

To substantiate the findings of the research, ANOVA statistical approach was conducted. The objective of the test was to determine the relationship between independent and dependent variables. For the purposes of testing hypotheses the suitable test was adapted in this study. Regression analysis test was employed and the results of hypotheses are shown in Table 5.

According to Table 5 the hypothesis  $H_1$  examines the link between AIS and financial performance. AIS is significantly related to the financial performance ( $\beta = 0.393$ ;  $P < 0.01$ ). Therefore, the first hypothesis is accepted. It means accounting information system cause to have better financial performance.

With reference to Table 5, the hypothesis  $H_2$  also accepted because there is link between financial performance and organizational performance. The effect of financial performance is significant, as indicated by the path coefficient of 0.345 ( $P < 0.01$ ). The path coefficient ( $\beta = 0.456$ ) shows between AIS and organizational performance, there is also statistically significant ( $P < 0.01$ ). Therefore, the hypothesis  $H_3$  is supported.

With regard to Table 5, the hypothesis  $H_4$  is rejected and null hypothesis is accepted, in other words, there isn't any relationship between AIS and performance management ( $\beta = 0.075$ ;  $P < 0.01$ ). It means, AIS does not provide suitable information on performance management to facilitate the effective delivery of strategic and operational goals.

As table 5 shows, the hypothesis  $H_5$  is acceptable. It means that there is a positive relationship between performance management and organizational performance. As indicated by the path coefficient of 0.242 ( $P < 0.01$ ) it is also significant.

## 5. Discussion and Conclusion

The object of this paper was to empirically analyze the relationship between AIS and organizational performance on listed companies in Dubai Financial Market (DFM). Also, in this study usefulness of accounting information system was examined on financial performance and performance management. An information system is an organized means of collecting, entering, and processing data and storing, managing, controlling, and reporting information so that an organization can achieve its objectives and goals (Romney et al., 1997:18). Accounting information systems of the past focused on the recording, summarizing and validating of data about business financial transactions.

According to Flynn (1992), the effectiveness of AIS can be received providing management information to assist concerned decisions with regard to the successfully managing of corporations.

In recent years, many organizations have attempted to manage organizational performance using the balanced scorecard methodology where performance is tracked and measured in multiple dimensions such as; financial performance, performance management, social responsibility and employee stewardship which were used in this study to evaluate usefulness of AIS on effective organizational performance.

From generalization of the results, measuring research questions based on the opinion of the respondents. First, AIS was found to be the variable that most impacts financial performance. This tells us that AIS is the most important factor in firms that are listed in DFM. Second, it was found that financial performance and performance management have effect on an organizational performance. This means that financial performance and performance management are effective in building an organizational performance. Third, AIS was found that an important factor in building an organizational performance through collection, storage and processing of financial and accounting data to be evaluated by its impacts on improvement of decision-making process, quality of accounting information, performance evaluation, internal controls and facilitating company's transactions. Forth, there isn't any relationship between AIS and performance management. It means that there are several barriers that lead to implementation of AIS on performance management on listed companies in DFM. In such a condition it seems that without solving these problems these companies do not enjoy advantages of AIS.

The general conclusion seems to be that the nature of the model used, which specifies the accounting information requirements are indeed useful on organizational performance.

Like all empirical studies, the present research also has its own limitations due to the methodology employed. Use of questionnaire to collect data always has also its own limitations, since responses could be biased because of the common method used for the collection of all data. Although extensive care has been taking when designing the questionnaire and the pilot study refined the questions, still the criticism of the survey method can never be completely ignored and should be taken into account. Despite the above limitations, this research has provided useful results in paving the way for future research in this area. Since in UAE, recently increasing demand for AIS, as an effective tool in managing the organizations, has prevailed, this research could provide a supportive evidence for the implementation of AIS. Therefore, avenues for future research could be the effects of user participation on the implement of AIS, analysis of effectiveness of AIS on performance and productivity and etc.

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Table 1. Education-Information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	PhD (Doctorate)	38	16.1	16.1	16.1
	Masters	90	38.1	38.1	54.2
	Bachelors	108	45.8	45.8	100.0
	Total	236	100.0	100.0	

Table 2. Professional-Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 4 Years	61	25.8	25.8	25.8
	5 - 9 Years	121	51.3	51.3	77.1
	More than 10 Years	54	22.9	22.9	100.0
	Total	236	100.0	100.0	

Table 3. Reliability statistics

Measure	Cronbach's Alpha	N of Items
AIS	0.706	6
Financial performance	0.698	4
Performance management	0.610	5
Organizational performance	0.712	5

Table 4. Correlation matrix

Construct	AIS	Financial performance	Performance management	Organizational performance
AIS	1			
Financial performance	0.662**	1		
Performance management	0.267*	0.252*	1	
Organizational performance	0.656**	0.550**	0.481**	1

\*\* . Correlation is significant at the 0.01 level

\* . Correlation is significant at the 0.05 level

Table 5. Result of hypothesis testing

Hypothesis	path	coefficient	t-value	Result
H <sub>1</sub>	AIS → Financial performance	0.393	6.434	Accepted
H <sub>2</sub>	Financial performance → Organizational performance	0.345	2.420	Accepted
H <sub>3</sub>	AIS → Organizational performance	0.456	7.580	Accepted
H <sub>4</sub>	AIS → Performance management	0.075	1.094	Rejected
H <sub>5</sub>	Performance management → Organizational performance	0.242	3.812	Accepted

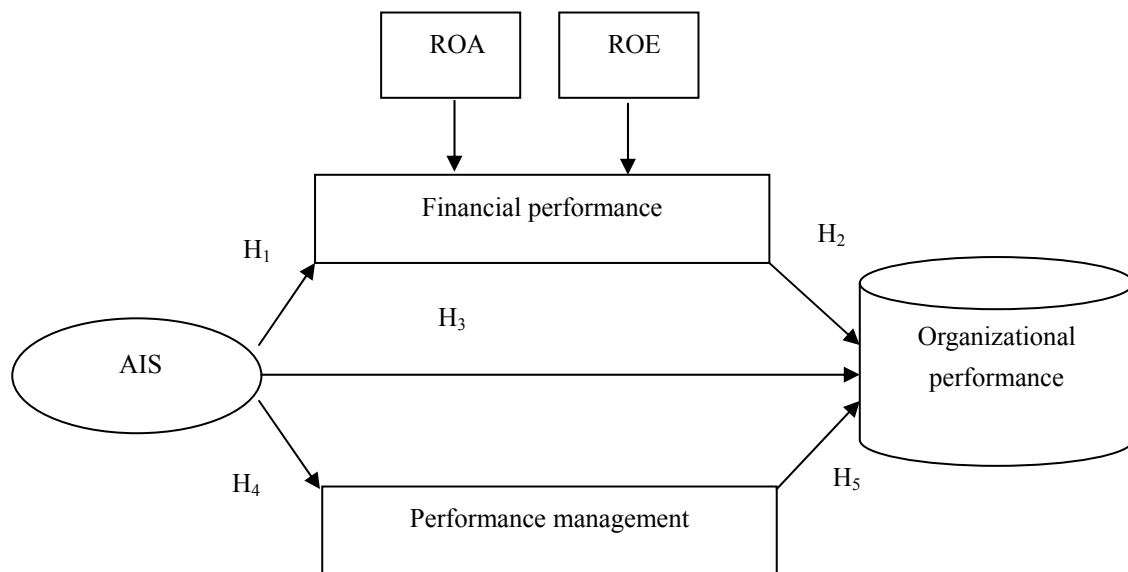


Figure 1. Research model for the study

**Questionnaire**

<b>Latent Variables</b>	<b>Measurement</b>	<b>Sources</b>
AIS	<p>1 The Data storage contributes to the integrity of the financial reporting process</p> <p>2 The Data storage in sufficient details to accurately and fairly reflect company asset</p> <p>3 The implementation of Data collection could save shareholder's money and time</p> <p>4 Data processing has capable of making a difference in a decision by helping managers to form predictions about the outcomes of past, present, and future events to evaluate financial performance in organization.</p> <p>5 Data processing caused the improvement of the quality of the financial reports and facilitated the process of the company's transactions</p> <p>6 The automated data collection speed up the process to generate financial statements and overcome human weaknesses in data processing</p>	<p>Marshall R and Paul steinbart, 2006</p> <p>Zulkarnain Muhamad Sori, 2009</p> <p>H. Sajady, H. Sajady and H. Hashem Nejad, 2008</p> <p>Zulkarnain Muhamad Sori, 2009</p>
Financial performance	<p>1 The satisfaction of various stakeholder groups is instrumental for organization</p> <p>2 Return on asset measures that assess profitability, size, and growth rates are essential to monitor overall organizational performance and progress</p> <p>3 Return on equity is a key to provides useful information about the performance of debt in the capital structure that the general manager must try to influence in order to improve financial performance</p> <p>4 Operating margin is a measurement of what proportion of a company's revenue is left over, before taxes and other indirect costs, after paying for variable costs of production as wages, raw materials, etc</p>	<p>Marc Orlitzky, Frank L. Schmidt and Sara L. Rynes, 2003</p> <p>Alan Miller, Michael Boehlje and Craig Dobbins, 2001</p> <p>Wikipedia.rog</p>
performance management	<p>1 Labor is the largest controllable expense item in your organization. Successful practices to improve performance can lower your labor cost</p> <p>2 An effective measurement and reporting process can improve performance and lower costs</p> <p>3 Employee engagement is critical to any organization that seeks to retain valued employees</p> <p>4 Employee engagement emphasizes the importance of employee communication on the success of a business. An organization should thus recognize employees, more than any other variable, as powerful contributors to a company's competitive position</p> <p>5 Interactive control systems help managers integrate new data and learning into the decision-making process</p>	<p>F.Crutis barry &amp; company, 2008</p> <p>Nitin vazirani, 2008</p> <p>Vince Kellen, 2008</p>
Organizational performance	<p>1 Effective inventory management is the single most important tool to improve customer service</p> <p>2 Successful organizations show respect for each employee's qualities and contribution – regardless of their job level</p> <p>3 Social responsibility of business refers to all such duties and obligations of business directed towards the welfare of society. These duties can be a part of the routine functions of carrying on business activity or they may be an additional function of carrying out welfare activity.</p> <p>4 Social responsibility is a voluntary effort on the part of business to take various steps to satisfy the expectation of the different interest groups.</p> <p>5 Employee stewardship is an opportunity exists for ensuring high employee morale and customer satisfaction, an increase in employee and customer retention rates, and a positive long-term outlook for the company's successful performance.</p>	<p>F.Crutis barry &amp; company, 2008</p> <p>Nitin vazirani, 2008</p> <p>Milton friedman, 1970</p> <p>Barbara J. Fretwell,2002</p>

# Group Lending Model under Sequential Moves

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## Abstract

We build a simple dynamic model to investigate the sequential group lending's ability to resolve the ex-ante moral hazard and under-monitoring problems among group members in comparison with simultaneous group lending. We found that the interest rates proposed by the lender are critical to the analytical results. If the interest rate is under certain parameter conditions, both the leader member and the follower member in sequential lending choose higher working effort levels even with the presence of lower peer monitoring in the second period. In this case, the arrangement of sequential lending is beneficial for mitigating the ex-ante moral hazard and under-monitoring problems. If the interest rate is higher than a level with certain parameter configurations, the leader member chooses higher working and monitoring effort levels, whereas the follower member chooses lower working and monitoring effort levels. We also found that the repayment rate in the sequential lending model is higher than that in the simultaneous lending model.

**Keywords:** Group lending, Ex-ante moral hazard, Sequential moves

## 1. Introduction

It is common knowledge that information asymmetries between the lender and poor borrowers, coupled with the lack of conventional collateral of the poor, are the key reasons why credit markets fail for the poor (Simtowe and Zeller, 2006). However, in the past three decades, the group lending programs of Grameen Bank of Bangladesh and Banco Solidario (Bancosol) of Bolivia, as well as other similar microfinance institutions (MFIs), have succeeded in “being able to reach the poor and realizing high repayment performance” (Mehrteab, 2005, p.1) (Note 1). This success has motivated economics theorists to undertake a significant amount of economic research focusing on explaining how and why group lending works in such an information-intensive and enforcement-intensive environment. In this context, most studies have attributed the success to the ability of the so-called *group lending contract*—which “exploits new contractual structures and organizational forms that reduce the riskiness and costs of making small, uncollateralized loans” (Morduch, 1998, p.1)—to overcome asymmetric information problems, namely, adverse selection, ex-ante moral hazard and ex-post moral hazard, as well as limited enforcement (Note 2).

The basic idea of group lending is that borrowers who can not provide conventional collateral organize themselves into groups in which members are mutually liable for each other's repayments (*joint liability (JL)*), even though loans are made to individuals. If the entire group debt is not paid in full—referred to as collective default—the entire group will be denied access to future financing by the lender, until other members repay on behalf of the defaulter (*non-refinancing threat (NRT)* under renewal contingent discipline). Another distinguishing feature of group lending is *sequential lending within the group*: The loan delivery process continues in turn as long as those who first received loans repay on time. In the Grameen Bank system, two members of a five-person group are given the first loans and their repayment performance is observed for one or two months. If their repayment performance is deemed satisfactory, the next two get loans. Finally, the fifth member gets his/her loan if the repayment performance of the previous four borrowers is satisfactory. In principle, if a member defaults, all five will be denied future credit. Obviously, NRT is the key factor behind “sequential lending within the group”. By employing these mechanisms,

group lending finds “a way to combine the banks’ resources with the local information and cost advantages of informal credit” (Armendáriz de Aghion and Morduch, 2005, p. 8).

Among the most notable ex-ante moral hazard and peer monitoring theories are models built by Stiglitz (1990), and Ghatak and Guinnane (1999). Stiglitz (1990) provided an early treatment of group lending to show how peer monitoring can be used to mitigate ex-ante moral hazard: Under individual liability lending, the form of limited liability—the borrower does not offer collateral and repays the loan only when his/her project succeeds—can encourage the borrower to take risky decisions that increase the probability of default. However, under group lending, the arrangements that group members are mutually liable for each other’s repayments and those who succeed have to repay a failed partner’s debt obligation give borrowers an incentive to make safe decisions. More importantly, JL creates an incentive for group members to monitor each other’s project choices to ensure that partners make safe decisions that protect the borrower from repayment problems. Consequently, group lending mitigates ex-ante moral hazard behavior of the individual group member and enhances repayment rates. In Stiglitz (1990), group members have better information about each other than the lender does and peer monitoring is cheaper than direct monitoring by the lender; therefore, theoretically, group lending leads to greater monitoring which mitigates ex-ante moral hazard.

Based on Stiglitz (1990), Ghatak and Guinnane (1999) developed a modified model to show how JL and peer monitoring can mitigate ex-ante moral hazard with respect to the borrower’s working effort. Their model revealed that when group members decide on working effort non-cooperatively, group lending achieves the same equilibrium individual working effort as individual liability lending; however, when group members act cooperatively, group lending achieves equilibrium individual working effort that compares favorably to that under individual liability lending (Note 3).

Although Stiglitz (1990) and Ghatak and Guinnane (1999) have identified the importance of the incentive JL creates in group lending contracts, the dynamic incentive of NRT has escaped their notice. The individual’s motive to avoid the negative consequences of being denied access to future financing has significant effects on a borrower’s behaviors (Note 4) and hence giving NRT its due importance in the economic analysis will allow us to better understand the working of group lending. As a response to Stiglitz (1990) and Ghatak and Guinnane (1999), Zhang (2008a) proposed a theoretical framework inclusive of NRT to establish a benchmark that compares borrowers’ working effort levels and loan repayments between individual liability lending and group lending. The results demonstrate that: (1) group lending in which group members decide on working effort non-cooperatively leads to lower equilibrium individual working effort than individual liability lending, and hence exacerbates ex-ante moral hazard; (2) group lending in which group members act cooperatively does not necessarily lead to higher equilibrium individual working effort than individual liability lending; and (3) group lending in which group members act non-cooperatively leads to the same repayment rate as individual liability lending, while group lending in which group members act cooperatively achieves higher repayment rate than individual liability lending.

It is important to note that the analyses of Stiglitz (1990) and Zhang (2008a) rest on *costless and perfect peer monitoring* and *full side contract* assumptions (Conning, 2005), in which borrowers within a group can perfectly and costlessly observe each other’s actions and enforce any side contracts related to their actions. Such assumptions are separate to the cost of peer monitoring and the difficulty in enforcing side contracts. In reality, monitoring will incur a cost and the enforcement of side contracts in developing countries would be very difficult (Guttman, 2006a); and hence, “[m]onitoring and social sanctions are (.....) costly substitutes for collateral” (Conning, 1999, p. 54). Ghatak and Guinnane (1999) further included costly peer monitoring and social sanctions in their model, and simply presented the condition under which the optimal result of Stiglitz (1990) can still be achieved. Similarly, Zhang (2008b) constructed a theoretical framework inclusive of NRT, costly peer monitoring and social sanctions to investigate the determinants of a borrower’s ex-ante working effort and ex-ante monitoring effort, as well as the conditions under which group lending performs better in mitigating ex-ante moral hazard and improving economic efficiency.

The studies of Stiglitz (1990), Ghatak and Guinnane (1999), Zhang (2008a and 2008b) and some other papers (e.g., Banerjee et al., 1994) have concluded that lending efficiency is enhanced when borrowers mutually observe each other’s actions and impose credible social sanctions on those who shirk. Although a group lending contract can provide monitoring incentives even when monitoring partner’s effort incur a cost, a dilemma arises when the advantage of peer monitoring is counteracted by borrowers’ collusion. Because the monitoring intensities with which the group members choose to monitor their peers are strategic complements—i.e., the greater the monitoring effort the partner exerts, the greater the monitoring effort the borrower will exert and vice versa (Zhang, 2008b)—group lending will become ineffective when the cost of monitoring is too high and/or the payoffs from investing in the decisions to monitor and to be diligent subsequently are not high enough; in such cases, group

members may collude on the decision to monitor by not monitoring at all, and hence save the cost of monitoring and obtain the non-monitored private benefits.

Some recent papers (e.g. Chowdury, 2005; Aniket, 2007) have argued that sequential lending within a group can be an instrument to resolve the problem of borrowers' collusion in monitoring (Note 5). Chowdury (2005) found that in a costly monitoring setup, sequential lending enhances the incentive for peer monitoring and may mitigate the under-monitoring problem even in the absence of joint liability (Note 6). Aniket (2007) concluded that sequential lending makes collusion among group members impossible by separating the borrower's effort and monitoring decisions. However, Chowdury (2005) and Aniket (2007) have relatively neglected other features of group lending, namely, NRT and social sanctions. In contrast to Chowdury (2005) and Aniket (2007), we seek to develop a framework inclusive of all these incentive mechanisms to investigate the sequential group lending's ability to resolve the ex-ante moral hazard and under-monitoring problems among group members in comparison with simultaneous group-lending.

The rest of this paper is organized as follows. In Section 2, we analyze simultaneous lending. Section 3 develops the sequential lending model. In Section 4, we compare the abilities of simultaneous and sequential group lending to encourage a borrower's working and monitoring efforts, and to encourage repayment. Concluding remarks are presented in Section 5.

## 2. Simultaneous Group Lending

For simplicity, we restrict the model to a group involving two members (A and B). They make their investments and make efforts to help the investments succeed independently.  $p_i \in [0,1]$  (where  $i \in \{A, B\}$ ) represents the level of effort and success probability for member  $i$ 's investment. The effort cost function is quadratic and it is assumed to be specified by  $(\alpha/2)p_i^2$  where  $\alpha > 0$ . The benefit of this investment is represented by  $Y > 0$ .

A group lending contract is described as  $(R, A)$ , where  $R$  is the pre-specified gross interest rate and  $A \in (0, R]$  is the JL payment, i.e., the portion of the debt obligation of the failed member for which the successful one is liable.  $A$  measures the degree of JL and it is decided by the lender. Members make efforts to succeed independently but they are jointly liable for the entire group loan. If one member succeeds and the other member fails, the former has to repay his/her individual liability component  $R$  plus an additional JL component  $A$ . Assuming that  $Y > R$  since borrowers are assumed to have no wealth to provided as collateral and then limited liability requires that a borrower can not be forced to pay more than what his/her project yields. For analytical convenience, we assume that borrowers undertake full joint liability, i.e.,  $A = R$  (Note 7).

When both members succeed, the lender will extend the second-period credit and both members can get benefit  $V > 0$  from the future financing. In contrast, if both members fail, they will not get this benefit because they can not get future credit from the lender. In the case of "one succeeds, one fails", the successful member repays the failed partner's debt obligation on his/her behalf in order to maintain the credit facility. We assume that if the successful member chooses to default strategically, the failed member will report the partner's action to the lender because he/she loses the future benefit. In this case, the successful member has to pay  $R$  to the lender, and the incentive compatibility constraint, where the successful member is always willing to repay for the failed member, has to be assumed as  $Y - R \leq Y - R - R + V \Rightarrow R \leq V$ . The left-hand side of this equation represents the benefit when a successful member chooses strategic default, while the right-hand side of this equation represents the benefit when a successful member does not choose strategic default and proceeds to the second period.

The arrangements of group lending create incentives for the two group members to monitor each other's effort choices to ensure that the partner works hard, thereby avoiding having to repay for a failed partner. After disbursement of the loan in the first period, the two members will then agree on a level of effort and an individual monitoring level. Suppose that if a member chooses a level of monitoring effort  $m \in [0,1]$ , he/she can observe the true action taken by his/her partner with probability  $m$ , while he/she receives a completely uninformative signal with probability  $1 - m$ . If the action undertaken by the partner is different to that agreed on, the monitoring member will impose a non-monetary punishment  $W > 0$  on the partner and he/she can get some monetary and/or non-monetary value, represented by  $\gamma W$  where  $\gamma \in (0,1)$ . The monitoring cost function is quadratic and it is assumed to be specified by  $(\beta/2)m_i^2$  where  $\beta > 0$ .

If both members jointly choose their effort level, represented by  $p$ , to maximize the social surplus, the equilibrium effort level can be derived from the following maximization problem:

$$\text{Max } pY - \frac{\alpha}{2} p^2. \quad (1)$$

Then,  $p = Y/\alpha$  is the joint effort level that maximizes the social surplus. To guarantee a value in the range of  $[0,1]$ , we assume  $\alpha \geq Y$ .

The expected payoff of member A, which is denoted by  $E_A$ , is

$$E_A = p_A p_B (Y - R) + [1 - (1 - p_A)(1 - p_B)]V - (1 - p_A)m_B W - \frac{\beta}{2}m_A^2 + (1 - p_B)m_A \gamma W - \frac{\alpha}{2}p_A^2, \quad (2)$$

where  $(1 - p_B)m_A \gamma W$  is a non-monetary value—which may take the form of “free labor services or services of agricultural implements” (Ghatak, 2000)—that A gets from B when A discovers B’s non-diligence.

This game is dynamic and it consists of the following two stages:

First stage: the two members choose their own effort levels simultaneously.

Second stage: the two members choose their own monitoring levels simultaneously.

Thus, to derive the equilibrium (sub-game perfect equilibrium), we have to consider the second stage before the first stage.

Consider the second stage. Both members want to choose their own monitoring levels to maximize their expected payoffs. Thus, each first-order condition is

$$\frac{\partial E_A}{\partial m_A} = -\beta m_A + (1 - p_B)\gamma W = 0 \Rightarrow m_A = \frac{(1 - p_B)\gamma W}{\beta}. \quad (3)$$

Then,

$$m_A^* = \frac{(1 - p_B)\gamma W}{\beta}, \quad (4)$$

where the asterisk indicates the equilibrium value. Next, consider the first stage. Using equation (4), equation (2) can be rewritten as follows:

$$E_A = p_A p_B (Y - R) + (p_A + p_B - p_A p_B)V - \frac{(1 - p_A)^2 \gamma W^2}{\beta} + \frac{(1 - p_B)^2 \gamma^2 W^2}{2\beta} - \frac{\alpha}{2}p_A^2. \quad (5)$$

From equation (5), each first-order condition, which represents the best response function, is

$$\frac{\partial E_A}{\partial p_A} = p_B (Y - R - V) + V + \frac{2\gamma W^2}{\beta} \left( \frac{2\gamma W^2}{\beta} + \alpha \right) p_A = 0. \quad (6)$$

From equation (6), both equilibrium effort levels are derived as follows:

$$p_A^* = p_B^* = \frac{\beta V + 2\gamma W^2}{(R + V + \alpha - Y)\beta + 2\gamma W^2}. \quad (7)$$

### 3. Sequential Group Lending

In this section, we consider a sequential group lending model. Without loss of generality, we assume that member A is the leader and member B is the follower because both members are symmetric. The timing of lending is described as follows.

In the first period, member A receives the first-period loan from the lender and chooses effort level  $p_A$ , and member B chooses monitoring level  $m_B$ . If member A fails, both members will be denied future credit and the game is terminated. If member A succeeds, he/she pays  $R$  to the lender and gets  $Y - R$ . The game will continue and member B will get the first-period loan.

In the second period, member B is given the first-period loan by the lender and chooses effort level  $p_B$  and member A chooses monitoring level  $m_A$ . If member B succeeds, he/she pays  $R$  to the lender and gets  $Y - R$ . In contrast, if B fails, the game is terminated.

The two expected payoffs are written as follows:

$$\hat{E}_A = \hat{p}_A \left[ \hat{p}_B (Y - R) + V - \frac{\beta}{2} \hat{m}_A^2 + (1 - \hat{p}_B) \hat{m}_A \gamma W \right] - (1 - \hat{p}_A) \hat{m}_B W - \frac{\alpha}{2} \hat{p}_A^2, \quad (8)$$

$$\hat{E}_B = \hat{p}_A \left[ \hat{p}_B(Y-R) + V - (1-\hat{p}_B)\hat{m}_A W - \frac{\alpha}{2}\hat{p}_B^2 \right] + (1-\hat{p}_A)\hat{m}_B \gamma W - \frac{\beta}{2}\hat{m}_B^2, \quad (9)$$

where the hat indicates variables in the sequential lending model. From the game structure, member A chooses  $\hat{p}_A$  in the first round and  $\hat{m}_A$  in the fourth round. In contrast, member B chooses  $\hat{m}_B$  in the second round and  $\hat{p}_B$  in the third round. Thus, the four equilibrium values can be derived by backward induction.

First, consider the computation of  $\hat{m}_A$ . The first-order condition with respect to  $\hat{m}_A$  is

$$\frac{\partial \hat{E}_A}{\partial \hat{m}_A} = -\hat{p}_A [\beta \hat{m}_A - (1-\hat{p}_B)\gamma W] \quad (10)$$

Then, the optimal monitoring level of member A can be derived as

$$\hat{m}_A^* = \frac{(1-\hat{p}_B)\gamma W}{\beta} \quad (11)$$

Second, consider the computation of  $\hat{p}_B$ . Substituting equation (11) into equation (9), we obtain

$$\hat{E}_B = \hat{p}_A \left[ \hat{p}_B(Y-R) + V - \frac{(1-\hat{p}_B)^2 \gamma W^2}{\beta} - \frac{\alpha}{2}\hat{p}_B^2 \right] + (1-\hat{p}_A)\hat{m}_B \gamma W - \frac{\beta}{2}\hat{m}_B^2. \quad (12)$$

The first-order condition with respect to  $p_B$  is

$$\frac{\partial \hat{E}_B}{\partial \hat{p}_B} = \hat{p}_A \left[ Y-R + \frac{2(1-\hat{p}_B)\gamma W^2}{\beta} - \hat{p}_B \alpha \right] = 0. \quad (13)$$

Then,

$$\hat{p}_B^* = \frac{\beta(Y-R) + 2\gamma W^2}{\alpha\beta + 2\gamma W^2}. \quad (14)$$

Third, consider the computation of  $m_B$ . Substituting equation (14) into equation (12), we obtain

$$\hat{E}_B = \hat{p}_A \left[ \hat{p}_B^*(Y-R) + V - (1-\hat{p}_B^*)\hat{m}_A^* W - \frac{\alpha}{2}\hat{p}_B^{*2} \right] + (1-\hat{p}_A)\hat{m}_B \gamma W - \frac{\beta}{2}\hat{m}_B^2, \quad (15)$$

from which we can easily derive the first-order condition with respect to  $\hat{m}_B$  as follows:

$$\frac{\partial \hat{E}_B}{\partial \hat{m}_B} = -\beta \hat{m}_B + (1-\hat{p}_A)\gamma W = 0. \quad (16)$$

Then, the optimal level of  $\hat{m}_B$  is represented by

$$\hat{m}_B^* = \frac{(1-\hat{p}_A)\gamma W}{\beta}. \quad (17)$$

Last, we consider the computation of  $\hat{p}_A$ . Substituting equations (11), (14), and (17) into equation (8), we show

$$\hat{E}_A = \hat{p}_A \left[ \hat{p}_B^*(Y-R) + V - \frac{\beta}{2}\hat{m}_A^{*2} + (1-\hat{p}_B^*)\hat{m}_A^* \gamma W \right] - (1-\hat{p}_A)\hat{m}_B^* \gamma W - \frac{\alpha}{2}\hat{p}_A^2. \quad (18)$$

For simplicity of the expression, we define

$$\Omega \equiv \hat{p}_B^*(Y-R) + V - \frac{\beta}{2}\hat{m}_A^{*2} + (1-\hat{p}_B^*)\hat{m}_A^* \gamma W. \quad (19)$$

Because  $\Omega$  is not function of  $\hat{p}_A$ , the first-order condition with respect to  $\hat{p}_A$  can be written as

$$\Omega - \hat{p}_A \alpha + \frac{2(1-\hat{p}_A)\gamma W^2}{\beta} = 0. \quad (20)$$



From equation (20), the optimal level of  $\hat{p}_A$  is

$$\hat{p}_A^* = \frac{\beta\Omega + 2\gamma W^2}{\alpha\beta + 2\gamma W^2}. \quad (21)$$

#### 4. Comparing Simultaneous and Sequential Group Lending

Let us compare two kinds of effort and monitoring levels. It is easy to verify that the forms of the optimal levels of monitoring are the same for the simultaneous and sequential lending models by comparing equation (4) with equations (11) and (17). Furthermore, these equations are monotone decreasing functions of the effort level. Thus, we only compare the two effort levels.

First, consider the effort levels of member B, who is the follower in the sequential lending model. From equations (7) and (14), we simply compute  $\hat{p}_B^* - p_B^*$  as follows:

$$\hat{p}_B^* - p_B^* = -\frac{(R+V-Y)(R+\alpha-Y)\beta^2}{(\alpha\beta + 2\gamma W^2)[(R+V+\alpha-Y)\beta + 2\gamma W^2]}. \quad (22)$$

There are two distinct cases:

- If  $Y > R+V$ , we have  $\hat{p}_B^* - p_B^* > 0$ . Then member B chooses a higher effort level in period 2, whereas member A chooses a lower monitoring level, that is,  $\hat{m}_A^* < m_A^*$ .
- If  $Y \leq R+V$ , we have  $\hat{p}_B^* - p_B^* \leq 0$ . Then member B chooses a lower effort level in period 2, whereas member A chooses a higher monitoring level, that is,  $\hat{m}_A^* \geq m_A^*$ .

Next, consider the effort levels of member A, who is the leader in the sequential lending model. Note that  $\alpha\beta + 2\gamma W^2 \leq (R+V+\alpha-Y)\beta + 2\gamma W^2$  because  $R+V \geq Y$ . From equations (7) and (21), we compute  $\hat{p}_A^* - p_A^*$  as follows:

$$\begin{aligned} \hat{p}_A^* - p_A^* &= \frac{\beta\Omega + 2\gamma W^2}{\alpha\beta + 2\gamma W^2} - \frac{\beta V + 2\gamma W^2}{(R+V+\alpha-Y)\beta + 2\gamma W^2} \\ &\geq \frac{\beta\Omega + 2\gamma W^2}{(R+V+\alpha-Y)\beta + 2\gamma W^2} - \frac{\beta V + 2\gamma W^2}{(R+V+\alpha-Y)\beta + 2\gamma W^2} = \frac{\beta(\Omega - V)}{(R+V+\alpha-Y)\beta + 2\gamma W^2}. \end{aligned} \quad (23)$$

Furthermore, we find that

$$\Omega - V = \hat{p}_B^*(Y - R) - \frac{\beta}{2}\hat{m}_A^{*2} + (1 - \hat{p}_B^*)\hat{m}_A^*\gamma W = \hat{p}_B^*(Y - R) + \frac{(1 - \hat{p}_B^*)^2\gamma^2 W^2}{2\beta} > 0. \quad (24)$$

From equations (23) and (24), we show

$$\hat{p}_A^* - p_A^* > 0 \Rightarrow \hat{p}_A^* > p_A^*. \quad (25)$$

Equation (25) indicates that member A chooses a higher effort level in period 2, whereas member B chooses a lower monitoring level, that is,  $\hat{m}_B^* < m_B^*$ .

Then for a given  $R$ , if  $R < Y - V$ , both A and B choose higher working effort levels and lower monitoring levels in period 2. In this case, sequential lending is beneficial for mitigating ex-ante moral hazard and under-monitoring problems in comparison with simultaneous lending. If  $R \geq Y - V$ , member B will choose a lower effort level and member A has to choose a higher monitoring level in period 2. Then the repayment schedule  $R$  proposed by the lender is critical to the comparison between sequential lending and simultaneous lending.

We further compare two kinds of repayment rates. It is easy to see that the repayment rates, which are denoted by  $\gamma$  in the simultaneous lending model and  $\hat{\gamma}$  in the sequential lending model, are as follows:

$$\gamma = 1 - (1 - p_A)(1 - p_B) = 2p_A^* - p_B^{*2}, \quad (26)$$

$$\hat{\gamma} = \hat{p}_A^* + \hat{p}_B^*. \quad (27)$$

Using equations (7), (14), and (21), we compute  $\hat{\gamma} - \gamma$  as follows:

$$\begin{aligned}
\hat{\gamma} - \gamma &= \hat{p}_A^* + \hat{p}_B^* - 2p_A^* + p_A^{*2} \\
&= \frac{\beta\Omega + 2\gamma W^2}{\alpha\beta + 2\gamma W^2} + \frac{\beta(Y - R) + 2\gamma W^2}{\alpha\beta + 2\gamma W^2} - \frac{2\beta V + 4\gamma W^2}{(R + V + \alpha - Y)\beta + 2\gamma W^2} + \left[ \frac{\beta V + 2\gamma W^2}{(R + V + \alpha - Y)\beta + 2\gamma W^2} \right]^2 \\
&> \frac{\beta(\Omega + Y - R) + 4\gamma W^2}{(R + V + \alpha - Y)\beta + 2\gamma W^2} - \frac{2\beta V + 4\gamma W^2}{(R + V + \alpha - Y)\beta + 2\gamma W^2} + \left[ \frac{\beta V + 2\gamma W^2}{(R + V + \alpha - Y)\beta + 2\gamma W^2} \right]^2 \\
&= \frac{\beta(\Omega + Y - R - 2V)}{(R + V + \alpha - Y)\beta + 2\gamma W^2} + \left[ \frac{\beta V + 2\gamma W^2}{(R + V + \alpha - Y)\beta + 2\gamma W^2} \right]^2 \\
&= \frac{\beta(\Omega + Y - R - 2V) \left[ (R + V + \alpha - Y)\beta + 2\gamma W^2 \right]}{\left[ (R + V + \alpha - Y)\beta + 2\gamma W^2 \right]^2} + \left[ \frac{\beta V + 2\gamma W^2}{(R + V + \alpha - Y)\beta + 2\gamma W^2} \right]^2 \\
&> \frac{\beta(\Omega + Y - R - 2V)(\beta V)}{\left[ (R + V + \alpha - Y)\beta + 2\gamma W^2 \right]^2} + \left[ \frac{\beta V}{(R + V + \alpha - Y)\beta + 2\gamma W^2} \right]^2 \\
&= \frac{\beta^2 [V(\Omega - V) + (Y - R)V]}{\left[ (R + V + \alpha - Y)\beta + 2\gamma W^2 \right]^2} > 0 \Rightarrow \hat{\gamma} > \gamma. \tag{28}
\end{aligned}$$

Equation (28) indicates that the repayment rate in the sequential lending model is higher than that in the simultaneous lending model.

## 5. Concluding Remarks

In a moral hazard environment with costly peer monitoring, we investigate the sequential group lending's ability to resolve the ex-ante moral hazard and under-monitoring problems among group members in comparison with simultaneous group lending. The results show that when credit is allocated to group members simultaneously, the borrowers make their decisions regarding monitoring and effort collectively. Alternatively, when credit is disbursed sequentially within the group, i.e., the second borrower gets a loan only if the first borrower succeeds and repays his/her debt, the borrower's effort and monitoring decisions are temporally separated. The interest rates proposed by the lender are critical to the comparison between simultaneous and sequential group lending in mitigating ex-ante moral hazard and under-monitoring problems. If the interest rate is under certain parameter conditions, both the leader member and the follower member in sequential lending choose higher working effort levels even with the presence of lower peer monitoring in the second period. If the interest rate is higher than a level with certain parameter configurations, the leader in sequential lending chooses higher working and monitoring effort levels, whereas the follower member chooses lower working and monitoring effort levels. Furthermore, we found that the repayment rate in the sequential lending model is higher than that in the simultaneous lending model. The findings in this paper are to some extent different to the conclusions of the existing literature that sequential lending can help in mitigating the moral hazard and under-monitoring problems. The reason is that we incorporate the relatively neglected features of group lending, NRT and social sanctions, in our model, which is not only helpful to better understand the working of group lending and provide guidance for empirical studies, but also beneficial for identifying appropriate policies and scheme designs.

Finally, although many MFIs, such as Grameen Bank and many of its replicators, have widely adopted sequential lending in their programs and the theoretical literature has predicted positive impact of the mechanism of sequential lending on mitigating moral hazard and encouraging repayment, theoretical predictions has been seldom explored by empirical studies. The reason may be that because the theoretical models take different stands on the underlying hypothesized economic environments from the empirical environments and the "filed experiments, while feasible, are difficult to implement and sometimes come at the cost of some loss of experimental control" (Cason et al., 2012, p.193, Note 5). Cason et al. (2012) took a laboratory experiments approach to deal with this issue and they found that contrary to theoretical predictions, simultaneous and sequential lending rules provide equivalent empirical performance. The theoretical propositions are needed to be examined and refined by more empirical evidence, which provides a room for our future research.

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## Notes

Note 1. Compared to the subsidized credit programs and other theoretical forms of rural credit, the representative group-based microcredit programs have enjoyed remarkable success reflected by repayment rates often about 95% (Morduch, 1999).

Note 2. The theoretical explanations generally confirming that group lending leading to higher repayment rates due to more effective of screening, monitoring and enforcement among group members can be roughly categorized into:

(1) those dealing with joint liability, peer selection and adverse selection problem (e.g. Ghatak 1999 and 2000; Sadoulet, 2000; Van Tassel; 1999; Armendáriz de Aghion and Gollier, 2000; Laffont and N'Guessan 2000; Guttman, 2008; Zhang, 2009), (2) those concerned with joint liability, peer monitoring and ex-ante moral hazard problem (e.g. Stiglitz, 1990; Banerjee et al., 1994; Conning, 1996, 1999 and 2005; Ghatak and Guinnane, 1999; Armendáriz de Aghion and Morduch, 2000; Laffont and Rey, 2003; Chowdhury, 2005; Guttman, 2006b; Aniket, 2007; Cason et al., 2008; Zhang, 2008a and 2008b), and (3) those addressing joint liability, non-refinancing threat, social sanctions, peer monitoring, and ex-post moral hazard problem (e.g. Besley and Coate, 1995; Armendariz de Aghion, 1999). The empirical studies on group lending can be roughly categorized into: (1) those addressing peer matching and group formation (e.g. Sadoulet and Carpenter, 2001; Lensink and Mehrteab, 2003), (2) those exploring the relevance of social capital to repayment performance (e.g. Wydick, 1999; Ahlin and Townsend, 2007a; Cassar et al., 2007; Karlan, 2007), and (3) those concerned with the relative advantages of group lending versus individual liability lending (e.g. Giné and Karlan, 2006; Ahlin and Townsend, 2007a and 2007b; Cull et al., 2007).

Note 3. Banerjee et al. (1994) discussed credit cooperatives, which were common in the late 1890s and the early 1900s in Europe, and they found that German credit cooperatives create similar incentive structures to group-based lending, which induces peer monitoring among borrowers. Furthermore, the monitoring member may impose a penalty on the borrowing member in the case of default, which is helpful in reducing ex-ante moral hazard. Because monitoring by microcredit institutions is assumed to be costly, most theoretical analyses focusing on ex-ante moral hazard in group lending emphasize peer monitoring. In contrast, Conning (1996, 1999 and 2005) examined whether the monitoring by lending institutions or delegated monitoring is as good as or better than peer monitoring at enforcing loan repayment and argued that only when group lending is optimal to individual liability lending do group members have a substantial monitoring and enforcement advantage over outsiders (the delegated monitor or the lender) and when the correlations across borrowers' outputs are not high.

Note 4. Armendáriz de Aghion (1999) investigated the effect of NRT in mitigating ex-post moral hazard (strategic default) and interpreted NRT as a punishment imposed on borrowers who default strategically.

Note 5. Cason et al. (2012) examined this issue by taking a laboratory experiments approach.

Note 6. Chowdhury (2007) focused on sequential financing and contingent renewal, and also examined the efficacy of those two schemes in harnessing social capital.

Note 7. As it is assumed, the lender cannot observe the outcome of a borrower's project, i.e., success or failure, prior to the repayment of the loan. If  $A < R$ , such that both of them succeed, borrowers within a group may pretend to partly fail and pay  $(R + A)$  instead of  $2R$  to the lender. The lender will make a negative profit in such a case. If  $A > R$ , when one member fails, rather than tell the lender the truth, the two borrowers may collude to tell the lender that they both succeed, and then pay  $2R$  instead of  $(R + A)$  to the lender. If  $A \neq R$ , the lender will never get paid as it expected. Therefore, the optimal and maximum feasible joint liability payment is  $A = R$ . To make the expression clear, we use  $A$  rather than  $R$  to denote JL payment in the following analysis.

# The Intraday Pattern of Trading Activity, Return Volatility and Liquidity: Evidence from the Emerging Tunisian Stock Exchange

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## Abstract

The purpose of this paper is to investigate the intraday pattern of trading activity, liquidity and return volatility in the emerging Tunisian Stock Market (TSE) which is an order-driven market using intraday data covering the period October 2008 to June 2009. To achieve this objective, we have applied two methods: the temporal analysis that consists to estimate a dichotomy model for each variable by following the methodological approach of Vo (2007) and the second method is to apply the spectrum analysis by using the Fourier Transform fast (FFT). The results have shown that all identified variables are characterized by notable seasonality justified the rejection of the hypothesis of constancy ( $H_0$ ). Both methods have shown the existence a seasonal pattern in U. The reason considered to justify this intraday behavior is the crucial role played by the problem of adverse selection especially between the two dimensions of liquidity: the spread and depth at the best limit. It should also be noted the effect of inventory management on the optimal allocation of the portfolio.

**Keywords:** Intraday pattern, Trading volume, Liquidity, Return volatility, Intraday data, FFT algorithm, Tunisian stock market.

*JEL classifications:* G12, G14, G15

## 1. Introduction

Intraday pattern in stock markets has attracted much research attention. This importance is due to the existence of intraday regularities in stock market that contests the Efficient Markets Hypothesis. To analyze this anomaly, we are forced to focus on the causes generating this behavior. The understanding of these causes has a significant interest in the microstructure theory in order to study the market reaction and the trading activity. Indeed, the obtaining of an efficient market is difficult in this situation since the arrival of new information generates abnormal micro-structural pattern called the "Intraday pattern". In this context, the researchers have tried to explain the sources of this anomaly by concentrating on the effect of information on strategies for insider trading and uninformed trading during the day. This anomaly may affect the market equilibrium. However, each investor wants to maximize his utility. This objective is legitimate but the question is how to achieve that? We are facing an enigma difficult to solve because the informed investors involved in the market take advantage of their private information when the uninformed intervene cautiously for the liquidity needs. Indeed, the strategic behavior of each investor depends on his position in the market. The literature of microstructure has focused on both types of information to explain behavior of intraday stock market. Public information comes on the market in the form "news". Degennaro and Shrieves (1997) have examined the importance of news in explaining the trading strategies of the investors and especially the market volatility. They divided the news into three categories based on Reuters: the macroeconomic news, the economic policies news and the news on interest rates. Cheung and Kwan (1992) presented an exhaustive literature review that focuses on the public information flow on the stock market. Kalev et al (2004) have used specific categories of news to companies listed on ASX as the announcement of results, dividends, changes in shareholding, the capital increase, the change of CEO, reports of accountants. According to Edmonds and Kutan (2002), most studies have examined the importance of public information by claiming that such information was not significant in explaining the variation of stock returns. This insufficiency in the role of public information obliged the researchers of the microstructure theory to examine the impact of public information by using the trading volume as a latent variable. Lamoureux and Lastrapes (1990) justified this theoretical approach by the fact that when public information is

disseminated on the stock market, this information is unobservable by investors but motivate them to make transactions purchase or sale, and especially to achieve an optimal allocation of resources in spite of its randomness. Moreover, it is unevenly distributed and interpreted differently. Researchers have identified the role played by the transactions numbers, turnover and news as explicit variables representing the implicit public information. The use of such variables was justified also by Clark (1973), Tauchen and Pitts (1983), Anderson (1996). This focus coincides with two theoretical explanations based mainly on information: the MDH (The mixture of distribution hypothesis) and SIAH (the sequential information arrival hypothesis).

However, we must not focus only on public information but also on private information. This concept has represented, according to several analysts, the source of the problem of adverse selection in the stock market. Madhavan et al (1997) reported that the information flow and transactions frictions represented the factors explaining the intraday volatility and liquidity. While Admati and Pfleider (1988) and Foster and Viswanathan (1990) attributed the difference in transaction activity, liquidity and volatility to the ability of investors to benefit from their private information. Indeed, take advantage of this information is beneficial for informed investors "the insiders" while the possession of private information is considered by the uninformed investors 'liquidity traders' as information risk. According to the theory of asymmetric information, informed investors have private information on the value of quoted companies. This information would put them in a favorable position than other investors. Brockman and Chung (2001) have argued that the presence of insiders can reduce market liquidity since these informed investors profit from the private information by including it implicitly in stock prices through their trading activities. This requires the informed investors to respond to this informational disadvantage by reducing trading activity. But, the problem is aggravated when the uninformed investors accept this situation and remaining on the market as followers. Indeed, Admati and Pfleider (1988,1989) have proposed, through their theoretical model, a solution that uninformed investors must do their transactions together to minimize monopolistic position of insiders. The strategy of uninformed investors consists to limit their losses by a large proportion with insiders. In addition, if a great part of transaction is realized in the interior of trading day and not at the start or the end of day, the needs liquidity may reduce the insider-information risk. But the adoption of this strategy does not hide many threats which can meet the uninformed because the risk of loss of wealth is very important particularly in the presence of opportunistic insiders who take advantage of their private information.

In this study, we use two methods to achieve our objective: the temporal analysis that consists to estimate a dichotomy model for each variable by following the Vo (2007) methodology and the second method is to apply the spectrum analysis by using the Fourier Transform Fast (FFT). Our objective is to examine the intraday behavior of trading activity, return volatility and market liquidity on the Tunisian stock market in order to see if it has similar intraday patterns observed in other markets. Our empirical investigation is founded on a sample covering, in intraday frequency, 38 stocks continuously quoted on the TSE for the period (October 2008-June 2009). Many questions have been asked leading to reasonable solutions allowing the comprehension of that irregularity: Why does that anomaly exist? What are the causes generating the intraday pattern? Does the shape of the pattern differ from one market to another? Does the existing pattern depend essentially on the periodicities of the information flow? The main finding observed is that both methods have shown the existence of seasonal pattern in U in Tunisian stock market. The reason defined to justify this intraday behavior is the crucial role played by the problem of adverse selection especially between the two dimensions of liquidity: the spread and depth at the best limit. It should also be noted the effect of inventory management on the optimal allocation of the portfolio. This present study also contributes to the related literature in several ways. To the best of our knowledge, our research is the first study that investigated the anomaly of seasonality on the Tunisian stock market after the promulgation of financial security information law since 2005 by the Financial Market Council. Second, we have used another dimension measuring liquidity. It is "the depth at the best limit". This variable is not used in any study on the Tunisian stock market to investigate the anomaly of seasonality. The unexploited of depth does not give a clear idea on the behavior of intraday liquidity. Third, the Fourier Transform fast (FFT) algorithm have never been employed in order to examine the seasonality in the Tunisian context. At last, we noted that a small number of empirical studies have focused on emerging stock markets particularly in countries of Middle East and North Africa(MENA). Major previous studies concentrated on developed stock markets.

The structure of the paper is as follows. Section 2 reviews the literature on the relationship between information and intraday pattern. Section 3 provides the theoretical explanation of intraday seasonality. Section 4 describes the Tunisia stock market, data used and presents the definition of variables of trading activity, return volatility and liquidity. The section 5 presents the methodology used in the paper and the main findings. The paper concludes by summarizing the main conclusions

## 2. The Relationship between Information and Intraday Pattern in Literature

The answer to these questions requires firstly the understanding of the relation between the information flow and this microstructural anomaly. "Intraday pattern" is certainly an anomaly due to its particular micro-structural features. The presence of this issue has motivated the researchs on the sources of this anomaly. However the detailed explanation of this notion obliges us to place it in an enormous quantity of literature. But the majority of the literature derived from developed countries, particularly the United States and Canada. Since the 80s, there have been a review articles on microstructure that have tried to analyze the existing patterns in the stock market. Admati and Pfleider (1988) have developed the theoretical foundations of trading pattern on the financial market. The authors have taken advantage enormously from the intraday transaction data since the daily data do not permit to investigate the behavior of the intraday market. They have demonstrated that the profile U characterized the pattern of trading volume and return volatility. That means that trading volume and return volatility are higher at the beginning of trading day and in the end but they are weak during the day. Their results have confirmed the findings of Jain and Joh (1986). Wood, Mc Inish and Ord (1985) have tested empirically the existence of a U-pattern using transactions data minute by minute. They argued that the return and return volatility are distinguished at the beginning and the end of the trading day by a U-shaped profile. On the basis of this result, theoretical approach of Admati and Pfleider (1988) consists in understanding the reasons why transactions tend to be concentrated more on specific periods of the day than during other periods, and especially to know why the patterns of volatility and trading volumes are identical. Microstructure literature was interested enormously in studying the behavior of different intraday micro-structural variables but the first academic researches have been commenced in a market driven price. This market is very specific since it is characterized by the presence of market makers. According to Madavan (1992), this market represents a location where the investors may get the price quotations of market makers prior to submission their purchase orders and sales orders.

In this case, the market maker acts as an intermediary between buyers and sellers with prices determined before quantities. He is regarded as a liquidity supplier in the financial marketplace. Given these specificities related to the mechanisms used to accomplish the transactions and particularly recent availability of transactional data, quotations and orders issued in numerous markets around the world, Researchers on phenomena intraday stock market have exploited efficiently these conditions in order to confirm that U-pattern was the form most particular in the majority of markets in United states and other developed countries whether for return and volatility, liquidity and trading volume. But the results do not overlook another area that the pattern can take the form L-pattern, Y-pattern, or the opposite case of both forms as they depend largely of the characteristics of structural conditions in markets, mechanisms of transactions and the information flow.

For the markets of United States, the study of Wood, Mc Inich and Ord (1985) is considered the first study which was concentrated on the availability for this anomaly as the presence of seasonality in the stock market can contradict the market efficiency. They have shown that trading volume, return, return volatility and liquidity followed a U-pattern. All of these variables are high at the opening of the trading day but they become low during the trading day in order to increase at closing. More precisely the behavior of the market at the opening and the closing is different than within trading day in the NYSE. Indeed, their article examined empirically the nature of the generating process respecting the features of the transaction size, transaction frequency and transaction interval for the majority of actions in the NYSE. This research was enhanced by the analysis Pfleider and Admati (1988). These authors have verified the same intraday pattern for the Exxon Company stock during the year 1981. They have based their study on a theoretical model respecting two complementary characteristics: the process of information and the number of uninformed investors. The patterns shown in trading volume and return are mainly due to the strategic interaction between insiders and investors need to liquidity. The microstructure analysis has verified the presence of other forms of seasonality other than U-pattern still in the American context. Amihud and Mendelson (1987) have tried to test the effect of information on the behavior of returns at various times of the transaction day for 30 stocks forming the Dow-Jones. They proved that the returns at the opening are more variable than those at the closing market. The same result was confirmed by Stoll and Whaley (1990) for the NYSE stocks. They have also shown a high return volatility at the opening of the NYSE. Within the same context, Cerety and Mulherin (1994) have examined the existence of transitional character of volatility during the transaction day. They looked that the returns are more volatile at the opening than at the closing day. For their part, Mc Inich and Wood (1992) have studied the behavior of Bid ask spread within the transaction day depending upon 4 very important factors: the trading activity, risk, information and competition. They found that the behavior of liquidity measure shaped profile follows the reversed J-pattern. Other researchers are also interested to test the presence of this micro-structural anomaly in the U.S. stock markets such as Harris (1986), Mc Inish and Wood (1990), Foster and Viswanathan (1993), Ho and Cheung (1991). All these authors have supported the presence of a seasonal U-pattern of return



volatility within the day. While other researchers have verified that the Bid-ask spread (Hashbrouck (1991a, b), and Mc Inich Wood (1992), Foster and Viswanathan (1993), Handa (1992), trading volume (Jain and Joh (1988), Mc Inich and Wood (1989, 1990 b)), the number of transaction (Mc Inich and Wood (1989), Chan et al (1995)) follow a U-pattern for the stocks of NYSE. Similarly, Chan, Christie and Schultz (1995) have shown that the bid-ask spread of the stocks comprising the NASDAQ index follows a J-pattern. In other words, it becomes weak during the trading day but it increases again during the closing minutes. This finding confirmed by Chung and Van Ness (2001), the NASDAQ, before and after the reforms in 1997 that have affected the market. Chan et al (1993) have proved that the intraday bid-ask spread is higher immediately after the opening of market to decline enormously over the day and returns to his initial situation at the end of transactions. That same behavior has characterized the trading volume and return volatility.

Other interested authors are still looking for this anomaly in other developed equity markets. Such studies have benefited recently from the availability of the high-frequency data on these price-driven markets. In this context, Abhyanker et al (1997) contributed to enriching the existing literature by their study on the London Stock Exchange. They showed that the bid-ask spread, trading volume and return volatility are characterized by a seasonal pattern in the form U, but this behavior differs depending on the liquidity of the stocks. However, the main lesson retained from the study of the intraday pattern in the price driven market was clear because no many countries adopt that transactional structure within their markets.

The majority of countries around the world introduced another system for trading within their stock markets. This system is characterized by a negligence of the role played by market maker in favor of the investor. In this sense, Madavan (1992) defined an order-driven market like a system in which investors place their orders in order to be executed by the method of the auction. The flexibility of this organization is mainly due the functioning because it can operate under continuous trading and gives investors the opportunity to submit their purchasing or selling orders for immediate execution against orders on the existing order book with prices determined multilaterally. While a quotation in auction provides an opportunity for investors to submit their orders before the opening in the marketplace to run when the market is opened with a price determined unilaterally. In order to understand the role played by the order-driven market, we had to try to distinguish this market with the price-driven market. Indeed, the order-driven market became more and more used as a suitable field to understand the anomalies. According to Ahn, Bae and Chan (2001), all the liquidity is supplied by the purchase orders and sales orders and not by the market maker. Without forgetting the role played by those orders as a source of volatility and transaction activity, researchers have exploited the situation enormously in order to show the seasonal pattern of each variable in this order-driven market.

In this framework, it is important to examine the informational content the order book by concentrating on the structural properties of the stock market. According to Noes and Skjeltorp (2006), this book represents the heart of the order-driven market through its ability to provide useful information on the liquidity and trading activity. On the developed stock markets as the Paris Bourse, Biais et al (1995) have confirmed the dependence of the pattern with the information effect. For their part, Hamao and Hasbrouck (1995) have concentrated on the stock market in Tokyo (TSE). This market represented one among the largest market in the world given its structural characteristics. This has allowed Lehman and Modest (1994) to investigate the behavior of the bid ask spread the trading volume, transaction and other variables of transactions by confirming the presence of a U-pattern. For his part, Vo (2007) attempted to show the pattern characterizing the liquidity, trading volume and volatility in the stock market (TSE) in the context specified by a dependency between the information flow and the investors. The results shown confirmed the presence of this anomaly in this market as the trading volume and the bid ask spread follow a U-pattern while the depth follows an inverted U-pattern. Recently, several researchers have oriented their microstructure studies on emerging stock markets adopting the order-driven system seen the improvement Technologies in information dissemination. This approach supports the view of Handa et al (1998, p.48) who said: "differently to a price driven market, the provision of liquidity in an order-driven market has received special attention in relation the microstructure literature." Within this framework it is part of the study of Brockman and Chung (1999) on the stock market in Hong Kong. They made two tests: an intertemporal analysis that allows them to confirm the inverted U-shaped profile of depth. And a cross-sectional analysis that enables them to demonstrate that the depth depends essentially on the adverse selection problem similar to the bid-ask spread. But the inter-temporal analysis appeared as a significant dependence of the behavior of liquidity with other variables such as price level, trading volume and volatility in order to verify that the provision of liquidity is a competitive dimension that will help to identify the best structure of mechanism transaction. Brockman and Chung (1998) also verified that the profile characterizing the Bid ask spread on the Hong Kong stock market is a profile in U. In a context of microstructure marked by a strategic interaction between insiders and uninformed, Lee, Fok and Liu (2001) have exploited the recent

availability of order book data from the stock market in Taiwan. They have tried to analyze the pattern of intraday information and liquidity. The results indicated that investors using an investment strategy generating a J-shaped profile for the volume of transaction. Ahn and Cheung (1999) have studied the evolution of the intraday Bid ask spread and depth on the Hong kong stock market They have confirmed the existence of the U-shaped profile of the Bid ask spread and an inverted U-shaped profile of the Bid ask spread. Research in this context also has motivated Ahn, Bae and Chan (2001) to investigate the role played by the order book in order to explain this anomaly on the Hong kong stock market They have focused their study on the empirical relationship between transitional volatility and orders flow depending on the investment strategies of orders by insiders and uninformed investors. The results shown seem to provide a clear explanation of how the placements of orders since investors want to place them at the opening and closing session of trading. By adopting J-pattern according to the pattern of trading volume, the phenomenon of the presence of regularity will be privileged because it also goes beyond the anomalies on the market efficiency but it also allows considering the micro-structural side of the market. This anomaly has been a famous importance that has also very interested Choe and Shin (1993). These authors have tried to study the stock market in South Korea. They found that the intraday pattern of return of the KSP index (KOSPI) is a U-pattern either throughout the trading day or during the morning session. This anomaly is all the same examined in the context Filanda by Camerton-Forde et al (2007). These authors have analyzed the intraday liquidity and trading activity, volatility and information. They found that the transactions of insiders and uninformed are concentrated at the opening and closing of the session transaction which confirms the presence of a U-pattern. In addition, the seasonal anomaly is more and more examined by other researchers on other emerging markets like Kalev and Pham (2009) who have exploited the availability of order book data and transactions in Australian market (ASX) for a period from October 2001 to January 2002. They have verified that the presence of intraday regularities is clearly higher for the stocks of small or medium sized companies compared to the actions of large companies. They verify the existence of an inverted U-shaped pattern of intraday trading activities and showed that informed traders search to minimize their transaction costs by the selection an optimum day of the week in order to trade. Indeed, they also show that informed traders determine the trading strategies depending on the time of day.

### 3. "Intraday Pattern" in the Theory

Several theoretical studies have attempted to explain this micro-structural phenomenon whether for a price-driven market or order-driven markets. They provided several theoretical explanations in order to conclude that this anomaly depends essentially on the information. In the financial market; the objective of all investors is to maximize their utility based on trading strategies depending on their possession of the information. This dependence represented the main process generating the micro-structural anomaly. But the availability of high frequency data which has motivated the research in this context. However, this new situation constituted empirically an appropriate ground so that the different patterns appear since the study of Wood et al (1985) on the NYSE. In order to achieve an explanation of what is "intraday pattern," the researchers focused their efforts to address this question theoretically : Why is there this anomaly is she? It seems more interesting to talk deeply as several explanations that have been used to support our thinking.

The first theoretical explanation of Admati and Pfleider (1988). They tried to answer three very important questions: Why were transactions concentrated in specific times of day compared to other times? Why are the returns more volatile in periods and less volatile in other periods? Why do the periods at high trading volume coincide with periods at high return volatility? In this context, they developed a theoretical model based on asymmetric information. This model essentially depends on the relationship between informed investors and investors need liquidity. They justified the presence of investor's liquidity in the market for strategic reasons in order to minimize the monopoly power of insiders since they seek to exploit their private information when uninformed investors make their transactions. Admati and Pfleider (1988) argued that the adoption of these behaviors on the part of insiders and investors need for liquidity can justify the behavior of intraday liquidity, trading volume, return volatility and return. Their theoretical model represented the first theoretical essay explaining the theory "Intraday pattern" in the financial market. Indeed, this theory has shown that all patterns are the result of strategic interaction between insiders and uninformed investors. In addition, their theoretical model is based primarily on investor liquidity needs and their actions in order to identify the different types of patterns. Investors seek the good times to make their transactions when market liquidity is high and transaction costs are down. This approach is also adopted by insiders who choose to do their transactions when the market is liquid. This strategic interaction between these two types of investors generates a situation of concentration of transactions at specific times during the trading session. This confirms the theoretical proposition that the trading of insiders at precise moments reflect the importance of private information. More precisely, the assertion that the increase in transaction costs depends on the occurrence of the problem of asymmetric information. This group of informed and uninformed investors at specific times of trading

day contributes to the development of a theoretical explanation of different types of intraday pattern. These patterns depend mainly on high liquidity and low cost of information asymmetry.

Another theoretical explanation has been advanced by Brock and Kleiden (1992) on the reasons of the emergence of seasonality in trading day. They developed a model showing that the demand for transactions at the opening and closing of the market is high and less elastic than other times of trading day. They tried to answer a very important question: why are transactions bent on opening and closing of the market? They focused their analysis on the necessity to rebalance the portfolio of actions at the opening and closing of the trading session by investors. First, the accumulation of information is made the night after market closure, ie during periods of non-transaction, generating a deviation from the optimal position. This situation obliges investors to increase their transaction at the opening of the market order to arrive at the optimum position and reach equilibrium of their portfolio. Second, before moving to the non-transaction period, the optimal position at the end is different from the optimal position during the trading day, forcing investors to increase their transaction at the end to achieve an optimal position. Their model shows that the grouping of transactions at the opening and closing for the goal in order to rebalance the portfolio that can lead to U-shaped profile. Kleiden Brock (1992) showed that the occurrence of seasonality in session is caused by the monopoly power of market makers and especially their willingness to have an optimal position at the close of the trading day before receiving information during the transaction and also to the inelastic demand of investors. They developed a model showing that market makers have filled their monopoly and exploit the inelastic demand of investors for making transactions at the opening and closing by increasing the bid ask spread. The main result of Brock and Kleiden (1992) was that seasonality depends mainly on the investor needs to rebalance their optimal positions. However, it should be noted that these authors have inspired their explanation the following lessons: First, the trading volume follows a U-pattern throughout the trading day. Second, the trading volume and liquidity are positively correlated due to the relentless demand for liquidity at the opening and closing of the market. In addition, the bid ask spread follows a U-pattern similarly to the trading volume. Third, the volatility is not correlated with trading volume and liquidity because the information flow is constant and does not follow "intraday pattern». Indeed, with the arrival of new information during the period of non-transaction, the portfolio that is optimal during the closure of the preceding trading day will be suboptimal when the new session will begin. Therefore trading activity increases immediately after the opening since investors can attempt to rebalance their portfolios.

#### **4. Description of the Market, the Dataset, Definition of Variables**

##### *4.1 Presentation of BVMT*

The Tunisian Stock Exchange is a private organization whose the shareholders are the stock market intermediaries. It is the enterprise that manages the stock market. Its operation is subject to control by the council of Financial Markets (CMF). The BVMT is a centralized market and governed by the orders because the investment can be achieved only through the brokers. Trading of shares takes place through quotation system developed by the Euronext group. Purchase orders and sales orders introduced in this system will be confronted depending on the degree of liquidity in two ways: The less liquid stocks are quoted according to the auction mode. The most liquid stocks are quoted according to the continuous mode. The BVMT is organized by the Law No. 94-117 of November 14<sup>th</sup>, 1994 on the reorganization of the financial market. But this legislation is inadequate for the development of BVMT, which motivated BVMT authorities to modify the Law No. 99-92 of August 17<sup>th</sup>, 1999 on the recovery of financial market. In the same context, there is the law No. 2005-96 of October 18<sup>th</sup>, 2005 on the strengthening of Financial Security. This law is an extension of the legislative reforms introduced by the financial authorities to strengthen financial transparency in the Tunisian stock market. Besides the legal reforms, there are other reforms in the Tunisian Stock Exchange. These include the introduction of an electronic trading system called SUPER-CAC UNIX in October 25<sup>th</sup>, 1996. This system is managed by a central computer which makes the comparison of purchase orders and sales orders. On December 3<sup>rd</sup>, 2007, the Tunisian Stock Exchange launched the new version of the electronic trading system V900 developed by Atos Euronext. All these reforms have focused on the development of the Tunisian Stock Exchange to enhance the stock market, to increase the trading activity and to restore the investor confidence that will be reflected by the liquidity evolution. The trading day in the Tunisian stock market pre-opens from 9 am to 10 am. During this period, the purchase orders and sales orders are entered without giving effect to the transactions. As soon as the market is open, the system determines an opening price that will be used only to transactions by the opening auction at 10 am. After opening and during the continuous session that lasts from 10 am to 2 pm, the introduction of an order in the system can generate an instantaneous transaction when there is an opposite order.

##### *4.2 Data*

In this study, we analyze the intraday behavior of trading activity, volatility and liquidity of stocks in the Tunisian stock market. Our sample includes 38 shares that have a continuous trading for a period of 9 months spanning the beginning of October 2008 to the end of June 2009. It consists of a database composed of two intraday files: a

trading file and quotation file. The transaction file contains intraday transaction prices and quantities next to the code of each stock on the transaction system, the date and transaction time. The second file represents the set of limit orders purchases and sales next to the code of each purchase order and sale order, the date and time entry of the order, the ASK price, the BID price entered by the intermediary stock exchange and the quantity appropriate for each ASK price and BID price. However, it should be noted that the constraints have made our task difficult in order to constitute our final database: at this level, we must mention the narrowness of the Tunisian secondary market and especially the problem of illiquidity of certain listed securities. The choice of this period in our study is justified by the recovery of Tunindex index in the first half of 2009, of its performance compared to the final quarter of 2008. It was able to achieve its level of September 2008 at the end of April 2009. To attain the final list of our study, we conducted several stages of filtering. Initially, the list contains 50 stocks. However, we exclude 12 shares listed on fixing since at this level, the law of supply and demand is not involved in this quotation type. Table 1 contains the final list of securities in our study. It provides the code and identification name of the 38 shares quoted continuously in the Tunisian stock market as well as the sectors they belong to. In addition, we determined the descriptive statistics of our sample. The details of this descriptive analysis are presented in Table 2. To conduct our research, this table shows that the daily average of trading volume per session during our retained period is about 34 transactions. The average number of transactions traded per day is 17,506. In addition, it is clear that the number of sale orders exceeds the number of purchase orders. The total amount of transactions performed during the period of study was 121 399 567. The total maximum quantity negotiated is 20163175 (Attijari Bank) while the total minimum quantity negotiated is 119,409 (BTE-ADP).

#### 4.3 The Determination of Variables

4.3.1 The return : Generally, we begin our analysis by the calculation of Stock return. From the transaction file, we are applying the following formula on the series of transaction prices of 38 securities traded continuously in order to measure geometrically the rate of return. The geometric rate of return is used in our study because several previous studies have adopted it. This authorizes us to compare our results with those from other studies.

$$R_t = [100 * (\ln(P_t) - \ln(P_{t-1}))] \quad (1)$$

with:  $R_t$ : Represents the return on stock  $i$  in interval  $t$ ,  $P_t$ : Represents the closing price of stock  $i$  in interval  $t$ .  $P_{t-1}$ : Represents the closing price of stock  $i$  in interval  $t-1$

4.3.2 The trading volume: Likewise to the return, the trading volume indicates the number of shares traded on each interval. We can measure it by this formula. The reason for using the natural logarithm is to normalize this variable so as not to fall into fallacious estimates.

$$V_t = [100 * \ln(\text{NAE}_t)] \quad (2)$$

With:  $V_t$ : Represents the trading volume of stock  $i$  in interval  $t$ .  $\text{NAE}_t$ :  $\text{NAB}$ : Represents the number of shares traded for stock  $i$  in interval  $t$ .

4.3.3 The return volatility: To proxy return volatility, the squared values of intraday stock returns are used. Brailsford (1996) employed the squared as volatility proxies for the Australian stock market.

$$R^2 = [R_t * R_t] \quad (3)$$

4.3.4 The quoted spread: The difference between the best of limited price for sale and the best of limited price of purchase represents the quoted spread.

$$\text{QSPR}_t = [(P_B) - (P_A)] \quad (4)$$

with:

$\text{QSPR}_t$ : The quoted spread in the interval  $t$ .  $P_B$ : The best limit price to buy (BID) of the interval  $t$ .  $P_A$ : The best limit price to buy (ASK) of the interval  $t$ .

4.3.5 The Depth: The depth indicates the quantity available for the purchase and sale, for each price level at a given instant.

$$\text{DEP}_t = \frac{(Q_B - Q_A)}{2} \quad (5)$$

With :  $\text{DEP}_t$ : Depth in the interval  $t$ .  $Q_B$ : The quantity available at the purchase price in the interval  $t$ .  $Q_A$ : The quantity available at the selling price in the interval  $t$ . Once all the series of all variables are determined, we need to construct a cross-sectional database. To do this, Abhyanker et al (1997) have presented an empirical methodology to achieve this aim. For each time interval  $t$  ( $t = 1 \dots .24$ ). We compute the weighted average for all shares  $i$  ( $i = 1 \dots 38$ )

through all the trading sessions  $j$  ( $j = 1 \dots 184$ ). The study of the seasonal anomaly in the Tunisian stock market will be investigated as soon as the cross-sectional database is created.

## 5. Methodology and Empirical Results

Our study is inspired of the Vo (2007) study on the Canadian stock market. At this level, the availability of high-frequency data on the Tunisian stock market especially after the implementation of the Financial Security Law in 2005 motivated us to use this data to analyze profoundly the seasonal liquidity, volatility and trading activity and especially to study the different correlations between the micro structural aggregates. However, before we implement our methodology, we, first, try to identify the variables necessary to respond to our research questions. The achievement of the importance of intraday analysis of the seasonal anomaly requires the division of trading day in equal intervals of time. The application of this empirical approach of our sample allows us to divide the trading day from 10 am to 2 pm over 24 intervals and retain a sampling interval of 10 minutes each. Indeed, the analysis of seasonality requires, first of all, the determination and definition of variables in our study.

### 5.1 Testable Hypothesis

In this section, we investigate the intraday behavior of trading activity, volatility and liquidity. To do this, we analyze graphically all variables in order to finalize with the estimation of models. Table 3 refers to the standardized average values for all variables of 38 securities for each time interval during the trading day. To accomplish our detailed analysis of the regularities in the Tunisian stock market, we needed to formulate the following hypotheses. The market efficiency hypothesis considers that the stock prices include all the information available on the market. Indeed, this hypothesis supports the idea that the variables of liquidity and transactions are constant throughout the trading day. So our approach is based on the following hypothesis:

Hypothesis 1: The evolution of variables of trading activity, return volatility and liquidity are constant during the trading day.

Hypothesis 2: The evolution of variables of trading activity, return volatility and liquidity are not constant during the trading day. At this level, we will attempt to test these hypotheses on the Tunisian stock market in order to analyze the evolution of different variables. It would certainly be interesting to follow an empirical process based upon two paths.

### 5.2 The Graphical Analysis of Intraday Behavior of the Trading Activity, Return Volatility and Liquidity

It is therefore appropriate to start with a graphical analysis that is important for viewing the behavior of different variables in the Tunisian stock market. Table 3 presents the cross-sectional average of standardized return, standardized trading volume, Standardized return volatility, standardized quoted spread and standardized depth for each interval of 10 minutes of the trading day. The following figures show the evolution of liquidity and trading activity over time in the Tunisian stock market.

From the visualization of different figures, we can observe that the figure 1 displays the intraday movements of return during the trading day. It reveals that the intraday behavior of return follows almost the U-Pattern. During the first minutes of trading, the return attained a high level that is equal to 2,049. This return decreases and varies between -1 and 1 throughout the trading day. At the end of quotation, it achieved a peak that reaches 3,451. Hence, the confirmation of our second hypothesis. Certainly, we can say that this result coincides with the results shown on the order-driven market (Bildik (2001)). Second, the trading volume is globally variable in the day. Figure 2 also highlights that the configuration of intraday trading volume is in U and more precisely in W. We notice, however, a high trading volume over the first ten minutes of the session quotation as well as a strong increase at the close of the day. However we find in the middle of the day that the trading volume comes to decrease after the first interval in order to increase again until reaching the value 1 at 11:30 am. This persistence of the growth of the trading volume has been interrupted and has declined again. Third, figure 3 shows clearly that the intraday behavior of return volatility follows the shape U. We observe that high return volatility exists at the beginning of the session quotation. However this volatility has declined rapidly and continues to decrease throughout the day in order to pick up again in the last ten minutes. The latter result is consistent with the results of Ahn, Bae and Chan (2001). In addition, the figure 4 shows that the quoted spread also follows the U-shaped profile. We notice that the spread is high at the beginning of the market followed by a reduction during the two following intervals. During the trading day, the liquidity has decreased again except a slight reduction at the level of interval 15 to regain on the rise to the market close. This finding of U-shaped profile coincides with the results of Chung et al (1999) on the NYSE and those of Vo (2007) on the TSE. Finally, the visualization of the figure 5 provides information on the intraday behavior of depth. This figure also supports the U-shaped profile. But this profile is different compared to the profile of the quoted spread. The depth was high at the beginning of the session, and then decreases throughout the trading day

and it is growing during the last half hour before the closure of negotiations. This showed U-shape in the Tunisian stock market is consistent with the proven results on the NYSE by Lee, Mucklow, and Ready (1993) and on the Paris stock exchange by Biais et al (1995) and the SEH justified by Ahn et al (2001).

However, the question asked here is to know whether our proposed hypotheses in accordance with the theory of efficiency have been confirmed or not. In the first stage, the evolutions profiles show that the Tunisian stock market is liquid at the beginning of quotation, since we find that the spread and the depth at the best limit are very high during the first 10 minutes in order to decrease during the next 20 minutes. While during the trading day, the Tunisian stock market is illiquid since the price dimension of liquidity (quoted spread) increased while the quantity dimension (the depth at the best limit) is down. But the observation of the profiles confirms the finding of an upward trend of market liquidity during the last 30 minutes of quotations. It is clear that the spread and depth at the best limit are very high at the end of quotations. This change in liquidity at the Tunisian stock market tends to confirm the presence of anomaly of seasonality.

In a next phase, we observe an intraday evolution very similar of trading activity with that of liquidity. A possible interpretation, consistent with the results obtained here would be that the hypothesis 2 presented above was accepted either for liquidity variables or trading activity variables. These results coincide with the results shown by several empirical studies such as studies of Jain and Joh (1988), Foster and Viswanathan (1993), Jang and Lee (1993) on the NYSE and Chan, Christie and Schultz (1995) on the NASDAQ. For this, the question that arises at this level, why do these patterns exist? It is necessary to submit briefly the explanations justifying the presence of this seasonality in liquidity and trading activity in the Tunisian stock market. We will build our analysis on two theoretical foundations: the adverse selection theory and inventory theory. Initially, the simultaneous analysis of the spread and depth will doubtlessly allow us to have a better comprehensive view on the supply of liquidity in the order book. However, the primary objective of investors is to position itself in an optimal way on the market and rebalance their portfolios by increasing the spread and decreasing the depth in order to cope with the risk of adverse selection.

However, our results showed that the spread and the depth have the same behavior at the opening and closing trading. In other words, there is an improving liquidity during the first minutes and last-minute of quotation. At the opening, the improving liquidity can be attributed to the intense competition between the agents of limit orders that place orders rapidly such that they are executed in order to search the profitable opportunities although the risk of detention of private information by informed investors is very important. Furthermore, this result does not agree with the hypothesis of asymmetric information that requires an illiquid market at the opening. Whereas at closing we observe an increase of two dimensions of liquidity. This change in the degree of liquidity at the closing might be explained by the need for investors to have an optimal inventory position, and especially to execute them by the price closing. But as from 10:30 a.m. we notice a deterioration in liquidity as investors become more conservative due to the increasing the risk of adverse selection. This prudence is reflected in a higher spread and low depth. This transaction strategy adopted by the underwriters to limit orders appears very different to that adopted in other markets.

In a second step, we are proposing to analyze and explain the dynamics of intraday trading activity. The results have shown that the Tunisian stock market is characterized by a concentration of trading volume at the opening and closing of the trading session. While inside the trading day, trading volume has remarkably declined. This U-shaped profile, according to Lee, Fok and Liu (2001), represents a global phenomenon, since several studies have revealed the presence of such intraday behavior as the works of Wood, McInish and Ord (1985), McInish and Wood (1990a), McInish and Wood (1992) and Lockwood and Linn (1990) respectively on the NYSE and the TSE. And the works of Chow, Lee, Liu (1994) and Liu (1994), Ho and Cheung (1991), as well as Ho Cheung and Cheung (1993) respectively on Taiwan stock market and SEHK. Jain and Joh (1988) have justified the high level of trading activity precisely at the opening by the willingness of investors to exploit the collected information the eve and before the opening of the market in order to achieve their transactions. Admati and Pfleiderer (1988) suggest that uninformed investors react together to make transactions to limit the informational advantage of insiders. For their part, informed investors attempt to exploit their private information and make transactions at the opening before this information becomes public. Brock and Kleidon (1992) provide an important explanation for this anomaly. They show that investors exploit the advent of new information and make transactions at the opening and closing of the market for the objective of rebalancing their portfolios. Next to the profile of trading activity, the U-profiles of return and return volatility may be allocated to the increased important accumulation of information the eve and before the opening of the Tunisian stock market. These results imply that the collected information (public or private) will be immediately and implicitly incorporated into stock prices since the market opening. Our results coincided with the results of Wood et al (1985), Harris (1986), Jain and Joh (1988) on the NYSE, Copeland and Jones (2002) on the Korean market. But it must be mentioned that the attribution of high levels of return and return volatility at

the opening and closing quotation in the Tunisian stock market, is only due to the information flow, is insufficient. Since the previous literature has shown the existence of a very important factor generating this anomaly. Amihud and Mendelson (1987), Stoll Whaley (1990) have highlighted the importance of trading in fixing on the return and volatility. They have shown that the return and the volatility calculated on the basis of price fixing are high during the first minutes and the last minutes of trading.

### 5.3 The Empirical Analysis of the Regularities of Intraday Trading Activity, Volatility and Liquidity

The graphical analysis has shown the presence of the anomaly of seasonality in the Tunisian stock market. It therefore seemed interesting to adopt and to estimate the same methodological approach of Vo (2007) to verify this result. To test the significance of different patterns of liquidity, volatility and trading activity, standardized variables are regressed on a set of dummy variables representing the intraday intervals. The following parameters of the model are estimated by using OLS.

$$SDR_t = \alpha_0 + \sum_{k=1}^n \alpha_t D_k + \varepsilon_t \quad (6)$$

$$SDV_t = \alpha_0 + \sum_{k=1}^n \alpha_t D_k + \varepsilon_t \quad (7)$$

$$SDR_t^2 = \alpha_0 + \sum_{k=1}^n \alpha_t D_k + \varepsilon_t \quad (8)$$

$$SDSPREAD_t = \alpha_0 + \sum_{k=1}^n \alpha_t D_k + \varepsilon_t \quad (9)$$

$$SDDepth_t = \alpha_0 + \sum_{k=1}^n \alpha_t D_k + \varepsilon_t \quad (10)$$

Where,  $SDR_t$ ;  $SDV_t$ ;  $SDR_t^2$ ;  $SDSPR_t$ ;  $SDDepth_t$  represent standardized variables of return, volatility, trading volume, spread and depth in the interval generating  $t$ .  $n$  is the number of intervals in the trading day with  $n$  ranging from 1 to 24.  $D_t$  are dummies variables equal to 1 if the observation  $t$  occurs in the interval  $k$ , 0 else. In addition, our sample is over 30. Above all, we estimate different equations for each stock market using the OLS estimation method. Thus, we exploit the  $t$ -statistics that is consistent against heteroscedasticity and autocorrelation in order to justify the significance of estimated parameters.

The estimation results are reported in Table 4. We are finding that the return is high at the beginning of the market since  $\alpha_1$  is statistically significant and positive and very superior to the other successive coefficients. But this decreasing trend throughout the day did not last long in order to achieve its high level at the closing of market. This result is translated by an increase of coefficient values during the last thirty minutes ( $\alpha_{24} > \alpha_{23} > \alpha_{22}$ ). Statistical significance and the positivity of these coefficients absolutely confirm the result that the return reaches its higher level at the end of the trading day. It is no surprise from the above that our results maintain the results generated by graphical analysis. In addition, we use the unconditional correlation as a measure of the degree of liaison between all the variables in our study. The observation of the unconditional correlation matrix confirms the presence of a very high positive correlation between the return with other variables (the trading volume (0,99 and 0,98), the return volatility (0,95 and 0,99), the spread (0,80 and 0,99) and the depth (0,64 and 0,97)) respectively during the first three intervals and the last day of trading. For the trading volume we notice that it reaches a high level at the beginning and closing of the market since the results have shown that coefficients  $\alpha_1$  and  $\alpha_{24}$  are statistically significant and positive and superior to other dummy coefficients estimated in the model (9). This also confirms the result shown by the graph of the trading volume profile. Similarly to the trading volume, we also observe that the return volatility is significantly high in the first and last minutes of the trading session. This is reflected by the significance and positive coefficients  $\alpha_1$  and  $\alpha_{24}$  and more specifically their superiority compared with other coefficients.

According to the above, we can mention that there is a positive relationship between trading volume and return volatility during the first minutes and the last minutes of trading day. This finding corresponds to the theoretical

proposition of Admati and Pfleiderer (1988) that periods of high trading volume tend to be periods of high return volatility. According to Easley and O'Hara (1992), we can also explain this situation by the fact that a high trading volume represents an indication of the arrival of insiders on the market. This will increase the risk of transactions with investors and especially the probability of achieving losses and therefore the opportunity to observe high levels of the return volatility during these periods. The analysis is thus clearer regarding the interpretation of the correlation matrix. Indeed, the results have shown the unconditional positive correlation between trading volume and return volatility (0, 96 and 0, 99) respectively for the first and last three intervals during the trading session.

For the dimensions of liquidity, the regression results have shown that the spread is characterized by a high level at the opening and closing of the market compared to the inside of the trading day. The values of estimated coefficients confirm our results of a U-shape since we have observed that the coefficient  $\alpha_1$  is statistically insignificant and negative but higher than the coefficients  $\alpha_{22}$  and  $\alpha_{23}$  that are significant. Similarly, the coefficient  $\alpha_{24}$  is significant and positive. It attained a high level compared to the coefficients  $\alpha_{22}$  and  $\alpha_{23}$ . To understand this phenomenon, we can deduce the existence of a direct relationship between the return volatility and the spread for the opening and closing of the market. Foucault (1999) justified this nature of relationship with the demonstration that when the market is volatile, the probability to encounter insiders increases, which will increase the losses of the uninformed investors. To resolve this problem, they try to place limit orders to buy at low prices and limit orders to sell at high prices. This investment strategy generates a higher spread. For depth, we have found that the coefficient  $\alpha_1$  is significant and positive. This means that this quantity dimension of liquidity is extremely high during the first minutes of trading. But this increasing trend does not long remain in order to decrease during the trading day ( $\alpha_1 > \alpha_2 > \alpha_3 > \alpha_4 > \alpha_5 > \alpha_6 > \alpha_7 > \alpha_8 > \alpha_9 > \alpha_{10} > \alpha_{15} > \alpha_{16} > \alpha_{17} > \alpha_{18} > \alpha_{19} > \alpha_{20} > \alpha_{21}$ ). Yet during the last minutes of trading, we noticed that liquidity is characterized by a remarkable increase. This behavior is reflected by the significance and negativity and especially the superiority of  $\alpha_{24}$  compared to  $\alpha_{22}$  and  $\alpha_{23}$ . The most surprising from the above is that although the high level of volatility at the opening and closing of the market, liquidity seekers do not hesitate to increase their spread but in return they retain high levels of the depth at the best limit. Similarly to the trading volume, we also notice, from the unconditional correlation matrix, that there is a positive correlation of the return volatility with the spread (0.94 and 0.99) and depth at the best limit (0.83 and 0.98) respectively during the first three and last intervals of the transaction day. This result does not coincide with the explanation of Foucault (1999) that the strategic behavior of the Agents of limit orders for these active periods is the increase of the spread and reducing of the depth at the best limit in order to protect against the risks mentioned above. The justification that we can offer is that the need for liquidity and rebalancing the optimal portfolio requires such applicant's liquidity to adopt this strategy. We apply reconciliation between intraday behavior of the depth and trading volume. Our results have shown the existence of high level of depth accompanied by a high level of trading volume. This result was confirmed by the presence of a very high positive correlation between trading volume and the two dimensions of liquidity (the spread (0.82 and 0.98) and depth at the best limit (0.66 and 0.99)) for the first and last half hour of the trading day. We think that this result is different from that shown by Lee et al. (1993), Ye (1995) and Kavajecz (1999). They have proven that during these trading periods, the trading volume is characterized by a high concentration when the depth reaches a low level. Indeed, this explanation implies more than the strategic actions of the applicants of liquidity represent the main source to have this type of relationship. In addition, the high level of spread and depth at the beginning and the end of the session shows that investors do not take into consideration the risk of non-execution of their orders whose objective is to have very advantageous position in the market in order face competition with other suppliers of liquidity. Therefore, the extension of two dimensions of liquidity is verified by the existence of positive unconditional correlation between spread and depth at the best limit.

#### 5.4 The Spectral Analysis of the Behavior of Intraday Trading Activity, Return Volatility and Liquidity

After having applied the graphical and empirical analysis, the next step consists of applying the spectrum analysis. The Fourier series development is founded on the principle that every periodic function of time  $x(t)$  can be decomposed into an infinite sum of sines and cosines of which frequencies start at zero and increase in integer multiples of a basic frequency  $f_0 = 1/T$ , where  $T$  is the period of  $x(t)$ . To account for time series, we decompose the process  $x(t)$  in periodic components by adopting the criteria of frequencies. In fact the Fourier transformation is one of the methods frequently used in spectral analysis. The Fourier transformation has already been considered as a particular mathematical case of Laplace transformation. This method can automatically detect the seasonality and more specifically to analyze the frequency of the process  $x(t)$ . In other words, the Fourier transform can be used to diagnose the periodic structures in time series data. It transforms an original function which is often a periodic function into another, which is called the frequency domain representing the original function. According to the Fourier theorem, any time series can be formulated as the sum of sines and cosines of different frequencies and



magnitudes. The Fourier transform allows decomposing a series  $x(t)$  ( $t=1\dots n$ ). We can write the Fourier development as follows:

$$x(t) = \alpha_0 + \sum_{k=1}^{\infty} (\alpha_k \cos(2\pi k f_0 t) + b_k \sin(2\pi k f_0 t)) \quad (11)$$

By knowing the basic frequency and the function  $x(t)$ , the achievement of a Fourier transform consists in determining all values  $\alpha_k$  and  $b_k$  that make up the series. The Fourier transform adopts another form that can be represented by the following function:

$$\hat{f}(w) = \int_{-\infty}^{+\infty} f(t) e^{-iwt} dt \quad (12)$$

The inverse Fourier transformation is as follows:

$$f(t) = \int_{-\infty}^{+\infty} \hat{f}(w) e^{iwt} dw \quad (13)$$

We had necessary to use Matlab in order to apply the spectrum analysis of the various series. However, the spectrum analysis has allowed us to appreciate the existence of seasonality and especially to take part in the determination of the appropriate pattern for all variables mentioned above. The application of Fourier transform (FFT) confirms our results proven above. To illustrate this point, we figure the results of the application of spectrum analysis on all variables by graphics with the abscissa and the ordinate respectively the frequency and the magnitude. These specters show clearly the existence of seasonality that is manifested by significant spectral peaks in seasonal frequencies at the opening and closing trading days reflecting a seasonal effect which characterizes all variables of liquidity, volatility and trading activity.

This type of frequential analysis is generally used to prove that a signal has the dominant frequencies: when we represent the spectra, we see that there were some significant peaks, indicating that the signal possesses a certain periodicity in the corresponding frequencies. Figure 6 illustrates the spectrum of the series standardized return. We find that there exists a significant peak at the opening trading day with a magnitude of 5.771 and a frequency of 0.001667 KHz and another significant peak at the end of the day with magnitude of 5.771 but frequency of 0.05167 kHz. Indeed, the series of return analyzed and presented two remarkable periodicities when frequencies present a remarkable peak. Similarly, the results illustrated in Figure 7 for the spectrum of standardized trading volume, showed that there were some large fluctuations at the start of trading session with a magnitude of 15,06 and a frequency of 0,001667 KHz and also at the end of trading for a magnitude of 15,06 but the frequency of 0,5167 KHz. The analysis of the frequential evolution of standardized return volatility illustrated in figure 8, indicates that the presented series is characterized by a considerable variability since there is a significant peak at the beginning of the trading session with a magnitude of 17, 57 and a frequency of 0,001667 KHz and another significant peak at the end of the day with a magnitude 17, 57 and frequency of 0, 5167 KHz.

Regarding the dimensions of liquidity, Figure 9 illustrates the spectrum of the standardized quoted spread. We also found that there is a great variability justified by significant peak at the opening of trading day with magnitude 18, 86 and frequency of 0,001667 KHz and another significant peak at the close of the day with magnitude but a frequency of 0, 05167 KHz. For the other dimension of liquidity, it is clear from Figure 10, that the spectrum analysis of the depth confirms the existence of significant peak at the opening with a magnitude 31,24 and a frequency of 0,5167 KHz and another significant peak at the close with a magnitude 31,24 and frequency of 0,5167 KHz.

Finally, our showed results in this study are important in both theoretical and applied implications. On the theoretical level, our study agreed with the theory of microstructure and more precisely with the theoretical explanation of the presence of an anomaly in the financial market by asymmetric information. On the applied level, our results can build an appropriate analysis to investors to be able to implement their strategies of speculation. More precisely, speculation is characterized by taking a risky position on a placement to invest on the future evolution of stock in order to accomplish capital gains. Indeed, investors, through their knowledge of the seasonal pattern characterizing trading activity, volatility return and liquidity, may react and achieve transactions for the adequate moments they want.

## 6. Conclusion

We have attempted in this paper to clarify the intraday behavior of liquidity, volatility and trading activity in financial markets. The existence of seasonality characterized this behavior which will contradict the hypothesis of market efficiency. The previous literature has shown the existence of this micro-structural anomaly since the study

of Wood, Mc Inish and Ord (1985). The majority of these studies showed that the trading volume, return volatility and liquidity profile follow the U-shaped. All these variables are at the highest level at the opening of trading, they decline rapidly to lower levels lower in the middle and then they increase again during the final minutes of trading. We have tried to verify the existence of seasonality in trading activity, volatility and liquidity, and especially to show the reasons for this anomaly in the Tunisian stock market: a market governed by the orders. To achieve this goal, we have used a sample of high-frequency data for a period which runs from October 2008 until June 2009. We have applied two methods: the temporal analysis is to estimate a dichotomic model for each variable by following the methodological approach of Vo (2007) and the second method is to apply the spectrum analysis by using the Fourier Transform fast (FFT). The results have shown that all identified variables are characterized by a notable seasonality justified the rejection of the hypothesis of constancy (H0). Both methods have shown the existence a seasonal pattern in U. The reason considered to justify this intraday behavior is the crucial role played by the problem of adverse selection especially between the two dimensions of liquidity: the spread and the depth at the best limit. We should also note that the effect of inventory management on the optimal allocation of the portfolio.

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Table 1. The list of shares listed continuously on the Tunisian stock market during the period October 2008 - June 2009

<b>Code</b>	<b>Stock</b>	<b>INDUSTRY</b>
725001	ADWYA	Health
340005	AMEN BANK	Financials
730001	ARTES	Consumer services
714001	ASSAD	Consumer goods
360035	ATB	Financials
470010	ATL	Financials
160015	ATTIJARI BANK	Financials
190060	BH	Financials
180045	BIAT	Financials
310060	BNA	Financials
220005	BT	Financials
130055	BTE-ADP	Financials
420085	CIL	Financials
720001	EL WIFACK LEASING	Financials
665001	ELECTROSTAR	Consumer goods
721001	ESSOUKNA	Industrials
713001	GIF	Consumer goods
644001	MAGASIN GENERAL	Consumer services
100010	MONOPRIX	Consumer services
570001	POULINAGROUP HLD	Financials
110025	SFBT	Consumer goods
659001	SIAME	Industrials
400005	SIMPAR	Industrials
667001	SIPHAT	Health
718001	SITS	Industrials
678001	SOMOCER	Industrials
653001	SOTETEL	Telecommunication
666001	SOTRAPIL	Oil and Gas
658001	SOTUMAG	Consumer services
656001	SOTUVER	Industrials
140070	SPDIT-SICAF	Financials
606001	STAR	Financials
260095	STB	Financials
727001	TPR	Basic Material
410020	TUNINVEST-SICAR	Financials
120040	TUNISAIR	Consumer services
210090	TUNISIE LEASING	Financials
390010	UIB	Financials

Table 2. Descriptive statistics over the period October 2008 - June 2009

Variables	Value
Number of companies	38
Trading days	184
Number of transactions	240564
Quantities of transactions	121399567
Daily Average of the number of transactions by stock	34
Total maximum quantity traded for Attijari Bank	20163175
Total minimum quantity traded for BTE-ADP	119409
Average daily of trading volume by the action	17506
Number of purchase orders submitted	170413
Quantities of stocks submitted by purchase orders	130262717
Number of sale orders submitted	158099
Quantities of stocks submitted by sale orders	130616034

Table 3. The standardized average of return, trading volume, return volatility, spread and depth of 38 shares quoted in the Tunisian stock market during the period of October 2008-June 2009.

Time Interval	Stand return	Stand trading volume	Stand return volatility	Stand quoted spread	Stand depth
10:00:00-10:10:00	0.8994	3.8556	6.5690	-0.2669	3.2521
10:10:00-10:20:00	-0.3397	0.1709	2.1558	-1.0366	3.0942
10:20:00-10:30:00	-0.2573	0.2864	0.7928	-1.9360	2.5917
10:30:00-10:40:00	-0.4611	0.2675	-0.1478	-1.5782	2.1298
10:40:00-10:50:00	-0.4635	0.5032	0.2974	-1.3097	1.9516
10:50:00-11:00:00	-0.5281	0.6226	0.2563	-1.2487	1.5843
11:00:00-11:10:00	-0.2454	0.4679	-0.1482	-0.7586	1.1715
11:10:00-11:20:00	-0.4800	0.6026	0.0554	-0.8748	1.0153
11:20:00-11:30:00	-0.2340	0.8543	-0.1303	-0.5915	0.8403
11:30:00-11:40:00	-0.2640	0.3362	-0.4138	-0.5413	0.1713
11:40:00-11:50:00	-0.2174	0.5057	-0.3939	-0.3601	0.2582
11:50:00-12:00:00	-0.1775	0.1502	-0.6186	-0.1237	-0.0843
12:00:00-12:10:00	-0.2285	-0.1036	-0.7242	0.0330	-0.2031
12:10:00-12:20:00	0.1890	-0.8539	-0.9079	-0.0724	-0.9182
12:20:00-12:30:00	-0.1872	-1.0989	-1.1878	-0.2090	-0.9698
12:30:00-12:40:00	0.0289	-0.9780	-0.7344	0.4608	-1.4721
12:40:00-12:50:00	-0.0009	-1.5465	-1.0798	0.6596	-1.4800
12:50:00-13:00:00	0.0824	-1.5922	-0.6250	0.6435	-1.7698
13:00:00-13:10:00	0.0269	-1.4585	-0.9340	0.5848	-2.0680
13:10:00-13:20:00	-0.2196	-1.4928	-0.8808	0.7660	-2.2019
13:20:00-13:30:00	0.4064	-1.5666	-0.8513	1.3140	-2.4283
13:30:00-13:40:00	0.1778	-1.1224	-0.8307	1.5469	-2.1907
13:40:00-13:50:00	0.5659	0.3719	-0.3692	1.8643	-1.5452
13:50:00-14:00:00	1.9276	2.8180	0.8515	3.0349	-0.7290

Table 4. Estimation of different models of the intraday liquidity, volatility of return and trading activity for the 38 stocks quoted in the Tunisian stock market during the period of October 2008-June 2009.

		Stand return	Stand trading volume	Stand return volatility	Stand quoted spread	Stand depth
$\alpha_0$	Coefficient	-0,1086	-0,0295	-0,3392	-0,0671	-0,1215
	t-statistic	-2,1150**	-0,6476	-7,4333*	-1,6051	-3,7709*
$\alpha_1$	Coefficient	1,0080	2,0049	3,7102	-0,0698	1,7903
	t-statistic	8,7793*	19,6436*	36,3517*	-0,7468	24,842*
$\alpha_2$	Coefficient	-0,2311	0,1554	1,4455	-0,4648	1,7093
	t-statistic	-2,0128***	1,5230	14,1635*	-4,9693*	23,7180*
$\alpha_3$	Coefficient	-0,1487	0,2134	0,7461	-0,9263	1,4515
	t-statistic	-1,2950	2,0913**	7,3105*	-9,9031*	20,1404*
$\alpha_4$	Coefficient	-0,3525	0,1725	0,2634	-0,7427	1,2144
	t-statistic	-3,0702*	1,6904**	2,5810**	-7,9403*	16,8511*
$\alpha_5$	Coefficient	-0,3549	0,2772	0,4919	-0,6049	1,1230
	t-statistic	-3,0909*	2,7162*	4,8199*	-6,4675*	15,5829*
$\alpha_6$	Coefficient	-0,4195	0,3980	0,4708	-0,5736	0,9345
	t-statistic	-3,6540*	3,8995*	4,6130*	-6,1328*	12,9673*
$\alpha_7$	Coefficient	-0,1368	0,2561	0,2632	-0,3221	0,7227
	t-statistic	-1,1916	2,5096**	2,5788**	-3,4439*	10,0284*
$\alpha_8$	Coefficient	-0,3714	0,3108	0,3677	-0,3817	0,6425
	t-statistic	-3,2347*	3,0454*	3,6030*	-4,0814*	8,9162*
$\alpha_9$	Coefficient	-0,1254	0,4510	0,2724	-0,2363	0,5527
	t-statistic	-1,0924	4,4193*	2,6689**	-2,5271*	7,6702*
$\alpha_{10}$	Coefficient	-0,1554	0,1710	0,1269	-0,2106	0,2094
	t-statistic	-1,3539	1,6761	1,2435	-2,2517**	2,9066*
$\alpha_{15}$	Coefficient	-0,0786	-0,4973	-0,2702	-0,0401	-0,3761
	t-statistic	-0,6847	-4,8730*	-2,6480**	-0,4289	-5,2195*
$\alpha_{16}$	Coefficient	0,1375	-0,4699	-0,0375	0,3036	-0,6339
	t-statistic	1,1980	-4,6047*	-0,3682	3,2460*	-8,7958*
$\alpha_{17}$	Coefficient	0,1076	-0,7898	-0,2148	0,4056	-0,6379
	t-statistic	0,9378	-7,7384*	-2,1048	4,3365*	-8,8519*
$\alpha_{18}$	Coefficient	0,1911	-0,8213	0,0185	0,3974	-0,7866
	t-statistic	1,6644	-8,0471*	0,1816	4,2485*	-10,915*
$\alpha_{19}$	Coefficient	0,1355	-0,7325	-0,1400	0,3672	-0,9396
	t-statistic	1,1805	-7,1770*	-1,3719	3,9265*	-13,038*
$\alpha_{20}$	Coefficient	-0,1110	-0,7356	-0,1127	0,4602	-1,0084
	t-statistic	-0,9673	-7,2073*	-1,1042	4,9205*	-13,992*
$\alpha_{21}$	Coefficient	0,5150	-0,7997	-0,0975	0,7414	-1,1245
	t-statistic	4,4860*	-7,8358*	-0,9559	7,9265*	-15,604*
$\alpha_{22}$	Coefficient	0,2864	-0,5607	-0,0870	0,8609	-1,0026
	t-statistic	2,4945*	-5,4945*	-0,8525	9,2041*	-13,911*
$\alpha_{23}$	Coefficient	0,6745	0,2119	0,1497	1,0238	-0,6714
	t-statistic	5,8746*	2,0762**	1,4675	10,9456*	-9,3160*
$\alpha_{24}$	Coefficient	2,0362	1,4940	0,7762	1,6245	-0,2526
	t-statistic	17,733*	14,6381*	7,6056*	17,3673*	-3,5049*

Notes: \*\*\* 10% significance level, \*\* 5% significance level, \* 1% significance level



Table 5. Matrix of unconditional correlation between all variables

	Variables	Stand return	Stand trading volume	Stand return volatility	Stand quoted spread	Stand depth
<b>All intervals</b>	Stand return	1.0000	0.4129	0.3247	0.7775	-0.2703
	Stand trading volume		1.0000	0.7821	-0.1145	0.6688
	Stand return volatility			1.0000	-0.1937	0.6760
	Stand quoted spread				1.0000	-0.7604
	Stand depth					1.0000
<b>The first three intervals</b>	Stand return	1.0000	0.9994	0.9590	0.8092	0.6404
	Stand trading volume		1.0000	0.9675	0.8275	0.6646
	Stand return volatility			1.0000	0.9425	0.8317
	Stand quoted spread				1.0000	0.9694
	Stand depth					1.0000
<b>The eighteen intervals within the trading day</b>	Stand return	1.0000	-0.7616	-0.7346	0.8534	-0.8314
	Stand trading volume		1.0000	0.8342	-0.8609	0.9166
	Stand return volatility			1.0000	-0.8088	0.8685
	Stand quoted spread				1.0000	-0.9716
	Stand depth					1.0000
<b>The last three intervals</b>	Stand return	1.0000	0.9851	0.9984	0.9999	0.9704
	Stand trading volume		1.0000	0.9932	0.9836	0.9974
	Stand return volatility			1.0000	0.9979	0.9824
	Stand quoted spread				1.0000	0.9683
	Stand depth					1.0000

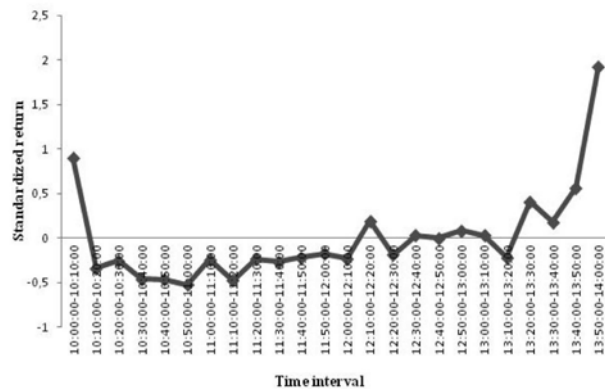


Figure 1. Evolution of intraday standardized return

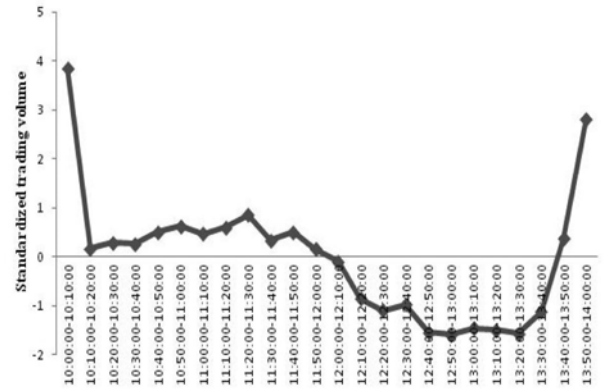


Figure 2. Evolution of intraday standardized trading volume

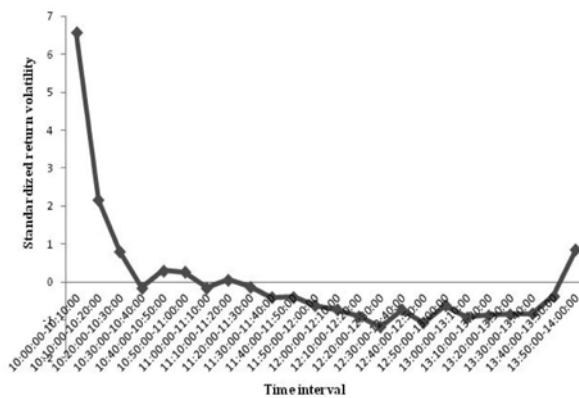


Figure 3. Evolution of intraday standardized return volatility

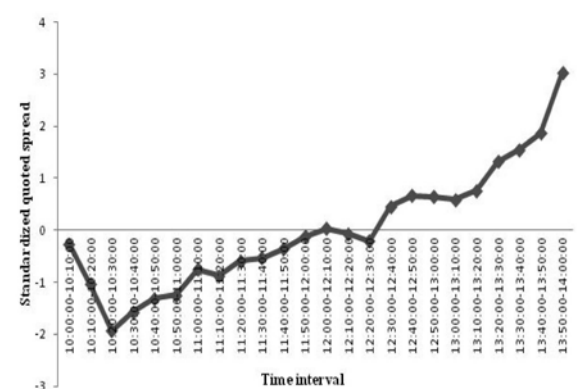


Figure 4. Evolution of intraday standardized quoted Bid ask spread

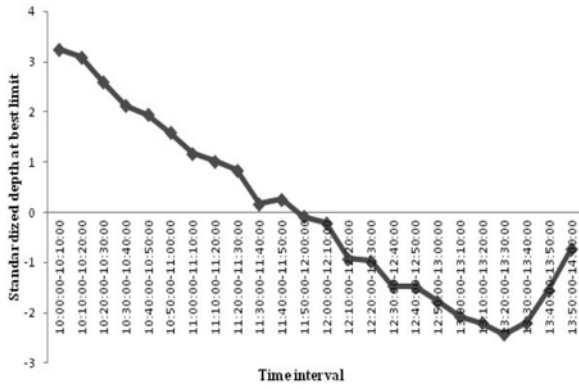


Figure 5. Evolution of intraday standardized depth at best limit

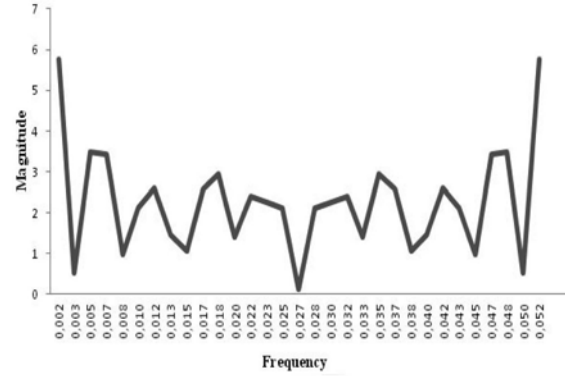


Figure 6. The return spectrum obtained by FFT

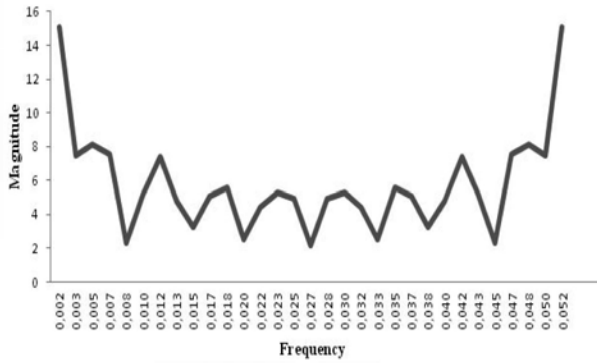


Figure 7. The trading volume spectrum obtained by FFT

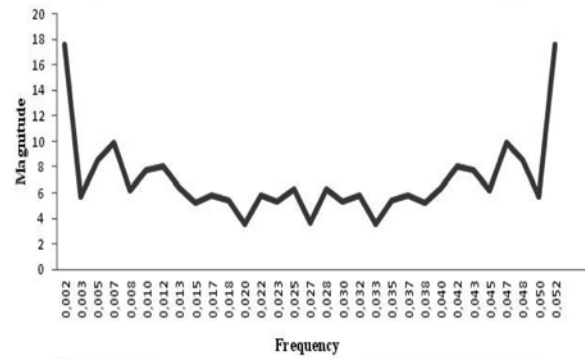


Figure 8. The return volatility spectrum obtained by FFT

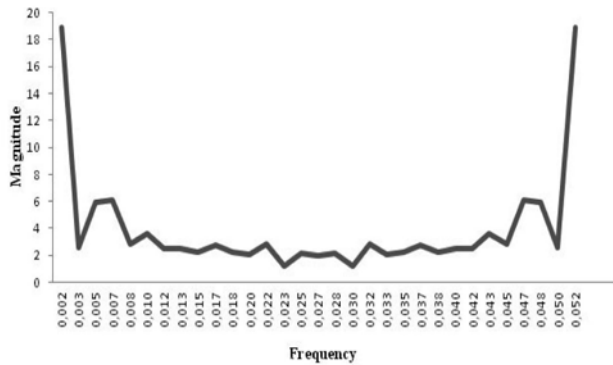


Figure 9. The quoted spread spectrum obtained by FFT

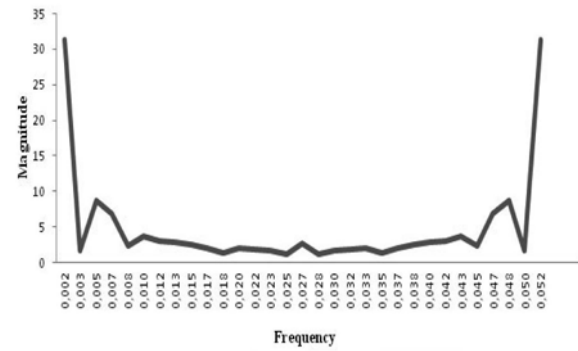


Figure 10. The depth spectrum obtained by FFT

# The Validity of the Arbitrage Pricing Theory in the Jordanian Stock Market

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## Abstract

This paper aims to test the validity and applicability of the Arbitrage Pricing Theory (APT) in Amman Stock Exchange (ASE) during the period 2001-2011. To achieve this objective, the study utilized six variables, four macroeconomic variables, i.e., interest-rate term structure, inflation, money supply and risk premium, and two market indicators i.e., dividend yield and productivity of the industry. Using ordinary least square method (OLS), the six variables against twelve industry portfolios of Amman Stock Exchange have been tested. Overall, the finding of the paper support the validity and applicability of APT in ASE, as the results show that four out of the six tested variables, are able to explain 84% of the change in the stock returns of the Jordanian industrial firms during the study period. Another finding of this paper is that the effect of the tested variables varies among industries.

**Keywords:** Arbitrage pricing theory, Amman stock exchange

## 1. Introduction

The Arbitrage Pricing Theory (APT) proposed by Ross 1976 is a model for pricing assets, such as the capital asset pricing model (CAPM). The expected rate of return of the financial asset is determined as a linear function of a number of macroeconomic factors or market indicators, so that each factor has its own beta coefficient, which measures the sensitivity of the expected rate of return for each of these factors. The resulting rate of return is used as the discount rate to calculate the price of the financial asset. Unlike CAPM which links the expected return with a linear function with only systemic risk, the APT reflects a linear multi-factor relationship, in addition to the systematic risk, there are several non diversifiable risk factors that are macroeconomic in nature and affect all stocks returns.

There is no theoretical framework in choosing the macroeconomic factors or market indicators to be included in the APT model (Tunali, H., 2010). However, this can be seen as a strength point for the model, in terms of allowing researchers to choose the best available factors that explain the change in the expected return without restrictions.

The study is an attempt to analyze the validity of the APT to the pricing of the Jordanian industrial companies stocks, listed on the Amman Stock Exchange (ASE), in terms of identifying the most important macroeconomic factors that assist in the determination or interpretation of the changes on the stocks market value. The study includes four macroeconomic variables: interest-rate term structure, inflation, money supply and risk premium, and two market indicators: dividend yield and the productivity of the industry. The macroeconomic variables and market indicators have been tested against twelve industry portfolios to investigate the effect of these variables on the stocks' expected return, and thus the validity of the Arbitrage Pricing Theory in the Jordanian Stock Market.

## 2. Related Literature

APT has been tested intensively in developed markets since its introduction in 1976. Among the first who have tested this theory was Gehr (1978) and later Roll and Ross (1980), after that many researchers tested the APT applying difference methodology. For instance, Connor and Korajczyk (1986) applied the principal component analysis and identified five variables that have a direct effect on asset returns. Brown and Weinstein (1983) tested the APT using the bilinear model on a special case in which the numbers of the macroeconomic variables were pre-defined. They rejected the five and seven factors APT models and suggested three factors model, concluding a few rather than many macroeconomic factors that can be priced in the APT model. Cho et al., (1984) tested the APT by applying the inter battery factor analysis and found six factors in two industry groups of securities which could be priced in the APT model. Ozcam (1997) investigated seven macroeconomic factors in Turkey, and concluded that only the expected factors were rewarded in the market. Alty (2003) used a various macroeconomic factors, which

were the key indicators of the economy in both Turkey and Germany, and concluded that in Germany only the unanticipated interest rate affected the stock returns, and thus, rewarded in the stock market. While in Turkey, none of the factors that are tested had an impact in the stock returns.

Chen and Jordan (1993) studied both models: the Factor Analytic Model and the Macroeconomic Variable Model modeling of the APT and their ability to predict the return on securities. They found little difference between the two models, and concluded that the Macroeconomic Variable Model may be a little more accurate for predicting stock returns when tested against a specific time period. Mohseni (2007) tested the APT model in the Tehran Stock Exchange applying the Fama and Macbeth (1973) methodology and concluded that the model was able to explain the returns of the firms' sample through the two macroeconomic factors: oil price and money supply.

Gunsel and Cukur, (2007) aimed to investigate the validity of the APT model in London Stock Exchange using seven macroeconomic factors during the period 1980-1993 on a monthly base. The study concluded a significant relationship between macroeconomic factors and the expected earnings per share. The study also has concluded that the effect of these factors on the expected returns varies from one factor to another and from one sector to another. For instance, there is a significant positive effect for the money supply on the expected returns in the construction and Food and Beverage industries, while the effect is negative in household goods and textiles industries.

In their study Mansor and Syuhada, (2009) aimed to investigate the relationship in the long and short-term between the ratios of cash dividend to price and average price to earnings per share and the stock returns in the Malaysian Securities Market, the study has found that there is a strong positive relationship between these variables and stock returns over the long-term, while in the short-term, the study concluded a significant positive relationship between the ratio of cash dividend to price and the stock returns, and a negative relationship between the ratio of average price to earnings per share and the stock returns.

### 3. Data and Methodology

The study sample consists of all Jordanian industrial companies listed at Amman Stock Exchange (ASE) and available during the period 2000-2010, and of which there were 70 Jordanian industrial companies. The monthly closing prices of stocks of the sample firms were used in order to calculate the monthly return of the industry portfolios. The industrial sector was divided into eleven industries. Monthly return was calculated for each industry portfolio. Table 1 presents the classification and the number of the companies in the sample study.

Table 2 shows the macroeconomic variables and the industry-specific variables used in the analysis. The variables are measured by the change in the values of these variables instead of the value itself. The reason for this is that the change in value facilitates comparison with stock returns and achieves the relative stability of the values analyzed.

In this study, six variables have been used to test the effect of macroeconomic factors on stock returns in the Amman Stock Exchange (ASE), The model has been designed to take into account the macroeconomic variables (interest-rate term structure, inflation, money supply and risk premium) and the market indicators (dividend yield and productivity of the industry)

Following the study of Chen et al. (1986) and using the ordinary least square (OLS) method, the six variables were added together in a linear regression model as follows:

$$R_{it} = \beta_0 + \beta_{i1}IRTS_t + \beta_{i2}UIF_t + \beta_{i3}MoS_t + \beta_{i4}RkP_t + \beta_{i5}UDY_t + \beta_{i6}PGI_t + \varepsilon_t \quad (1)$$

Where,  $R_{it}$  is the return on the industry portfolio  $I$ ,  $\beta_0$  constant,  $\beta_i$  the linear regression coefficients,  $IRTS$  interest-rate term structure,  $UIF$  unpredictable inflation rate,  $MoS$  money supply,  $RkP$  risk premium,  $UDY$  unpredictable dividend yield of the industry and  $PGI$  productivity growth of the industry, and  $\varepsilon$  is the error term.

Since equation (1) represents the expected return on industry portfolio  $I$ , or the minimum return required by investors in industry portfolio  $I$ , this required return can be used as the risk adjusted discount rate to discount future cash flows of the financial asset to price it. Thus, the main aim is to determine the macroeconomic factors that affect the stocks' return on ASE.

#### 3.1 Interest-rates Term Structure

According to the theories of pricing financial assets, the value of the stocks are directly affected by the risk adjusted discount rate. Therefore, the interest rates are taken into account in the pricing model of financial assets, through its basic component risk-free rate of return. But, because the interest rates are linked directly with the other macroeconomic variables, the interest-rates term structure will be used rather than interest rates to avoid collinearity problem between the macroeconomic variables in the linear regression model.

The effect of the interest-rates term structure on the ASE can be determined by the difference between the long and short-term of government interest rate as follows:

$$IRTS_t = JGB_t - T.B_t \quad (2)$$

Where,  $IRTS_t$  is the interest rate term structure,  $JGB_t$  is the return on the 25 years Jordanian government bond,  $T.B_t$  is the one month rate of the Jordanian Treasury bill.

### 3.2 Unpredictable inflation rate

Inflation affects the market value of the firm, through its impact on future cash flows and discount rate used in pricing models of financial assets. The effects of inflation depend on whether it is predictable or unpredictable, and since the predictable inflation is taken into account when determining the future cash flows through determining prices for products, and when determining the discount rate used in pricing models of financial assets, only the unpredictable rate of inflation will affect the stock's market value, unpredictable rate of inflation can be defined as follows:

$$UIF_t = Inf_t - E(Inf_t)_{t-1} \quad (3)$$

Where,  $UIF_t$  unpredictable inflation rate for the period  $t$ ,  $Inf_t$  is the actual inflation rate for the period  $t$ ,  $E(Inf_t)_{t-1}$  is the expected inflation rate for period  $t$  on period  $t-1$ .

### 3.3 Money Supply

Generally speaking, the activity level of the stock market is influenced by two factors: first, the initial public offerings and the trading activities, second, the demand on the stock which is not only affected by investment behavior but also by the supply of the money in the economy. In general, studies that tested the impact of money supply on stock returns concluded the existence of the significant effect of the money supply, so that the significant increase in money supply, leads to a trend towards investors to invest in real assets resulting in upward pressure on stock prices.

Increasing the money supply leads to increasing the demand on companies' products and thus, increases future cash flows of the company, increasing the money supply also results in a significant reduction in real interest rates, which leads to discount future cash flows with lower discount rates, resulting in an increase in the market value of the company because its stock price rises, as a result of discounting higher cash flow with lower discount rates.

From the above, and based on rational economic logic that supports the relationship between money supply and stock returns, the money supply is included in the linear regression model as one of the macroeconomic factors that can affect ASE. Money supply can be defined as  $M0$  (M zero) which includes cash and assets that can be converted easily into cash in circulation.

### 3.4 The Risk Premium

In the literature review, the risk premium indicates the amount by which a financial asset's expected rate of return exceeds the risk-free rate of return. Common method to calculate the risk premium is to compare the risk-free rate of return on Treasury-Bills and the risky rate of return on other investments. The difference between these two returns is due to the risks borne by the investor by investing in risky investments, and refers to the risk premium.

For the stock market, the risk premium is the expected return of the market portfolio minus the risk free rate of return. The expected return of the market portfolio is the total of the dividend yield and capital gains. In determining the discount rate used in the theories of pricing financial assets, the risk premium required by investors plays an important role in determining the discount rate. Increase (decrease) in risk premium required by the investors leads to an increase (decrease) in the discount rate, and thus, reduction in (increasing) the value of the financial assets.

From the above it can be said that the degree of risk aversion can be viewed through the changes in the level of risk premium, therefore the stock returns is affected by changing the level of risk premium. Risk premium for the stock market can be defined as follows:

$$RkP_t = LwGB_t - JGB_t \quad (4)$$

Where,  $RkP_t$  is the risk premium,  $LwGB_t$  is the return on the low grade corporate bond;  $JGB_t$  is the return of the 25 years Jordanian government bond.

### 3.5 Dividend Yield

The relationship between dividend yield and stock returns received great attention in the finance literature. Most of these studies have been conducted to test the capital assets pricing model (CAPM), which concluded that the positive relationship between dividend yield and stock returns is due to the disparity in tax rates on dividend and capital gain (e.g., Lizenberger and Ramaswamy (1979), and Blume (1980)), While the study of Miller and Scholes (1982) concluded that the reason for the positive relationship is due to information biases, other studies (e.g., Banz (1981) and Reinganum (1981)) have attributed the positive relationship to the anomalous effects.

If dividend yield affects the stock returns at the firm's level, we expect the dividend yield to have the same effect on the market level, and since the predictable dividend yield are taken into account when evaluating companies, only the unpredictable dividend yield will affect the stock's market value, unpredictable industrial dividend yield can be defined as follows:

$$UDY_t = DY_t - DY_{t-1} \quad (5)$$

Where,  $UDY_t$  unpredictable dividend yield for the period  $t$ ,  $DY$  is the dividend yield.

### 3.6 Productivity Growth of the Industry

From a purely economic perspective, increase in productivity growth rates leads to decrease in unemployment rates, rise in wage rates, accelerated output growth, and low rates of inflation, and with continuity, even a small increase in the rate of productivity growth, leads to a large increase in living standards. These changes along with the rise in living standards are reflected positively on the firm's profitability, and therefore on the market value of the firms. Therefore, the market return may give an idea about earlier changes in the level of productivity. The productivity growth of the industry can be defined as follows:

$$PGI_t = IP_t - IP_{t-1} \quad (6)$$

Where,  $PGI_t$  is the productivity growth of the industry for the period  $t$ ,  $IP$  is the Productivity of the industry.

## 4. Empirical Results

The results of investigating the effect of Macroeconomic Factors on the stock returns of the Jordanian industrial companies listed on the Amman Stock Exchange are illustrated in the following section.

Table 3 represents the correlation coefficients matrix between the variables of the study, it shows that the correlation coefficients between the variables of the study are relatively low, due to the conversion process that has been done on the variables where all the variables are in logarithmic, so to avoid the problem of multicollinearity. Table 4 represents the correlation coefficients between the industries' portfolios returns, where the table shows that the coefficients are significantly high, which means that the industries within the Jordanian industrial sector have the same reaction to the macroeconomic variables. Since each portfolio will be analyzed on its own, there will be no problem of multicollinearity resulting from the high correlation between the industries portfolios' returns.

The results of regression analysis shows that there are significant differences in the ability of macroeconomic and financial variables to explain the change in stock returns among industry portfolios, as the coefficient of determination ( $R^2$ ) ranges between 23% and 84%. One of the reasons that can cause this result is the use of the industry-specific variables, the dividend yield of the industry and the productivity growth of the industry, among the variables of the study. The results of the regression analysis for the pricing relation between macroeconomic variables and stock returns appear in Table 5.

Table 5 shows the results of the multiple regression analysis to investigate the impact of the macroeconomic variables and market indicators on the stock returns of the Jordanian industrial companies at the level of the Jordanian industrial sector as a whole, and the level of each industry.

### 4.1 Market Portfolio Level

Results show that interest-rate term structure has a positive statistically significant effect on the market portfolios' returns ( $AMFI$ ) at a level of significance less than 0.05.

Money supply has a positive statistically significant effect on  $AMFI$  at a level of significance less than 0.1. This finding is consistent with the findings of previous studies which conclude that the increase in money supply has a positive impact on the economy in general, and therefore it is not surprising to have a positive impact on  $AMFI$ .

Risk premium has a positive statistically significant effect on  $AMFI$  at a level of significance less than 0.01. This means that when the market risk premium rises, the market responds to this rise by increasing the expected return on stocks. This finding is consistent with the Risk-Return Tradeoff Theory.

Productivity growth of the industry seems to have positive statistically significant effect on  $AMFI$  at a level of significance less than 0.05, indicating that as the productivity moves unexpectedly, the return on stock moves in the same direction, and the market price reflects the upward movement of the productivity.

The probability values of the  $UIF$  and  $UDY$  were greater than 0.1 indicating that these two factors do not have significant effect on the  $AMFI$  at a level of significance less than 0.1. One reason can support this result is that investors expect both inflation and dividend yield accurately, so that there is no significant differences when announcing the actual rates, and therefore, when announcing the actual rates the market does not react as expected.

#### 4.2 Industry Portfolio Level

The results of regression analysis at the level of the industry portfolio show that interest-rate has a positive influence on seven industries portfolio returns, *CHEM*, *GL\_CE*, *PHAR*, *TOBA*, *EN\_CO*, *FO\_BE* and *MI\_EX*, and a negative impact on three industries return, *PR\_PA*, *ELEC* and *TEXT*, at a level of significance less than 0.1. It is well known that when interest rates go up, investors direct their savings toward depository institutions to take advantage of higher interest rates, and as a response to that, the stock market works to adjust the expected return on stocks as an attempt to withdraw back savings to the capital market, leading the interest rates to associate positively with the stock returns. However, if the market fails to adjust the expected return on stocks, the increase in interest rates will reduce the profitability of firms and thus stock prices go down, because the investors will deposit their savings in bank accounts rather than investing in stock market, leading the interest rates to associate negatively with the stock returns.

For inflation, the results show no effect of *UIF* on portfolio returns of all industries except for *TOBA* and *TEXT*, where the probability value for *UIF* is greater than 0.1 for all industry portfolios except for *TOBA* and *TEXT*. This result confirms the previous result of this study at the level of the market portfolio, where the study concluded that unexpected inflation rate has no effect on the stock returns due to the fact that the investors' expectations regarding inflation rates are too accurate. As for the negative relationship between inflation and return on each of the *TOBA* and *TEXT*, it can be interpreted as the stock price is directly associated with the firms' performance. In cases when inflation increases, the firm's value will also subside. This will adversely affect the stock prices and certainly the stock returns.

Surprisingly, the results show that money supply has a different impact on the industry portfolio returns, while it has a positive impact on all of *CHEM*, *GL\_CE*, *TOBA*, *PR\_PA*, *ELEC* and *TEXT* portfolio returns, the results show a negative impact for the *M0* on the returns of *PA\_CA*, *PHAR* and *EN\_CO* portfolios. Whereas the positive effect of the *M0* is consistent with the real activity theorists view that the increase in the growth rate of money supply enhances the rate of increase in stock prices, the negative effect of *M0* on stock prices and therefore on stock returns is not clear and needs further study and research.

Results of the analysis show that the *RkP* is directly proportional with the stock returns of all industries portfolios at a significant level less than 0.1. Indicating that investors demand more risk premium for holding additional risks that they cannot diversify. This result is consistent with the capital asset pricing model (CAPM), and with the risk-return tradeoff theory.

The regression analysis results show that the probability value for *UDY* is greater than 0.1 for all industry portfolios, indicating that *UDY* does not have any impact on any of the industry portfolio returns, this finding supports the previous result of this study which concludes that *UDY* does not have any influence on the market portfolio return.

Productivity growth of the industry seems to have different impact on the industry portfolios returns, while it associates positively with *GL\_CE*, *PA\_CA*, *TOBA*, *EN\_CO*, *FO\_BE* and *TEXT* returns, and negatively with *PHAR* and *MI\_EX*.

#### 5. Conclusion

The results indicate validity and applicability of the *APT* in *ASE*, as evident from the statistically significant relation between the tested variables and the stock returns. At the market level, the macroeconomic variables along with the market indicators explained 84% of the variation in the return on market portfolio. The results showed that four out of the six tested variables, *IRST*, *M0*, *RkP* and *PGI*, were able to explain 84% of the change in the stock returns of the Jordanian industrial companies during the study period, and these variables were directly proportional to the market portfolio returns.

Another finding of this study is that the effect of variables that have been tested varies between industries, while the factor is directly proportional to the stock return in a particular industry, it is associated inverse relationship in another industry (e.g. *IRST* associated positively with the returns of *CHEM*, *GL\_CE*, *PHAR*, *TOBA* and *MI\_EX* and negatively with *PR\_PA*, *ELEC* and *TEXT*).

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Table 1. Firms Classification

Industry	Notation	Count
All Manufacturing Firms Index	AMFI	
Chemical		70
Glass and Ceramic	CHEM	
Paper and Carton	GL_CE	11
Pharmaceutical	PA_CA	2
Tobacco	PHAR	3
Engineering and Construction	TOBA	6
Printing and Packaging	EN_CO	2
Electrical	PR_PA	9
Food and Beverage	ELEC	2
Mining and Extraction	FO_BE	5
Textiles	MI_EX	10
	TEXT	14
		6
Total		70



Table 2. Notation and measure of the macroeconomic and industry-specific variables

Variables	Measure	Notation
Interest-rates term structure		IRTS
Unpredictable inflation rate	$IRTS_t = JGB_t - T.B_t$	UIF
Money supply	$UIF_t = Inf_t - E(Inf_t)_{t-1}$	M0(M Zero)
	Cash and assets that could quickly be converted into currency	
The risk premium	$RkP_t = LwGB_t - JGB_t$	RkP
Unpredicted dividend yield	$UDY_t = DY_t - DY_{t-1}$	UDY
Productivity growth of the industry	$PGI_t = IP_t - IP_{t-1}$	PGI

JGB; the 25 years Jordanian government bond, T.B; one month rate of the Jordanian Treasury bill. Inf<sub>t</sub>; the actual inflation rate for the period t, E(Inf<sub>t</sub>)<sub>t-1</sub>; the expected inflation rate for period t on period t-1. LwGB<sub>t</sub>; the return on the low grade corporate bond, JGB<sub>t</sub>; the return of the 25 years Jordanian government bond. DY; the dividend yield. IP; the Productivity of the industry.

Table 3. Pearson correlation coefficients matrix between the tested factors

Variables	IRST	UIF	M0	RkP	UDY	PGI
	1					
IRST						
Sig.(2-tailed)	.541**	1				
UIF	.000					
Sig.(2-tailed)	-.347	-.017*				
M0	.170	.049	1			
Sig.(2-tailed)	.647*	.075				
RkP	.041	.138	.594**	1		
Sig.(2-tailed)	.271**	.083*	.000			
UDY	.000	.039	.297	.309**	1	
Sig.(2-tailed)	.030**	-.179**	.317	.000		
PGI	.005	.002	.419**	-.283**	.493**	1
Sig.(2-tailed)			.009	.007	.000	

All variables are in logarithm.  
Factors definitions are given at Table 2  
\*, \*\*; correlation is significant at 0.05, 0.01 respectively

Table 4. Pearson correlation coefficients matrix between the industry portfolio returns

	<i>AMFI</i>	<i>CHEM</i>	<i>GL_CE</i>	<i>PA_CA</i>	<i>PHAR</i>	<i>TOBA</i>	<i>EN_CO</i>	<i>PR_PA</i>	<i>ELEC</i>	<i>FO_BO</i>	<i>MI_EX</i>
<i>AMFI</i>	1										
<i>Sig.(2-tailed)</i>											
<i>CHEM</i>	.785**	1									
<i>Sig.(2-tailed)</i>	.000										
<i>GL_CE</i>	.716*	.771*	1								
<i>Sig.(2-tailed)</i>	.023	.023									
<i>PA_CA</i>	.831**	.850**	.985**	1							
<i>Sig.(2-tailed)</i>	.000	.000	.000								
<i>PHAR</i>	.665*	.577*	.887**	.988**	1						
<i>Sig.(2-tailed)</i>	.041	.027	.000	.000							
<i>TOBA</i>	.763*	.860*	.986**	.859**	.803**	1					
<i>Sig.(2-tailed)</i>	.032	.047	.000	.000	.000						
<i>EN_CO</i>	.998**	.681	.414*	.385*	.332*	.518*	1				
<i>Sig.(2-tailed)</i>	.000	.051	.047	.045	.046	.036					
<i>PR_PA</i>	.630*	.922**	.950**	.987**	.777**	.978**	.433	1			
<i>Sig.(2-tailed)</i>	.015	.000	.000	.009	.000	.000	.067				
<i>ELEC</i>	.672*	.546**	.431*	.102	.415**	.207	.824**	.826**	1		
<i>Sig.(2-tailed)</i>	.019	.003	.013	.097	.000	.072	.000	.000			
<i>FO_BO</i>	.998**	.526	.550	.506	.875**	.410	.473*	.388*	.806**	1	
<i>Sig.(2-tailed)</i>	.000	.078	.097	.063	.000	.084	.037	.047	.000		
<i>MI_EX</i>	.963**	.531	.437	.393*	.112	.529*	.996**	.627**	.770*	.420*	1
<i>Sig.(2-tailed)</i>	.000	.061	.074	.046	.068	.029	.000	.000	.023	.021	
<i>TEXT</i>	.790**	.593*	.480*	.446**	.402*	.576**	.997**	.485**	.783**	.402**	.997**
<i>Sig.(2-tailed)</i>	.009	.029	.048	.000	.048	.003	.000	.000	.000	.000	.000

All variables are in logarithm.

portfolio definitions are given at Table 1

\*, \*\*, correlation is significant at 0.05, 0.01 respectively

Table 5. The results of regression analysis for the impact of macroeconomic factors on the stocks returns  
At the level of the market and the level of each industry portfolio

Factor \ portfolio	AMFI	CHEM	GL_CE	PA_CA	PHAR	TOBA	EN_CO	PR_PA	ELEC	FO_BO	MI_EX	TEXT
Constant												.007
Factors	.0013	.814	.0076	.578	.147	.0465	.0081	.6741	.914	.0001	.3651	
IRST												-.047**
UIF	.031**	.023**	.107***	.001	.077*	.107**	.001**	-.004*	-.084*	.005**	.001**	.027
M0	.043	.041	.007	.193	.059	.027	.031	.053	.089	.033	.017	-.007*
RkP	.412	.005	.042	.007	.089	-.031*	.091	.084	.197	.074	.001	.067
UDY	.271	.124	.581	.817	.317	.094	.725	.142	.217	.157	.252	.064***
PGI	.071*	.071*	.009*	-.011*	-.002**	.019*	-.006**	.0142***	.097*	1.24	.027	.007
R-Square	.063	.069	.063	.054	.031	.084	.079	.003	.062	.341	.481	.047**
Adjusted R-Square	.103***	.037**	.003**	.109**	.207***	.096**	.087**	.173*	.004**	.083***	.173*	.042
df	.003	.017	.029	.031	.007	.035	.032	.064	.017	.006	.074	.011
Regression	.076	.043	1.87	.009	.081	.017	.003	.019	.163	.360	.047	.571
F.	.169	.137	.782	.741	.487	.192	.104	.374	.352	.274	.192	.183*
Sig.	.047**	.125	.068*	.033*	-.011*	.082**	.040*	1.31	.912	.008*	-.043*	.079
	.017	.437	.094	.058	.073	.037	.067	.571	.341	.091	.086	.602
	.839	.713	.501	.492	.261	.662	.801	.293	.572	.641	.772	.580
	.830	.697	.474	.465	.221	.644	.790	.255	.549	.621	.759	6
	6	6	6	6	6	6	6	6	6	6	6	113
	113	113	113	113	113	113	113	113	113	113	113	119
	119	119	119	119	119	119	119	119	119	119	119	28.48
	98.14	46.78	18.90	18.24	6.651	36.88	75.80	7.80	25.16	33.62	63.78	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	

All variables are in logarithm.

Industry portfolios definitions are given at Table 1; Factors definitions are given at Table 2; \*, \*\*, \*\*\*; significant at 0.1, 0.05, 0.01 respectively; First line estimated coefficients, Second line t. Sig. (2-tailed).

# Aid and the Public Sector in East Africa: Endogenous and Disaggregated Aid

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## Abstract

This paper addresses the question of the relationship between foreign aid and the fiscal behavior of the public sector in developing countries. We treat aid as an endogenous variable in the public sector's utility maximization problem. We also disaggregate the aid variable into three components of official development assistance. Data on the East African countries Ethiopia, Sudan, Kenya, Tanzania, and Uganda for the period 1990-2009 is used to estimate the parameters of the model. The results indicate that aid increases both public investment and recurrent government expenditure. The results also show that aid reduces taxation and domestic borrowing. An incremental aid results in much higher reduction in domestic borrowing than the reduction in Taxation.

**Keywords:** Disaggregated aid, Endogenous aid, Fiscal Response Models

## 1. Introduction

Since the late 1960s many underdeveloped countries have adopted economic planning to achieve rapid development with the public sector playing an important role in the planning and implementation of development projects. These countries have received substantial amounts of foreign aid in different forms. Yet, no significant improvements in the economic growth rates were observed in many of these countries. This led economists to question the effectiveness of foreign aid in promoting growth and development. Since the publication of the influential paper by Heller (1975) on the fiscal behavior of the public sector in the presence of aid, large amounts of work have been done on aid effectiveness and the fiscal response. Nevertheless, the results of the aid effectiveness and the fiscal response have not been quite conclusive. Heller (1975) using a cross-section study of some African countries shows that aid increases the public expenditure on investment and reduces the public sector's current expenditure. His results also confirm the Plese's hypothesis. Khan & Hoshino (1992) show, in a cross-section study of Asian countries, that aid increases public investment, current government spending, and as well the tax revenue. Iqbal (1997) using a time series study of Pakistan shows that aid increases government current expenditure. Franco-Rodriguez *et al* (1998) using a time series study of Pakistan show that the total of effect of aid on public investment is positive, the total effect of aid government current spending is negative, and the total effect of aid on taxation is negative. Franco-Rodriguez (2000) in a time series study of Costa Rica shows that the total effect of aid on public investment and public borrowing is negative, while the total effect of aid on government current spending and taxation is positive. Phijaisant (2010) using a time series study of Thailand shows that aid increases current government expenditure and reduces tax revenue.

The primary purpose of this paper is to empirically assess the relationship between three types of official development assistance (ODA) and the public sector's investment and consumption in the context of East Africa. The countries that are included in this study are: Ethiopia, Sudan, Kenya, Tanzania, and Uganda. The choice of the countries was dictated by the availability of data. This paper adapts the works of Franco-Rodriguez *et al* (1998), Mavrotas (2004), Mavrotas (2005), and Mavrotas & Ouattara (2006). Franco-Rodriguez *et al* introduce in their paper the view of endogenous aid. Previous fiscal response literature treats aid as an exogenous variable since the recipient countries have no direct control over the amount of aid by donors. However, Franco-Rodriguez *et al* maintain that even though the recipient countries have no direct control over aid; they do have effective control over

the amounts to be spent (disbursements) given commitments by donors. Commitments by donors are beyond the control of the recipient country and as such they cannot constrain the utility maximization problem of the public sector. With this justification, they treat the aid variable (disbursements) as a choice variable in the public sector's utility maximization problem. Mavrotas (2004), on the other hand, argues for disaggregation of the aid variable. He emphasizes on the importance of taking into account the heterogeneity of aid when modeling fiscal response models. He justifies his proposal on two grounds. Firstly, different types of aid operate in different ways in the recipient country thus resulting in different macro effects. Secondly, because of different conditions relating to each in different countries, there is also an extra reason to expect different effect of aid in each country. From these he concludes that failing to account for the heterogeneity of aid will disturb the empirical results. Mavrotas and Ouattara (2006) treat the disaggregated aid components (i.e. project aid, program aid, technical assistance and food aid) as endogenous variables. In this paper we disaggregate the aid variable into three ODA components (loans, grants, and technical assistance) and treat them as choice variables in the utility maximization problem of the public sector.

The plan of the paper is as follows. Section 2 develops the theoretical framework. Section 3 describes the data used and the estimation technique employed. Section 4 presents the results of the models. Section 5 wraps it up with some concluding remarks.

## 2. The Theoretical Framework

As in the standard response literature, we assume that the public sector aims to maximize the public utility by appropriately allocating the revenue generated from domestic borrowing, taxes, and foreign aid, among public investment and current public consumption expenditure. The following general form of utility function is used in this paper,

$$U = U(I_g, G, A_1, A_2, A_3, T, B) \quad (1)$$

where,

$U$  = utility function of the public sector,

$I_g$  = public investment expenditure for development purposes,

$G$  = government current consumption expenditure,

$A_1$  = ODA loans disbursements from all foreign sources,

$A_2$  = ODA grants disbursements from all foreign sources,

$A_3$  = technical assistance disbursements from all foreign sources.

$T$  = total tax revenue collected by the public sector, and

$B$  = public borrowing from domestic sources.

The public sector's policymakers are assumed to behave rationally and maximize utility. In the fiscal response literature, it is assumed that governments set targets for the various expenditures as well as for the revenue variables taxation and domestic borrowing. Following Mosley *et al* (1987) and Binh and McGillivray (1993), the utility function in (1) can be expressed as a quadratic loss function as follows:

$$U = \alpha_0 - (\alpha_1/2)(I_g - I_g^*)^2 - (\alpha_2/2)(G - G^*)^2 - (\alpha_3/2)(A_1 - A_1^*)^2 - (\alpha_4/2)(A_2 - A_2^*)^2 - (\alpha_5/2)(A_3 - A_3^*)^2 - (\alpha_6/2)(T - T^*)^2 - (\alpha_7/2)(B - B^*)^2 \quad (2)$$

where  $\alpha_i \geq 0$  for  $i=1, 2, 3, 4, 5, 6,$  and  $7$ , and the starred variables indicate the target level for the given variable. Unfortunately, the target level variables are not available and thus they have to be somehow estimated. Two approaches are available in the empirical literature. The first approach is to regress each choice variable on the exogenous variables that are assumed to determine the target level of the choice variable. Then use the predicted values of the choice variable as the target level variable. The second approach is to specify a target variable as a function of exogenous variables that are assumed to affect the target variable and then plug it in the structural equations. Both approaches have been criticized for good reasons, but the critics do not offer a better treatment of the target variables – see e.g. McGillivray and Morrissey (2001). The target aid variables are commitments by donors for a given year. Commitments are made by donors and it is left for the recipient country to decide how much of commitments to use. It makes perfect sense to view commitments as the target level of disbursements. This is a practice that is used by many authors in recent years – see for example Franco-Rodriguez (1998) and Mavrotas (2004). This treatment also makes sense intuitively since the donors determine the amount of aid committed and it is up to the recipient country to determine the amount to be disbursed given the commitments. The target variable for the development expenditure  $I_g$  is assumed to depend on the levels of private investment and the previous year's

income. This specification was first used by Heller (1975) per Harrod-Domar model. The target level of the public current consumption  $G^*$  is assumed to depend on primary school enrollment, the income level, and the previous year's public expenditure. The target level of the tax revenue  $T^*$  is assumed to depend on the previous year's income and imports. These specifications are also used by previous studies – see e.g. Heller (1975). As is the case with previous studies also, the desired level of public borrowing from domestic sources,  $B^*$  is set to zero. The justification being public borrowing from domestic sources is regarded as the last resort to finance the expenditures of the public sector.

Following Franco-Rodriguez *et al*, we assume that the policy makers of the public sector maximize the above utility function subject to the following constraints:

$$I_g + G = A_1 + A_2 + A_3 + T + B \tag{3}$$

$$G \leq \rho_1 A_1 + \rho_2 A_2 + \rho_3 A_3 + \rho_4 T + \rho_5 B \tag{4}$$

where,  $0 \leq \rho_i \leq 1$  for  $i = 1, 2, 3, 4$  and  $5$ . Franco-Rodriguez *et al* reject the constraints used in the standard fiscal response literature on three grounds. Firstly, it is implicitly assumed that donors grant aid for the purpose of investment only (and that all investment expenditures are captured in  $I_g$ ), hence any aid allocated to  $G$  is an *ex post* measure of fungibility. Secondly, the standard fiscal response literature constraints do not allow for the common practice in developing countries of financing current expenditure from domestic borrowing. Thirdly, and as pointed out by White (1994), the representation of the standard fiscal response constraints over-constrains the model, not necessarily allowing the government to reach  $\alpha_0$  even in the case where aid revenue is sufficient to meet all targets. This problem arises because although revenue may be sufficient to meet all the expenditures, the  $\rho$ s constrain allocation so that specific expenditure targets in (2) cannot be met. In the formulation (3) and (4), the parameters  $\rho_1, \rho_2, \rho_3, \rho_4$ , and  $\rho_5$  are of special interest as they reflect the way in which the public sector uses its resources to finance different components of its expenditure.

We now maximize the utility function specified in (2) with respect to the endogenous variables  $I_g, G, A_1, A_2, A_3, T$ , and  $B$ , subject to the fiscal constraints specified in (3) and (4).

$$\text{Max } \ell = \alpha_0 - (\alpha_1/2)(I_g - I_g^*)^2 - (\alpha_2/2)(G - G^*)^2 - (\alpha_3/2)(A_1 - A_1^*)^2 - (\alpha_4/2)(A_2 - A_2^*)^2 - (\alpha_5/2)(A_3 - A_3^*)^2 - (\alpha_6/2)(T - T^*)^2 - (\alpha_7/2)(B - B^*)^2 + \lambda_1 [I_g + G - A_1 - A_2 - A_3 - T - B] + \lambda_2 [G - \rho_1 A_1 - \rho_2 A_2 - \rho_3 A_3 - \rho_4 T - \rho_5 B] \tag{5}$$

where  $\lambda_1$  and  $\lambda_2$  are the Lagrangian multipliers. The first-order conditions (FOCs) of the maximization of  $\ell$  are as follows:

$$\partial \ell / \partial I_g = -\alpha_1(I_g - I_g^*) + \lambda_1 = 0 \tag{6}$$

$$\partial \ell / \partial G = -\alpha_2(G - G^*) + \lambda_1 + \lambda_2 = 0 \tag{7}$$

$$\partial \ell / \partial A_1 = -\alpha_3(A_1 - A_1^*) - \lambda_1 - \lambda_2 \rho_1 = 0 \tag{8}$$

$$\partial \ell / \partial A_2 = -\alpha_4(A_2 - A_2^*) - \lambda_1 - \lambda_2 \rho_2 = 0 \tag{9}$$

$$\partial \ell / \partial A_3 = -\alpha_5(A_3 - A_3^*) - \lambda_1 - \lambda_2 \rho_3 = 0 \tag{10}$$

$$\partial \ell / \partial T = -\alpha_6(T - T^*) - \lambda_1 - \lambda_2 \rho_4 = 0 \tag{11}$$

$$\partial \ell / \partial B = -\alpha_7(B - B^*) - \lambda_1 - \lambda_2 \rho_5 = 0 \tag{12}$$

$$\partial \ell / \partial \lambda_1 = I_g + G - A_1 - A_2 - A_3 - T - B = 0 \tag{13}$$

$$\partial \ell / \partial \lambda_2 = G - \rho_1 A_1 - \rho_2 A_2 - \rho_3 A_3 - \rho_4 T - \rho_5 B = 0 \tag{14}$$

Upon rearranging the FOCs, substituting out  $\lambda_1$  and  $\lambda_2$ , and imposing  $B^* = 0$  we obtain the following structural equations:

$$I_g = (1 - \rho_4)\beta_4 I_g^* + (1 - \rho_4)(\beta_4 + \beta_9) G^* + (1 - \rho_4)[1 - \rho_4\beta_9 - \beta_4] T^* + \sum_{i=1}^3 [(1 - \rho_i) - (1 - \rho_4)(\rho_i\beta_9 + \beta_4)] A_i + [(1 - \rho_5) - (1 - \rho_4)(\rho_5\beta_9 + \beta_4)] B \tag{15}$$

$$G = \rho_4\beta_4 I_g^* + \rho_4(\beta_4 + \beta_9) G^* + \rho_4[1 - \rho_4\beta_9 - \beta_4] T^* + \sum_{i=1}^3 [\rho_i - \rho_4(\rho_i\beta_9 + \beta_4)] A_i + [\rho_5 - \rho_4(\rho_5\beta_9 + \beta_4)] B \tag{16}$$

$$T = \beta_4 I_g^* + [1 - \rho_4\beta_9 - \beta_4] T^* + (\beta_4 + \beta_9) G^* - \sum_{i=1}^3 (\rho_i\beta_9 + \beta_4) A_i - (\rho_5\beta_9 + \beta_4) B \tag{17}$$

$$A_1 = \beta_1 I_g^* + (\beta_1 + \beta_6) G^* - [1 - \rho_1\beta_6 - \beta_1] A_1^* - \sum_{i=2}^3 (\rho_i\beta_6 + \beta_1) A_i - (\rho_4\beta_6 + \beta_1) T - (\rho_5\beta_6 + \beta_1) B \tag{18}$$

$$A_2 = \beta_2 I_g^* + (\beta_2 + \beta_7) G^* - [1 - \rho_2\beta_7 - \beta_2] A_2^* - \sum_{i=1,3} (\rho_i\beta_7 + \beta_2) A_i - (\rho_4\beta_7 + \beta_2) T - (\rho_5\beta_7 + \beta_2) B \tag{19}$$

$$A_3 = \beta_3 I_g^* + (\beta_3 + \beta_8) G^* - [1 - \rho_3\beta_8 - \beta_3] A_3^* - \sum_{i=1}^2 (\rho_i\beta_8 + \beta_3) A_i - (\rho_4\beta_8 + \beta_3) T - (\rho_5\beta_8 + \beta_3) B \tag{20}$$

$$B = \beta_5 I_g^* + (\beta_5 + \beta_{10}) G^* - \sum_{i=1}^3 (\rho_i \beta_{10} + \beta_5) A_i - (\rho_4 \beta_{10} + \beta_5) T \quad (21)$$

where, for  $i = 1, 2, 3, 4$ , and  $5$ :

$$\beta_i = \alpha_1 (1 - \rho_i) / [\alpha_{i+2} + \alpha_2 \rho_i^2 + \alpha_1 (1 - \rho_i)^2],$$

$$\beta_{i+5} = [\alpha_2 \rho_i - \alpha_1 (1 - \rho_i) / [\alpha_{i+2} + \alpha_2 \rho_i^2 + \alpha_1 (1 - \rho_i)^2]]$$

The reduced-form equations (22)-(28) can be obtained by solving for the endogenous variables in the above system of structural equations. The estimated parameters show the effect of the target level variables on each of the revenue and expenditure variables. The formulas of the parameters of the reduced-form equations are provided in the Appendix.

$$I_g = \pi_{11} I_g^* + \pi_{12} G^* + \pi_{13} T^* + \pi_{14} A_1^* + \pi_{15} A_2^* + \pi_{16} A_3^* \quad (22)$$

$$G = \pi_{21} I_g^* + \pi_{22} G^* + \pi_{23} T^* + \pi_{24} A_1^* + \pi_{25} A_2^* + \pi_{26} A_3^* \quad (23)$$

$$A_1 = \pi_{31} I_g^* + \pi_{32} G^* + \pi_{33} T^* + \pi_{34} A_1^* + \pi_{35} A_2^* + \pi_{36} A_3^* \quad (24)$$

$$A_2 = \pi_{41} I_g^* + \pi_{42} G^* + \pi_{43} T^* + \pi_{44} A_1^* + \pi_{45} A_2^* + \pi_{46} A_3^* \quad (25)$$

$$A_3 = \pi_{51} I_g^* + \pi_{52} G^* + \pi_{53} T^* + \pi_{54} A_1^* + \pi_{55} A_2^* + \pi_{56} A_3^* \quad (26)$$

$$T = \pi_{61} I_g^* + \pi_{62} G^* + \pi_{63} T^* + \pi_{64} A_1^* + \pi_{65} A_2^* + \pi_{66} A_3^* \quad (27)$$

$$B = \pi_{71} I_g^* + \pi_{72} G^* + \pi_{73} T^* + \pi_{74} A_1^* + \pi_{75} A_2^* + \pi_{76} A_3^* \quad (28)$$

### 3. Data and Estimation

Data on 5 East African countries is used to estimate the parameters of the structural equations specified in (15) - (21) and the parameters of the reduced-form equations (22) - (28). All the variables, except aid variables, are obtained from the World Bank's African Development Indicators (ADI). The aid variables are obtained from OCED statistics. All the variables are measured in current US dollars to unify the units of different measurements across countries and then deflated by the country specific GDP deflator. We use recent data from 1990 to 2009. The target aid variables are the commitments by donors. The remaining target variables are estimated using cointegrating regression. This approach is used by Gang and Khan (1991), Khan and Hoshino (1992), Otim (1996), and Ahmed (2002). The parameters of the structural equations (15) - (21) are estimated using the nonlinear three-stage least squares (N3SLS) technique and the parameters of the reduced-form equations (22) - (28) are estimated using the ordinary least squares (OLS) technique.

### 4. Empirical Results

In this section we present the results of the estimation of the parameters of the structural equations and the reduced-form equations. We should keep in mind that, theoretically, it is expected that the recipient country devotes all three ODA components for development purposes. However, this is generally not the case in developing countries. The public sectors of these countries generally view aid as an extra revenue. The decision of how much of each aid component to devote to recurrent consumption expenditure will differ from one country to another. As a result, it is best to conduct this type of study using time series data for a specific country. However, lack of long time series data for most developing countries hinders country-specific studies. Having said this, we should emphasize that it is difficult to attach economic intuition to the heterogeneous effects of different components of aid on each expenditure type. The estimates of the parameters of the structural equations (15)-(21) are presented in Table 1. The estimates of the constraint equation parameters  $\rho_1$ ,  $\rho_2$ ,  $\rho_3$ ,  $\rho_4$ , and  $\rho_5$  are statistically significant at the 5% level or lower except  $\rho_3$ , which is statistically insignificant. The estimates of these parameters suggest that 47% of ODA loans, 93% of ODA grants, 11% of technical assistance funds, 23% of taxes, and 73% of domestic borrowing are allocated to current public consumption expenditure. In other words, 53% of ODA loans, 7% of ODA grants, 89% of technical assistance funds, 77% of taxes, and 27% of domestic borrowing are allocated to the public investment expenditure. The estimate of  $\rho_5$  confirms the assumption that the least developed governments do rely on domestic borrowing to finance recurrent expenditure. Most of the remaining structural parameters are significant at the 5% level.

Table 2 computes the direct effect of the revenue variables on expenditure and revenue variables. These are the coefficients associated with the endogenous variables on the right-hand side of the equations in (15)-(21). The results indicate that different aid variables do not necessarily have the same impact on revenue and expenditure variables. The direct effect of the three aid variables on public investment is positive and hence the combined effect of aid on public investment is positive. This confirms the results of Heller (1975), Khan & Hoshino (1992), and Franco-Rodriguez *et al* (1998). The direct effects of ODA loans and ODA grants on current expenditure are positive while the direct effect of technical assistance on current spending is negative. The combined effect of aid on current

expenditure is positive. This confirms the results of Khan & Hoshino (1992), Iqbal (1997), McGillivray & Ahmed (1999), and Franco-Rodriguez (2000). The incremental impact of loans and technical assistance on taxation is negative. On the other hand, taxation increases with increased ODA grants. The combined effect of aid on taxation is negative. This confirms the findings of Heller (1975) and Franco-Rodriguez *et al* (1998). The incremental impact of all three aid variables on domestic is borrowing is negative. For instance, the increase of ODA loans by \$1 reduces public borrowing by about \$1.17. This result supports the findings of Franco-Rodriguez *et al* (1998) and Franco-Rodriguez (2000). We make the following conclusions from Table 1. The direct effect of a \$1 increase in aid disbursements increases the public investment expenditure by \$0.27. The direct effect of a \$1 increase in aid disbursements increases the current government expenditure by \$0.98. The direct effect of a \$1 increase in aid disbursements decreases taxation by \$1.57. Finally, the direct effect of a \$1 increase in aid disbursements decreases domestic borrowing by \$3.62.

Table 3 presents the estimates of the parameters of the reduced-form equation. Of particular interest, are the effects of aid commitments on revenue and expenditure variables. ODA loans commitments reduce the public investment ( $\pi_{14}$ ), while ODA grants and technical assistance commitments increase the public investment ( $\pi_{15}$  and  $\pi_{16}$ ). The combined effect of aid commitments on public investment is positive. An increase in aid commitments by \$1 increases public investment by \$0.63. This result confirms the finding of Franco-Rodriguez *et al* (1998) in the context of Pakistan and in contrast of Franco-Rodriguez (2000) in the context of Costa Rica. The ODA grants commitments decrease current expenditure ( $\pi_{25}$ ), while the ODA loans and technical assistance commitments increase current spending ( $\pi_{24}$  and  $\pi_{26}$ ). The combined effect of aid commitments on current expenditure is positive. A \$1 increase in aid commitments increases current government spending by about \$0.87. This finding supports Franco-Rodriguez (2000) results and contradicts the results of Franco-Rodriguez *et al* (1998). The ODA loans commitments and technical assistance commitments reduce taxes ( $\pi_{34}$  and  $\pi_{36}$ ), while ODA grants commitments increase taxes ( $\pi_{35}$ ). The combined effect of aid commitments on taxation is negative. An increase in aid commitments by \$1 reduces taxation by \$0.30. The ODA loans commitments increase public borrowing ( $\pi_{74}$ ) and the ODA grants commitments and technical assistance commitments reduce public borrowing ( $\pi_{75}$  and  $\pi_{76}$ ). The combined effect of aid commitments on public borrowing is negative. An increase in aid commitments by \$1 decreases domestic borrowing by \$1.11.

## 5. Summary and Conclusion

This paper addresses the question of the relationship between aid and the public sector's policy variables in the context of East Africa. The paper uses endogenous and disaggregated aid variables. The main findings of the paper is that aid increases both public investment and recurrent government expenditure keeping in mind that the aid variables used are intended for development. On the other hand, aid seems to reduce the tax collection efforts. It is comforting to also observe that both the direct and indirect effects of aid on public borrowing are negative. This is in contrast to the findings of Franco-Rodriguez *et al* (1998) in the case of Pakistan. The estimates of the constraint equation parameters indicate that East African countries take ODA loans funds more seriously than ODA grants funds when spending on public investment. The proportion of ODA loans allocated to current government expenditure is much smaller than the proportion of ODA grants spent on current public expenditure. Thus, one may conclude that loans contribute more to the development efforts than grants. Therefore, donors should limit the amounts of grants extended to the least developed countries.

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Table 1. Estimates of the Structural Equations Parameters

Parameter	Estimate (SE)	Parameter	Estimate (SE)	Parameter	Estimate (SE)
$\rho_1$	0.47 (0.1487)*	$\beta_1$	0.0168 (0.0178)	$\beta_6$	-0.0071 (0.0265)*
$\rho_2$	0.93 (0.0393)*	$\beta_2$	0.0018 (0.0606)*	$\beta_7$	0.2679 (0.0739)*
$\rho_3$	0.11 (0.1223)	$\beta_3$	0.0023 (0.0041)	$\beta_8$	0.0006 (0.0061)
$\rho_4$	0.23 (0.0718)*	$\beta_4$	1.1626 (0.1203)*	$\beta_9$	-1.2687 (0.1450)*
$\rho_5$	0.73 (0.0334)*	$\beta_5$	0.6304 (0.1418)*	$\beta_{10}$	1.1464 (0.1546)*

Figures in parentheses next to each parameter's estimate are the corresponding standard errors. The (\*) indicates the estimate is significant at the 5% level or lower.

Table 2. Direct Effect of Revenue Variables

Description	Effect
ODA Loans ( $A_1$ ) on Public Investment ( $I_a$ )	0.0939
ODA Loans ( $A_1$ ) on Current Spending ( $G$ )	0.3397
ODA Loans ( $A_1$ ) on Taxes ( $T$ )	-0.5663
ODA Loans ( $A_1$ ) on Domestic Borrowing ( $B$ )	-1.1692
ODA Grants ( $A_2$ ) on Public Investment ( $I_a$ )	0.0833
ODA Grants ( $A_2$ ) on Current Spending ( $G$ )	0.7297
ODA Grants ( $A_2$ ) on Taxes ( $T$ )	0.0173
ODA Grants ( $A_2$ ) on Domestic Borrowing ( $B$ )	-1.6966
Technical Assistance ( $A_3$ ) on Public Investment ( $I_a$ )	0.1023
Technical Assistance ( $A_3$ ) on Current Spending ( $G$ )	-0.0903
Technical Assistance ( $A_3$ ) on Taxes ( $T$ )	-1.0230
Technical Assistance ( $A_3$ ) on Domestic Borrowing ( $B$ )	-0.7565
Domestic Borrowing ( $B$ ) on Public Investment ( $I_a$ )	0.4977
Domestic Borrowing ( $B$ ) on Current Spending ( $G$ )	0.6521
Domestic Borrowing ( $B$ ) on Taxes ( $T$ )	0.2958
Domestic Borrowing ( $B$ ) on ODA Loans ( $A_1$ )	-0.0116
Domestic Borrowing ( $B$ ) on ODA Grants	-0.1974
Domestic Borrowing ( $B$ ) on Technical Assistance	-0.0027
Taxes ( $T$ ) on ODA Loans ( $A_1$ )	-0.0152
Taxes ( $T$ ) on ODA Grants ( $A_2$ )	-0.0634
Taxes ( $T$ ) on Technical Assistance ( $A_3$ )	-0.0024
Taxes ( $T$ ) on Domestic Borrowing ( $B$ )	-0.8941

These figures are calculated using Table 1 and the parameters specified in the structural equations (15)-(21).

Table 3. Estimates of the Parameters of the Reduced-Form Equations

Parameter	Estimate	Parameter	Estimate	Parameter	Estimate
$\pi_{11}$	1.0670	$\pi_{12}$	0.0011	$\pi_{13}$	-0.2273
$\pi_{14}$	-0.0360	$\pi_{15}$	0.5246	$\pi_{16}$	0.1376
$\pi_{21}$	-1.2300	$\pi_{22}$	0.9160	$\pi_{23}$	0.8999
$\pi_{24}$	0.2006	$\pi_{25}$	-0.1973	$\pi_{26}$	0.8690
$\pi_{31}$	-0.0095	$\pi_{32}$	0.0627	$\pi_{33}$	1.1486
$\pi_{34}$	-0.2681	$\pi_{35}$	0.6344	$\pi_{36}$	-0.6686
$\pi_{41}$	0.0414	$\pi_{42}$	-0.0642	$\pi_{43}$	-0.0192
$\pi_{44}$	0.4028	$\pi_{45}$	0.0855	$\pi_{46}$	0.6192
$\pi_{51}$	-0.1201	$\pi_{52}$	0.0752	$\pi_{53}$	-0.0796
$\pi_{54}$	-0.3972	$\pi_{55}$	0.9397	$\pi_{56}$	2.1114
$\pi_{61}$	-0.0200	$\pi_{62}$	-0.0262	$\pi_{63}$	-0.0354
$\pi_{64}$	-0.0190	$\pi_{65}$	-0.0166	$\pi_{66}$	0.9234
$\pi_{71}$	2.0515	$\pi_{72}$	-0.4975	$\pi_{73}$	-0.1620
$\pi_{74}$	0.1181	$\pi_{75}$	-0.2487	$\pi_{76}$	-0.9783

## Appendix

These are the formulas of the parameters of the reduced-form equations (22)-(28).

$$\pi_{11} = 1 - \gamma_3/\theta_1, \pi_{12} = -(\gamma_3 - \gamma_2)/\theta_1, \pi_{13} = (\gamma_3 - \rho_4\gamma_2)/\theta_1, \pi_{14} = (\gamma_3 - \rho_1\gamma_2)/\theta_1, \pi_{15} = (\gamma_3 - \rho_2\gamma_2)/\theta_1, \pi_{16} = (\gamma_3 - \rho_3\gamma_2)/\theta_1$$

$$\pi_{21} = (\gamma_3 - \rho_5\gamma_2)/\theta_2, \pi_{22} = 1 - [(\gamma_3 - \gamma_2) + (\gamma_1 - \gamma_2)]/\theta_2, \pi_{23} = [(\gamma_3 - \gamma_2) + \rho_4(\gamma_1 - \gamma_2)]/\theta_2, \pi_{24} = [(\gamma_3 - \gamma_2) + \rho_1(\gamma_1 - \gamma_2)]/\theta_2, \pi_{25} = [(\gamma_3 - \gamma_2) + \rho_2(\gamma_1 - \gamma_2)]/\theta_2, \pi_{26} = [(\gamma_3 - \gamma_2) + \rho_3(\gamma_1 - \gamma_2)]/\theta_2$$

$$\pi_{31} = (\gamma_3 - \rho_1\gamma_2)/\theta_3, \pi_{32} = [(\gamma_3 - \rho_1\gamma_2) + (\rho_1\gamma_1 - \gamma_2)]/\theta_3, \pi_{33} = - [(\gamma_3 - \rho_1\gamma_2) + \rho_4(\rho_1\gamma_1 - \gamma_2)]/\theta_3, \pi_{34} = 1 - [(\gamma_3 - \rho_1\gamma_2) + \rho_1(\rho_1\gamma_1 - \gamma_2)]/\theta_3, \pi_{35} = 1 - [(\gamma_3 - \rho_1\gamma_2) + \rho_2(\rho_2\gamma_1 - \gamma_2)]/\theta_3, \pi_{36} = 1 - [(\gamma_3 - \rho_1\gamma_2) + \rho_3(\rho_3\gamma_1 - \gamma_2)]/\theta_3$$

$$\pi_{41} = (\gamma_3 - \rho_2\gamma_2)/\theta_4, \pi_{42} = [(\gamma_3 - \rho_2\gamma_2) + (\rho_1\gamma_1 - \gamma_2)]/\theta_4, \pi_{43} = - [(\gamma_3 - \rho_2\gamma_2) + \rho_4(\rho_1\gamma_1 - \gamma_2)]/\theta_4, \pi_{44} = 1 - [(\gamma_3 - \rho_2\gamma_2) + \rho_1(\rho_1\gamma_1 - \gamma_2)]/\theta_4, \pi_{45} = 1 - [(\gamma_3 - \rho_2\gamma_2) + \rho_2(\rho_2\gamma_1 - \gamma_2)]/\theta_4, \pi_{46} = 1 - [(\gamma_3 - \rho_2\gamma_2) + \rho_3(\rho_3\gamma_1 - \gamma_2)]/\theta_4$$

$$\pi_{51} = (\gamma_3 - \rho_3\gamma_2)/\theta_5, \pi_{52} = [(\gamma_3 - \rho_3\gamma_2) + (\rho_1\gamma_1 - \gamma_2)]/\theta_5, \pi_{53} = - [(\gamma_3 - \rho_3\gamma_2) + \rho_4(\rho_1\gamma_1 - \gamma_2)]/\theta_5, \pi_{54} = 1 - [(\gamma_3 - \rho_3\gamma_2) + \rho_1(\rho_1\gamma_1 - \gamma_2)]/\theta_5, \pi_{55} = 1 - [(\gamma_3 - \rho_3\gamma_2) + \rho_2(\rho_2\gamma_1 - \gamma_2)]/\theta_5, \pi_{56} = 1 - [(\gamma_3 - \rho_3\gamma_2) + \rho_3(\rho_3\gamma_1 - \gamma_2)]/\theta_5$$

$$\pi_{61} = (\gamma_3 - \rho_4\gamma_2)/\theta_6, \pi_{62} = [(\gamma_3 - \rho_4\gamma_2) + (\rho_4\gamma_1 - \gamma_2)]/\theta_6, \pi_{63} = 1 - [(\gamma_3 - \rho_4\gamma_2) + \rho_4(\rho_4\gamma_1 - \gamma_2)]/\theta_6, \pi_{64} = - [(\gamma_3 - \rho_4\gamma_2) + \rho_1(\rho_4\gamma_1 - \gamma_2)]/\theta_6, \pi_{65} = - [(\gamma_3 - \rho_4\gamma_2) + \rho_2(\rho_4\gamma_1 - \gamma_2)]/\theta_6, \pi_{66} = - [(\gamma_3 - \rho_4\gamma_2) + \rho_3(\rho_4\gamma_1 - \gamma_2)]/\theta_6$$

$$\pi_{71} = (\gamma_3 - \rho_5\gamma_2)/\theta_7, \pi_{72} = [(\gamma_3 - \rho_5\gamma_2) + (\rho_3\gamma_1 - \gamma_2)]/\theta_7, \pi_{73} = - [(\gamma_3 - \rho_5\gamma_2) + \rho_4(\rho_5\gamma_1 - \gamma_2)]/\theta_7, \pi_{74} = - [(\gamma_3 - \rho_5\gamma_2) + \rho_1(\rho_5\gamma_1 - \gamma_2)]/\theta_7, \pi_{75} = - [(\gamma_3 - \rho_5\gamma_2) + \rho_2(\rho_5\gamma_1 - \gamma_2)]/\theta_7, \pi_{76} = - [(\gamma_3 - \rho_5\gamma_2) + \rho_3(\rho_5\gamma_1 - \gamma_2)]/\theta_7$$

where,

$$\gamma_1 = \sum_{i=1}^7 \frac{1}{\alpha_i}, \gamma_2 = \frac{1}{\alpha_2} + \sum_{i=1}^5 \frac{\rho_i}{\alpha_{i+2}}, \gamma_2 = \frac{1}{\alpha_2} + \sum_{i=1}^5 \frac{\rho_i^2}{\alpha_{i+2}}, \text{ and } \theta_i = [\alpha_i(\gamma_1\gamma_3 - \gamma_2^2)] \text{ for } i = 1, 2, 3, 4, 5, 6, 7$$

# Effects of Securitization on Credit Risk and Banking Stability: Empirical Evidence from American Commercial Banks

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## Abstract

This study investigates the impact of securitization on risk behavior and banking stability. Based on a sample of 174 US commercial banks from 2001 to 2008, we find that a greater recourse to securitization is associated with a deterioration in the quality of American banks' loan portfolios and an increase of the credit risk in their balance sheets. In the other hand, we observe a positive and significant impact of securitization on banking stability. We think that this paradox is due to the fact that different classes of securitized assets lead to heterogeneous effects on American banks' stabilities. Particularly, our results show that mortgage securitization has a positive and significant impact on banking stability, providing thus a support to the implicit recourse hypothesis. Inversely, non mortgage securitization has a negative effect on banking stability because of the reduction of banks' monitoring incentives related to this particular form of securitization.

**Keywords:** Credit risk transfer, Securitization, Risk taking, Banking stability

## 1. Introduction

Credit risk transfer markets and particularly securitization markets have experienced a remarkable growth in recent years. According to the data from the Securities Industry and Financial Market Association (SIFMA), the global amount of securitization outstanding has increased from 5731.625 millions of dollars in the year 2001 to 13997.294 millions of dollars in the year 2008. This growth can be attributed to the diversification benefits related to securitization transactions. Intuitively, we can think that banks, by transferring their credit risk through securitization, reduce the volume of credit risk in their balance sheets.

This reasoning refers however, to a static view of risk and ignores that banks may be encouraged to increase their risk taking as a result of the increased possibilities of liquidity and risk sharing through securitization. This leads thus, to the following paradox: The credit risk can increase after a securitization transaction. To explain this idea, Gorton and Pennacchi (1995) mention the reduction of banks' monitoring incentives once their loans have been sold. Santomero and Trester (1998) emphasize the effects of the liquidity improvements that loan sales techniques provide on bank's risk taking decisions. Besides, Instejford (2005) and Wagner (2007) establish that techniques of credit risk transfer reduce the amount of risk in banks' balance sheets giving the new possibilities of diversification and risk transfer out of the banking sector. This risk reduction can however, encourage an excessive risk taking from banks by reducing their efforts of selection and monitoring.

The aim of this study is to contribute to the existing literature by analyzing the relationship between securitization and risk taking in a sample of 174 American commercial banks during the period 2001-2008. We consider two alternative measures of risk: the ratio of risk weighted assets per total assets and the Z score which combines capital, profitability and return volatility measures. In addition, we consider different classes of assets and examine whether different types of securitized assets lead to heterogeneous effects on banking stability.

The paper proceeds as follows. In the following section, we relate the paper to the existing literature. Section 3 specifies our research methodology. Section 4 presents a discussion of our results. The final section concludes.

## 2. Review of Previous Studies

Studies on the effects of securitization on bank's risk behavior have reached ambiguous conclusions. Specifically, we can distinguish between two views: on one hand, those in favor of a negative association between securitization and credit risk and on the other hand, those in favor of a positive association.

According to the first view, many authors such Pavel and Phillis (1987), Pennacchi (1988) and Gorton and Pennacchi (1995) argue in favor of the risk reduction and loan growth that loans sales secondary markets can provide. Indeed, by separating the origination and financing operations, loan sales help banks to reduce their credit risks, increase their lending capacities and continue to finance profitable projects when funding costs are increasing. Demzets (2000) emphasizes the diversification advantages related to loan sales markets. Also, Jiangli and Pritsker (2008) find that the securitization of mortgage loans affects negatively the insolvency risk of American bank holdings. Similarly, Casu et al. (2010) find evidence supporting the stability effect of mortgage securitization in USA.

Regarding the second view, many researchers have warning against the reverse effects that the recourse to securitization markets can lead to, both on individual and aggregated levels. Among others, Dionne and Harchaoui (2003) using a simultaneous model derived from those of Shrieves and Dahl (1992) and Aggarwal and Jacques (2001), find a positive association between securitization and bank risk in Canada.

Krahnen and Wilde (2006) applied a Capital Asset Pricing model (CAPM) to determine reactions of European banks' stock returns following the announcement of a securitization transaction and then deduced changes in their systematic risks. Specifically, their results show that the announcement of securitization have a remarkable effect on systematic risk of European banks which seem to engage in more risky activities following a securitization event.

Baur and Joossens (2006) find also evidence that securitization, by transferring risks to other market participants, reduces banks' capital requirements and leads to an increase of the systemic risk especially when correlations between market participants increase. Two cases could explain this result:

- When risks are transferred to other banks, interbank linkages increase and therefore augment systemic risks.
- When risks are transferred to other unregulated participants, capital level in the economy become insufficient to cover risk. So, banking stability decreases.

The hypothesis of a destabilizing effect of securitization was also, supported by Michalac and Uhde (2009) in the European context. Especially, their results suggest that securitization is utilized by European banks as a source of capital relief and additional funding and that both direct and indirect effect may provoke a decrease in their financial stabilities.

Similarly, Uhde and Michalac (2010) applying the event study methodology of Krahnen and Wilde (2006), report a positive effect of securitization on systematic risks of European banks. This association seems however, depending on the amount of bank's systematic risk before a securitization event and on its strategy after securitization. In fact, if the bank reinvests its capital into risky assets, the systematic risk after the securitization event must increase and vice versa.

## 3. Methodology

### 3.1 Sample

Our empirical study focused on a sample of 174 American commercial banks having made at least one securitization transaction during the period from June 2001 until December 2008. This choice is conducted by the availability of securitization data. In fact, since June 2001, American banks have been required to provide detailed information on their securitization activities in their balance sheets. Giving that, we collect accounting and securitization data from the « Federal Deposit Insurance Corporation (FDIC) » database. For macro-economic data, we extract them from the World Bank database.

### 3.2 Definition and Measurement of the Variables

To explain bank risk taking behavior, we consider four types of variables: variables reflecting the securitization activity of the banks, bank specific variables related to the financial characteristics of the banks, macro-economic variables reflecting the economic environment of the banks as well as control variables. Notes on variables are presented in table 1.

Insert Table 1 Here

Table 2 reports descriptive statistics for the entire set of included variables.

Insert Table 2 Here

### 3.2.1 The Dependent Variable: Credit Risk

We employ two measures for credit risk: the ratio of risk weighted assets to total assets (RWATA) and the Z score. The first one captures the allocation of assets between different categories of risks. The second measure proposed by Roy (1952) and used by Goyeau and Tarazi (1992), Boyd et al. (2006), Laeven and Levine (2006) and Uhdle and Heimeshoff (2009), indicates the distance from insolvability. So, a higher value of Z score indicates a little default risk. Mathematically, Z score can be denoted as follows:

$$Zscore_{it} = \frac{ROAA_{it} + E_{it}/A_{it}}{\sigma(ROAA_{it})}$$

We define ROAA as the average return on assets, E/A as the capital ratio and  $\sigma(ROAA)$  as the volatility of the average return on assets.

### 3.2.2 The Independent Variables

#### 3.2.2.1 Credit Risk Securitization

Following Berger and Udell (1993), Dionne and Harchaoui (2003) and Casu et al. (2010), we approximate the securitization activity (TSECTA) using the ratio of the total securitized assets to total assets. Also, we distinguish between two classes of securitized assets and calculate: the ratio of mortgage securitized assets to total assets (MBSTA) and the ratio of non mortgage securitized assets to total assets (OSECTA).

Previous studies have not found any conclusive results about the relationship between securitization and bank credit risk. As explained by Gorton and Pennacchi (1995) and Wagner (2007), securitization allows on one hand, banks to reduce their credit risks by transferring them out of their balance sheets. On the other hand, it encourages banks to increase their risk taking by investing in more risky assets. Therefore, we can anticipate a positive or a negative coefficient on this variable.

#### 3.2.2.2 Bank Specific Variables

##### 3.2.2.2.1 Capital

We measure bank capital using the total capital (TCAP) and the capital per total assets (CAPTA) ratios. The first one measured by the ratio of equity capital to risk weighted assets, captures the level of bank's capital related to its risks. The second ratio measures however, the absolute level of bank's capital.

According to the literature, there isn't a consensus regarding the effects of capital on bank risk taking behavior. For example, Koehn and Santomero (1980) and Kim and Santomero (1988) find that banks with high capital ratios compared to regulatory standards can increase their risk taking by investing in more risky activities. However, Rochet (1992) shows that banks can behave with aversion towards risk after an increase of their capital levels. Therefore, we can anticipate a positive or a negative effect of this variable on bank risk.

##### 3.2.2.2.2 Liquidity

We measure bank liquidity by the ratio of liquid assets to total assets (LIQATA) used by Kashyap and Stein (2000), Goderis et al. (2007) and Loutskina (2011). Traditionally, a reduction of liquidity forces banks to restrain their loan supply and reduce their risk taking. The development of securitization has however, provided banks (notably the less liquid ones) with new alternative funds making thus, the relationship between liquidity and bank risk very ambiguous.

##### 3.2.2.2.3 Performance

We employ return on equity (ROE) as a proxy of bank performance. Following the argument that poor performing banks might increase their risk taking to re-establish their profitability levels, we can expect a negative coefficient on this variable.

##### 3.2.2.2.4 Size

We approximate size variable by the natural logarithm of total assets (LOGTA). Particularly, one could argue that large banks have better diversification opportunities than small banks. Following this argument, we expect a negative correlation between size and credit risk.

#### 3.2.2.3 Macro-economic variables

##### 3.2.2.3.1 Concentration:

We measure banking market concentration by the Herfindahl Hirschmann index (HHI) computed as the sum of squared market shares of all banks. Mathematically, HHI can be noted as follows:

$$HHI = \sum_{k=0}^{174} S_i^2$$

We define  $S_i$  as the market share of the bank  $i$ .

Previously empirical studies have concluded to mixed results about the relationship between market structure and bank risk: While Keeley (1990), Helmann et al. (2000), Repullo (2004), Levy-yeyati and Micco (2007) and Delis and Pasiouras (2009) were arguing in favor of a destabilizing effect of competition, many other authors such Boyd and De Nicolo (BDN 2005), Boyd et al. (2006) and De Nicolo and Loukoinova (2007) showed that banks become more risky as their markets become more concentrated. Therefore, we can expect an ambiguous effect for the HHI variable.

### 3.2.2.3.2 Real Interest Rate

We introduced interest rate (RINT) to take into account the effect of interest rates on bank risk taking behavior. Empirically, the literature suggests that increasing interest rates make loan repayment more difficult for borrowers which may result in high loan default rates and decreasing asset quality for the bank. Following this argument, we can expect a negative coefficient on this variable.

### 3.2.2.3.3 Inflation

We further introduced the level of inflation deflated by the GDP (INF). According to Hortlund (2005), its effect depends on the net effect of interest margin and financing costs which tend in general, to increase during inflation periods. Therefore, we can expect an ambiguous effect of the INF variable on bank risk.

### 3.2.3 Control Variable (Dummy)

In order to take into account the recent financial disturbances which have occurred since June 2007, we introduced a control variable (Dummy) which takes 1 during the crisis period (from June 2007 until December 2008) and 0 before that (from June 2001 until June 2007).

### 3.3 Model

To analyze the effect of securitization on credit risk of American commercial banks and verify the validity of our hypothesis, we will use the specification of a linear model which relates credit risk to a set of independent variables among them the securitization. Mathematically, our theoretical model can be written as follows:

$$RWATA_{it} = A TSECTA_{it} + \sum_{j=1}^k B_j X_{it} + C + \mu_{it}$$

Where,

RWATA: Bank credit risk measured by the ratio of risk weighted assets to total assets.

TSECTA: Ratio of total securitized assets to total assets.

X: Vector of the independent variables representing bank specific and macro-economic specificities of bank  $i$  for the quarter  $t$ .

A,  $B_j$  et C: Parameters to be estimated.

$\mu$ : Error term.

Alternatively, we will consider another proxy of credit risk: the Z score. For this variable, we will also, test for different types of underlined assets, the effects of securitization on bank stability. The basic regression can be written as follows:

$$Zscore_{it} = A' TSECTA_{i(t-1)} + \sum_{j=1}^k B'_j X'_{it} + C' + \mu'_{it}$$

Where,

Z score: Bank stability.

TSECTA: Ratio of total securitized assets to total assets. Also, we will consider the ratio of mortgage securitized assets to total assets (MBSTA) and the ratio of non mortgage securitized assets to total assets (OSECTA).

X': Vector of the independent variables representing bank specific and macro-economic specificities of bank  $i$  for the quarter  $t$ .

A',  $B'_j$  et C': Parameters to be estimated.

$\mu$ : Error term.

The estimation of these models is realized by the Generalized Least Squared method. This choice is justified by the results of the specification tests carried out via the STATA software.

#### 4. Results and Interpretations

In this section, we will continue with an analysis of the multicollinearity and the specification tests, and a discussion of the results of our estimations.

##### 4.1 Multicollinearity Matrix

By examining Pearson correlation matrix, we observe that some variables\_ RWATA and TCAP, TSECTA and MBSTA and HHI and RINT are strongly correlated (with a correlation coefficient higher than the critical value of 0.7). This indicates according to Kervin (1992), the existence of multicollinearity among them. Thus, these variables must not be included simultaneously in the same model. Also, we observe that the other independent variables are weakly correlated, allowing to exclude the possibility of an overlap of their significance in a multivariate model.

Insert Table 3 Here

##### 4.2 Specification Tests

We chose to estimate two specifications of the model I. In the first one, we introduced securitization and bank specific variables. In the second, we added variables related to macro-economic conditions such as concentration and inflation as well as control variable. Concerning the model II, we also, consider two specifications depending on whether we take into account the inflation rates effects on bank stability or not.

The table 4 reports the results of the specification tests.

Insert Table 4 Here

For each model, we firstly, tested the presence of individual effects. Based on the Fischer test, we show the presence of specific individual effects, which justifies the recourse to panel data. Then, we turned to determine the nature of these specific effects via the Hausman test (1978). This test clearly accepts the panel estimation with fixed specific effects against the random effects specification (p-value = 0.000).

Finally, we moved to detect the existence of heteroscedasticity and autocorrelation problems. In particular, the tests of Breuch and Pagan and wald modified show that we cannot accept the nul hypothesis of homoscedasticity for the different models (p-value = 0.000). Regarding autocorrelation, the Wooldridge test reveals that we have to reject the nul hypothesis of the absence of autocorrelation (p-value = 0.000). In other words, we support the presence of an autocorrelation problem of order 1 between errors.

##### 4.3 Estimation results

###### 4.3.1 Impact of Securitization On Bank's Credit Risk

Estimation results corrected from heteroscedasticity and autocorrelation problems are reported in table 5.

Insert Table 5 Here

The measurement of the total significance of the model was carried out by several criteria among which the value of wald chi2 and  $R^2$ . Table 5 shows that the wald chi2 test has a value of (4466.80) in model I.1 and (4544.12) in model I.2, which are significant to 1% level. Also,  $R^2$  within which gives an idea on the variability share of the credit risk variable explained by the other independent variables is respectively (0.3248) and (0.4035). This shows a mean quality of adjustment between banks. In the other hand, it justifies the addition of the variables related to macro-economic conditions to improve the robustness of the model.

According to our hypothesis, we report a positive and significant impact of TSECTA on bank's credit risk. In other words, a greater recourse to securitization is associated with a deterioration in the quality of American banks' loan portfolios and an increase of the credit risk in their balance sheets. Especially, our results suggest that an increase of the volume of securitized assets per total assets by 100% leads to an increase of the volume of risk weighted assets per total assets by 3.9% (6.6% when referring to the model I.2), all things being equal.

These results allow us to support a reversal effect of securitization in the management of credit risk. In fact, American banks that are very active in this market seem to reduce their risk aversion by holding more risky assets. We join thus, the results of Dionne and Harchaoui (2003) for the Canadian banks. Jiangli and Pritsker (2008) and Casu et al. (2010) have in contrast, supported a stabilizing effect of securitization techniques in the American banking system.

This positive association between securitization and credit risk can be explained as follows:



- If securitization is made without recourse, a positive association will be justified either by the reduction of the borrowers' selection efforts from banks as described by Gorton and Pennacchi (1995) or the reduction of their monitoring incentives as suggested by Gorton and Pennacchi (1995), Morisson (2003) and Wagner and Marsh (2006).

- If securitization is made with recourse, selection and monitoring motivations of banks were thus maintained. So, an increase of credit risk can be explained following Dionne and Harchaoui (2003), by the securitization by American banks of their safe assets; retaining thus, in their balance sheets the riskiest ones.

Credit risk seems also to be affected by the regulatory capital level. In fact, our results show a negative and very significant relationship between TCAP and RWATA.

Similarly, liquidity has a negative and significant effect on credit risk. In average, less liquid banks have taken more risks during the period 2001-2008. When relating this result to our context, this negative association between the holding of liquidity and bank risk taking can be explained in accordance to Loutschina (2011), by the role of securitization as an alternative funding source. Obviously, the availability of liquidity through securitization provides banks (e.g. the less liquid ones) with alternative funds, which lead them to involve in more risky assets.

Paradoxically, the effect of ROE is positive and very significant. In other words, the most profitable banks are also the most risky.

The coefficient related to LOGTA is also, positive and significant. The portfolio composition seems to turn to more risky branches when bank size increases. This contradicts the hypothesis of diversification advantages of large banks as advanced by Demsetz and Strahan (1997). It can however, be explained according to Petey (2004) by the specialization of the American largest banks in some branches of the lending market.

With regard to macro-economic conditions, the one period lagged HHI variable shows, conforming to our hypothesis, a positive and significant coefficient. This means that banks become more risky as their markets become more concentrated. To explain this idea, Boyd and De Nicolo (BDN, 2005), Boyd et al. (2006), Beck et al. (2006) and De Nicolo and Loukoianova (2007) argue that market concentration leads banks to charge high interest rates on their loans, which can increase borrowers' default risk and in consequence, the number of non performing loans in the banks' portfolios.

Also, INF shows a positive and significant impact on credit risk. For example, an increase of inflation rates by 100 base points is associated with an increase of credit risk by 0.271 %, all things being equal. This finding can be explained as follows: As interest rates tend to increase in inflation periods, this encourages banks to engage in risky portfolios in order to profit from the new investment opportunities. At the same time, an increase in interest rates makes loan repayment more difficult for borrowers leading thus, to a deterioration in the quality of banks' loan portfolios and an increase in credit risk in their balance sheets.

Finally, we observe that the coefficient of the Dummy variable is positive which indicates that the credit risk of American banks has increased during the subprime period.

#### 4.3.2 Impact of Securitization on Banking Stability

##### 4.3.2.1 Total Volume of Securitization and Banking Stability

We turn now, to analyze the effect of securitization on American banking stability. The results of the different estimations are summarized in table 6.

Insert Table 6 Here

As we can notice, the two models produce similar results. We proceed then, to choose between these models based on the information criteria of Akaike (AIC) and Schwartz (BIC). By definition, the most adequate model is the one that minimizes these two information criteria. The table 7 shows that the model II.2 is the most appropriate one.

Insert Table 7 Here

Thus, we will focus our interpretations on the results issued from the model II.2. In particular, we can observe that the effect of RWATA is negative. This means that bank's stability decreases when its portfolio becomes more risky.

Based on this result, we can expect that the securitization, by increasing the volume of risky assets on bank's balance sheet reduces its stability level. Surprisingly, our results show that the effect of the one period lagged TSECTA is significantly positive supporting thus, a stabilizing effect of securitization for American commercial banks.

This seems to be in contradiction with our prior conclusions obtained from the first measure of credit risk (RWATA). We think that this paradox is related to the fact that different classes of securitized assets lead to heterogeneous effects on banking stability.

The coefficient of CAPTA is significantly positive. This means that American overcapitalized banks appear in average, more stable. This result corroborates our first affirmations and justifies thus, the reinforcement of capital requirements efforts made by regulatory authorities to support banking stability.

ROE variable shows also, a positive and significant impact on Z score suggesting thus, a great stability of the most profitable American banks.

However, LIQATA variable reports a negative effect on Z score. This means that less liquid banks are less prone to insolvability problems. This can be explained by the new funding possibilities that less liquid banks can obtain through securitization. In fact, the recourse to these markets provides banks with additional funding sources that help them to fulfill their funding needs, to take more easily new profitable investment opportunities and to increase their stability levels.

The coefficient related to LOGTA appears also, negative and significant. This indicates that large banks are in average less stable than small banks. As explained before, the specialization of large banks on some credit market branches and the resulted risk concentration lead to a destabilizing effect on American banks.

The effect of the one period lagged RINT variable is significantly positive. This can be attributed to the fact that an increase in real interest rates increases bank profit margins and improves thus, their stability levels.

#### 4.3.2.2 Nature of the Underlying Assets and Banking Stability

In order to best understand interactions between securitization and banking stability, we chose to push more our analysis by considering different classes of securitized assets (e.g. securitization of mortgage assets Vs securitization of non mortgage assets). The results of our estimations are reported in table 8.

Insert Table 8 Here

As predicted, different forms of securitization seem to have heterogeneously effects on American banks' stabilities: whereas mortgage securitization (MBSTA) reinforces banking stability, securitization of non mortgage loans (OTSECTA) leads on the contrary, to reversal effects.

Focused firstly on mortgage securitization, our empirical results confirm the advantages of this type of securitization on banking stability. This can be explained following Casu et al. (2010), by the implicit recourse provided in mortgage securitization transaction. In fact, for this type of securitization the risk is not totally transferred to investors but maintained by the securitizer bank in its off-balance sheet engagements. This risk retention characterizing mortgage securitization transactions provides thus, a mean to maintain banks' incentives to monitor their borrowers and avoid in consequence, the reversal effects that securitization can have on banking stability.

Paradoxically, non mortgage securitization appears more risky. In fact, our results indicate that American commercial banks that are most involved in non mortgage securitization markets are less stable than less involved ones. For illustration, an increase in the volume of non mortgage securitized assets per total assets by 1% is associated with a decrease in banking stability by 6.8% (7% when we refer to the results of the model II.5). We join thus, the conclusions of Krahen and Wilde (2006), Baur and Joossens (2006), Michilak and Uhde (2009) and Uhde and Michilak (2010) having also, reported an increase in systematic risk of European banks after a securitization transaction. Therefore, we conclude that the net effect of securitization on bank stability will depend on the structure of the securitized portfolio and the credit support provided by the bank.

## 5. Conclusion

The object of this study was to investigate the effects of securitization on the credit-risk taking behavior of banks. Based on a sample of 174 US commercial banks during the period 2001-2008, we report an increase of the credit risk of American banks when they securitize their loans. This doesn't however, mean that these banks become less stable. In fact, our results suggest, contrary to what one could pretend, a positive and significant impact of securitization on banking stability.

We attribute this paradox to the fact that different classes of securitized assets lead to heterogeneous effects on American banks' risk. Indeed, our results show that mortgage securitization has a positive and significant impact on banking stability, providing thus a support to the implicit recourse hypothesis. Inversely, non mortgage securitization has a negative effect on banking stability because of the reduction of banks' monitoring incentives related to this particular form of securitization. Therefore, the net effect of securitization on bank stability will depend on the structure of the securitized portfolio and the credit support provided by the bank.

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Table 1. Definition of Variables

Variables	Designation		Description	Expected Sign on RC
<b>Dependent Variables :</b>				
Credit Risk	RC	RWATA	Risk weighted assets/total assets	
		Z Score	The sum of the return on average assets (ROAA) and equity capital to total assets to standard deviation of ROAA. the return on average assets (ROAA) and equity capital to total	
<b>Independent Variables :</b>				
	Securitization	TSECTA	Total securitized assets/total assets	(+/-)
		MBSTA	Mortgage securitized assets/total assets	(+/-)
		OSECTA	Non mortgage securitized assets/total assets	(+/-)
Bank Specific Variables	Capital	TCAP	Equity capital/risk weighted assets	(+/-)
		CAPTA	Equity capital/total assets	(+/-)
	Liquidity	LIQATA	Liquid assets /total assets	(+/-)
	Performance	ROE	Net income/equity capital	(-)
	Size	LOGTA	Logarithm of total assets	(-)
Macro-Economic Variables	Concentration	HHI	Sum of squared market shares of all banks	(+/-)
	Real interest rate	RINT	Lending interest rate adjusted for inflation as measured by the Gross Domestic Product deflator	(-)
	Inflation	INF	Inflation deflated by the Gross Domestic Product	(+/-)
<b>Control Variable:</b>				
	Subprime Crisis	Dummy	=0 : before crisis =1 : after crisis	(+)

Table 2. Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum	Number of observations
RWATA	0.696	0.129	0.239	0.993	5394
Z Score	33.288	15.949	1.202	191.113	5394
TSECTA	0.017	0.061	0	0.726	5394
MBSTA	0.013	0.056	0	0.723	5394
OSECTA	0.004	0.021	0	0.231	5394
TCAP	0.149	0.056	0.049	0.489	5394
CAPTA	0.097	0.027	0.025	0.261	5394
LIQATA	0.078	0.079	0.002	0.642	5394
ROE	0.067	0.058	-0.711	0.451	5394
LOGTA	13.137	2.237	9.256	21.110	5394
HHI	0.154	0.007	0.144	0.170	5394
RINT	0.032	0.012	0.014	0.052	5394
INF	0.026	0.005	0.017	0.033	5394
Dummy	0.258	0.438	0	1	5394

Table 3. Pearson Correlation Matrix

	rwata	tsecta	mbsta	osecta	tcap	capta	liqata	roe	logta	hhi	rint	inf	dummy
rwata	1.0000												
tsecta	0.2179	1.0000											
mbsta	0.1155	0.8444	1.0000										
osecta	0.2766	0.6164	0.2158	1.0000									
tcap	-0.7054	-0.2415	-0.1595	-0.2455	1.0000								
capta	-0.0511	-0.1110	-0.1031	-0.0134	0.5326	1.0000							
liqata	-0.2264	0.0103	-0.0017	0.0667	0.1600	-0.0013	1.0000						
roe	0.1947	0.0715	0.0335	0.0783	-0.1964	-0.2118	-0.0102	1.0000					
logta	0.2654	0.3361	0.2417	0.3628	-0.3724	-0.1895	-0.1447	0.1847	1.0000				
hhi	0.1278	0.0827	0.0649	0.0505	-0.0704	0.0570	-0.0791	-0.0792	0.0478	1.0000			
rint	0.1149	0.0655	0.0510	0.0422	-0.0665	0.0523	-0.0618	-0.0717	0.0398	0.8696	1.0000		
inf	0.0724	-0.0051	-0.0139	0.0001	-0.0219	0.0121	-0.1363	-0.0182	0.0344	0.2070	0.0815	1.0000	
dummy	0.1392	0.0840	0.0620	0.0508	-0.0832	0.0700	-0.0942	-0.1798	0.0748	0.5522	0.5315	-0.1329	1.0000

Table 4. Specification Tests

	Model I.1		Model I.2		Model II.1		Model II.2*	
	Fisher (p-value)	Chi2 (p-value)	Fisher (p-value)	Chi2 (p-value)	Fisher (p-value)	Chi2 (p-value)	Fisher (p-value)	Chi2 (p-value)
<b>Fisher Test</b>	F(173, 5216) = 144.82 (0.000)		F(173, 5212) = 161.38 (0.000)		F(173, 5039) = 49.86 (0.000)		F(173, 5038) = 49.99 (0.000)	
<b>Hausman Test**</b>		Chi2(4) = 54.99 (0.000)		Chi2(8) = 52.72 (0.000)		Chi2(7) = 56.89 (0.000)		Chi2(8) = 42.62 (0.000)
<b>Heteroscedasticity tests</b>								
<b>Breuch et Pagan test</b>		Chi2(1) = 1790.01 (0.000)		Chi2(1) = 39706.91 (0.000)		Chi2(1) = 2224.91 (0.000)		Chi2(1) = 2194.00 (0.000)
<b>Wald modified Test</b>		Chi2(174) = 96449.26 (0.000)		Chi2(174) = 1.1 10 <sup>5</sup> (0.000)		Chi2(174) = 1.2 10 <sup>5</sup> (0.000)		Chi2(174) = 1.2 10 <sup>5</sup> (0.000)
<b>Autocorrelation test</b>								
<b>Wooldridge Test</b>	F(1, 173) = 210.043 (0.000)		F(1, 173) = 210.097 (0.000)		F(1, 173) = 732.116 (0.000)		F(1, 173) = 732.316 (0.000)	

\* Specification tests were also conducted for the model II.2 by considering separately and simultaneously MBSTA and OSECTA variables instead of TSECTA variable. Similar results were obtained.

\*\* The decision consists to retain the presence of fixed specific effect if p-value is below 5%.

Table 5. Effect of securitization on the credit risk taking of American commercial banks

Variables	Dependant Variable : RWATA			
	Model I.1		Model I.2	
	Coeff	S.E	Coeff	S.E
TSECTA	0.039 (***)	0.012	0.066 (***)	0.013
TCAP	-1.264 (***)	0.028	-1.250 (***)	0.027
LIQATA	-0.418 (***)	0.009	-0.420 (***)	0.009
ROE			0.012 (**)	0.005
LOGTA	0.003 (***)	0.001	0.003 (**)	0.001
L.HHI			0.267 (***)	0.060
INF			0.271 (**)	0.110
Dummy			0.006 (***)	0.001
Constant	0.876 (***)	0.017	0.825 (***)	0.018
<b>Number of Observations</b>		5394		5220
<b>Wald chi2</b>		4466.80 (***)		4544.12 (***)
<b>R2</b>		0.3248		0.4035

Were reported in this table, the coefficients of the linear estimation and the standard errors related to each included variable.

\*\*\*, \*\*, \* represent the significance at 1%, 5% and 10% levels respectively.

**Variable Definition :** RWATA : risk weighted assets per total assets, TSECTA : total securitized asset per total assets, TCAP : total capital ratio, LIQATA : liquid assets per total assets, ROE : return on equity, LOGTA : logarithm of total assets, HHI : banking concentration index, INF : inflation rate, Dummy : takes 0 before the subprime crisis and 1 during the subprime crisis.

Table 6. Effect of securitization on American banking stability

	Dependent variable : Z score			
	Model II.1		Model II.2	
	Coeff	S.E	Coeff	S.E
RWATA	-10.134 (***)	1.009	-10.169 (***)	1.011
L.TSECTA	1.954 (*)	1.001	2.053 (**)	1.013
CAPTA	283.258 (***)	4.711	282.947 (***)	4.726
LIQATA	-7.873 (***)	1.290	-8.043 (***)	1.293
ROE	22.450 (***)	0.582	22.540 (***)	0.582
LOGTA	-0.650 (***)	0.059	-0.651 (***)	0.059
RINT	4.013	4.625		
L.RINT			9.586 (**)	4.617
INF			18.770	12.591
Constant	18.426 (***)	1.123	17.836	1.167
Number of observations		5220		5220
Wald chi2		5524.43		5510.32
R <sup>2</sup>		0.1907		0.1929

Were reported in this table, the coefficients of the linear estimation and the standard errors related to each included variable.  
 \*\*\*, \*\*, \* represent the significance at 1%, 5% and 10% levels respectively.

**Variable Definition:** Z score : sum of average return on assets and capital ratio per return volatility, RWATA : risk weighted assets per total assets, TSECTA : total securitized assets per total assets, CAPTA : equity capital per total assets, LIQATA : liquid assets per total assets, ROE : return on equity, LOGTA : logarithm of total assets, RINT : real interest rate, INF : inflation.

Table 7. Choice of the model

	Dependent Variable: Z score	
	AIC	BIC
Model II.1	36617.32	36669.81
Model II.2	36604.63	36663.67

Table 8. Effect of securitization on American banking stability: Distinction between Mortgage securitization (MBSTA) and non mortgage securitization (OTSECTA)

	Dependent Variable : Z score					
	Model II.3		Model II.4		Model II.5	
	Coeff	S.E	Coeff	S.E	Coeff	S.E
RWATA	-10.229 (***)	1.007	-9.782 (***)	1.019	-10.081 (***)	1.012
L.MBSTA	2.951 (***)	1.041			2.975 (***)	1.040
L.OSECTA			-6.789 (*)	3.594	-7.006 (*)	3.605
CAPTA	282.692 (***)	4.720	282.805 (***)	4.742	282.389 (***)	4.723
LIQATA	-8.055 (***)	1.293	-7.751 (***)	1.295	-7.942 (***)	1.298
ROE	22.537 (***)	0.583	22.597 (***)	0.580	22.587 (***)	0.584
LOGTA	-0.652 (***)	0.058	-0.607 (***)	0.060	-0.631 (***)	0.060
L.RINT	9.675 (**)	4.621	9.077 (**)	4.610	9.563 (**)	4.627
INF	19.015	12.598	18.344	12.586	18.786	12.616
Constant	17.905 (***)	1.155	17.047 (***)	1.177	17.576 (***)	1.171
Number of observations		5220		5220		5220
Wald chi2		5519.57 (***)		5463.25 (***)		5491.33 (***)
R <sup>2</sup>		0.1933		0.1923		0.1934

Were reported in this table, the coefficients of the linear estimation and the standard errors related to each included variable.  
 \*\*\*, \*\*, \* represent the significance at 1%, 5% and 10% levels respectively.

**Variables Definition:** Z score: sum of average return on assets and capital ratio per return volatility, RWATA : risk weighted assets per total assets, MBSTA : mortgage securitized assets per total assets, OSECTA : non mortgage securitized assets per total assets, CAPTA : equity capital per total assets, LIQATA : liquid assets per total assets, ROE : return on equity, LOGTA : logarithm of total assets, RINT : real interest rate, INF : inflation.



## Appendix 1. Construction of the variables

Variables	Code in the Call Report
Total asset	RCFD2170
Total Average Asset	RCFDA224
Risk weighted assets	RCFDA223
Global volume of securitized assets	RCFDB705+ RCFDB706+ RCFDB707+ RCFDB708+ RCFDB709+ RCFDB710+ RCFDB711
Mortgage securitized assets	RCFDB705
Other securitized assets	RCFDB706+ RCFDB707+ RCFDB708+ RCFDB709+ RCFDB710+ RCFDB711
Capital Ratio	RCFD3210
Total Capital Ratio	RCFD3792
Liquid Assets	<u>Until 2001</u> : RCFD0010+ RCFD1350+ RCFD3545 <u>From 2002</u> : RCFD0010+ RCONB987+ RCFDB989+ RCFD3545
Net Income	RIAD4340

\* Significance of the codes was obtained from the « *Consolidated financial statement for commercial banks* (2001-2008) » provided by « *The Board Governors of The Federal Reserve System* ».

### Notes:

- 1- The Securitization variable (TSECTA) was constructed as the sum of different classes of securitized loans: 1-4 family residential loans (RCFD B705), Home Equity Lines (RCFD B706), Credit cards receivables (RCFD B707), Auto loans (RCFD B708), Other Consumer loans (RCFD B709), Commercial and industrial loans (RCFD B710) and others assets (RCFD B711).
- 2- Bank liquidity was computed by adding the following items:
  - a) Cash and due from banks (RCFD 0010).
  - b) Federal funds sold and securities purchased under agreement to resell:
    - Until the year 2001: RCFD 1350.
    - Since the year 2002: « Federal funds sold » (RCON B987) + « Securities purchased under agreement to resell » (RCFD B989).
  - c) Total trading assets (RCFD 3545).

# An Empirical Analysis of Capital Adequacy in the Banking Sub-Sector of the Nigeria Economy

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## Abstract

The paper sets out to examine the impact of capital adequacy in the banking sub-sector and the growth of Nigeria economy. It specifically seeks to ascertain the effect of bank capital base and macroeconomic variables. Nigeria's data set from CBN statistical bulletin (2009) during the period 1980-2010 was used. It employed the error correction framework and co-integration techniques to test the relationship between bank capital base and macroeconomics variables. This implies that political stability may reduce financial distress and bankruptcy why foreign investment will affect Banks capital in most developing economy in the period of financial crisis. However, the study also establishes that there is a negative relationship between inflation and banks capital base as inflation erode banks capital in most developing economy. This simply means that Nigerian government should regulate investment policy why banks regulators should strive to keep inflation rate at a minimum level, if possible below 5% for them to be more efficient so as to be globally competitive.

**Keywords:** Capital adequacy, Macroeconomics variables, Global credit crunch

## 1. Introduction

One of the biggest achievements in the financial sector of the Nigeria economy in 2005 was the reform of the Banking Sector. It was an achievement via the Central bank of Nigeria increase in bank capital above 1000 percent. It was an exercise that resulted in the reduction of Nigeria motley group of mainly anemic 89 banks to 25 bigger, stronger and more resilient financial institutions. The reforms engineered a revolution in the financial services industry leading to an increase both in the quality of service and quantity of financial products available to Nigerians and to checkmate the capital adequacy of the banks.

Capital Adequacy can be percentage ratio of a financial institution's primary capital to its assets (loans and investments), used as a measure of its financial strength and stability. According to the Capital Adequacy Standard set by Bank for International Settlements (BIS), banks must have a primary capital base equal at least to eight percent of their assets: a bank that lends 12 dollars for every dollar of its capital is within the prescribed limits. However, the assessment of capital adequacy for precautionary purposes is problematic at best due to rapidly changing economic and financial services industry. Another role of capital is the fact that the viability of a bank depends to a critical extent upon public confidence. There is a strong public relation aspect to capital adequacy also. It is generally recognized that the availability of capital is neither a perfect indicator of the state of health of a bank nor a sufficient condition to ensure the maintenance of confidence by depositors and creditors, but no doubt, it represents a major element in

shaping their perception of the solidity of an institution. Capital level is used by most regulators to restrict credit expansion. That explains why banks management are inspired to determine the correlation between variables like Total credit loan, Demand deposit, Inflation rate, Political instability, Money supply, Liquidity risk, Investment etc and Capital and hence indicate whether large capital are negatively or positively compel banks to meet the capital adequacy requirement or seek additional capital so as to meet their credit expansion target. By looking at banks role as a financial intermediaries, capital adequacy and macroeconomic variables have become a key indicator of a bank capital whereby inflation erodes banks capital in most developing countries. Indeed, several studies have found evidence that the development of the banking sector is related to economic growth. The importance of capital adequacy in the banking sub-sector of the Nigeria economic and financial development directs us to investigate which economic- macro or micro, banks ratios and balance sheet and institutional factors that give rise to a vibrant capital adequacy.

Therefore, the problem here is to use co-integration to determine whether there is a linear relationship between banks capital and macroeconomics variables and if there is, whether the degree of linearity is such that capital adequacy issues could be largely a matter of bank failure or business exigencies as opposed to the current flex of legal muscle by the regulatory authorities. Against this backdrop, the objectives of the study are to empirically investigate the determinants of capital adequacy with respect to economics variables. To analyze the various issues involved in capital adequacy debate. To examine the components of bank capital and bank consideration in selecting capital mix. To expound the diverse measurements of capital adequacy particularly the CAMELS. Furthermore, capital adequacy in the banking sector model is to permit forecasting of capital adequacy pattern, which is useful for both policy makers and the banking sector in general for formulating informed course of action.

In spite of the importance of banks as financial intermediaries, capital adequacy modeling has not been in the mainstream of econometric research into the financial sector in Nigeria. Analyses of the banking sector have so far focused on qualitative assessment of growth trends and sectoral behaviour patterns in the industry. Discussion in those studies has, for instance, suggested a number of factors that may influence the failure pattern of banks, bank products and management. There has been no model designed to determine the relative impact of banks capital and macroeconomics variables and their possible linkages between the banking sector and the real sector of the economy. Since independence, no consensus has been reached by different Scholars as regards the determinants of capital adequacy with macroeconomics variables in Nigeria.

Opinion differs among experts in banking and finance as to what constitutes adequate capital but they all agree that it is an age long issue for which there do not seem to be any consensus in sight. Thus as noted by Nwankwo (1990), Adebite (2010), the issue of what constitutes an adequate capital for banks has a long history. It is in fact, almost as old as banking itself.

Sanusi (2010) was even more satirical in answering the question of how much capital a bank needs to ensure the confidence of depositors, creditors, investors and regulators in a country of high inflation rate and economic instability, when he noted "that in banking and finance literature, this question is noted as the issue of capital adequacy. Anyone who knows the answer can gain instant notoriety in the banking, financial and regulatory communities.

However, the battle between the banks and regulatory authorities is centered after a prolonged period of recession and macro-economic instability. Hitherto, several studies have emphasized the importance of capital adequacy and there is need to review related studies in order to gain more understanding of the subject.

Mpuga (2002) argued that the inadequacy of minimum capital standards in accounting for risks in banks assets portfolio could be one of the major factors leading to bank failures. He studied the 1998-99 banking crisis in Uganda and how the new banking guidelines in Uganda was to increase bank solvency and capital adequacy by shifting their portfolio towards lower risk assets, in an effort to meet the new requirements

Yu Min-The(2006), defined the adequate capital for banks as the level at which the deposit insuring agency would just breakeven in guaranteeing the deposits of individual banks with premium the banks pay. An option of theoretical framework was employed in his study for measuring fair capital adequacy holdings for a sample of depository institutions in Taiwan, during 1985-1992. Except for the 1989, most banks in their sample proved to be inadequately capitalized so that capital infusion is required.

George & Dimitrios (2004) applied non-parametric analytic technique (data envelopment analysis, DEA) in measuring the performances of the Greek banking sector with respect to capital adequacy. He proved that data envelopment analysis can be used as either an alternative or complement to ratio analysis for the evaluation of an organization's performance with attention to macroeconomics indicators.

Morris, Alan & Mukesh (2006) research studies examine the tendency for serial correlation in bank holding company profitability, finding significant evidence of reversion to the industry mean in profitability. The paper then considers the impact of mean reversion on the evaluation of post-merger performance of bank holding companies. The research concludes that when an adjustment is made for the mean reversion, post-merger results significantly exceed those of the industry in the first 5 years after the merger.

Robert (1997) estimated pre- and post-merger X-inefficiency in 348 mergers approved by the OCC in 1987/1988. Efficiency improved in only a small majority of mergers, and these gains were unrelated to the acquiring banks efficiency advantage over its targets. Efficiency gains were concentrated in mergers where acquiring banks made frequent acquisitions, suggesting the presence of experience effects.

Chol(2000), studied the credit crunch in the banking sector in Korea in year 1997, found the replacement of an old capital standards with risk based and macro economics based variables RBC & MBC 1997, increased banks below the regulatory capital requirements from 0-14, and a number reduced to 7 in 1998 and the banks capital deficiency amounted to 59 percent of the total Korea asset in 1997.

Hassan (2008), mentioned that banks had been exposed to standby letters of credit (SLC) and off-balance sheet activities, which has become a major concern to regulators. This means that macroeconomic variables such as inflation play a greater role in the determinants of capital adequacy in most developing countries like Nigeria.

Ajayi (2008), The macroeconomic indicators (i.e. inflation and economic growth) are significant in both spread, bank capital adequacy and profit regressions. This may suggest that banks tend to not being profitable in inflationary environment. In addition, economic growth does not reflect any aspects of banking regulations and technology advance in the banking sector with require pressing attention.

*1.1 Research Methods*

This applies to the error correction methodology to a regression model based on the traditional determinants of capital adequacy in the banking sub-sector of the Nigeria economy distilled from the literature. The idea is to subject the variables to stationary test and subsequently remove the non- stationary trends by differencing before regressing. This removes the possibility of the so-called spurious regression. Any previous studies on the determinants of capital adequacy in the banking sub-sector of the Nigeria economy if there exist any in Nigeria may not have considered the problem of unit roots in the determinants of capital adequacy and macroeconomics variables. As a result, the econometric methodology used in those studies did not account for non-stationarity in the data. The analysis here is primarily based on Engle and Granger (1987), and Engle and Yoo (1987). The idea is to determine the order of integration of the variables, that is, we test whether they are stationary in their levels or whether they have to be differenced once or more before they become stationary. Testing for unit roots is carried out by using an Augmented Dickey-Fuller (ADF) test.

In order to account for the determinants of capital adequacy in the banking sub-sector of the Nigeria economy, the model for the study is hereby specified as follows:

$$CAB = f(TL, MS, DIR, INFL, DL, POL, ER, LQ, OPEN, INV)$$

The above model is hereby written in log —linear form as:

$$(L) CAB = b_0 + b_1TCL(L) + b_2MS(L) + b_3DIR(L) + b_4INFL(L) + b_5DL(L) + b_6POL(L) + b_7ER(L) + b_8LQ(L) + b_9OPEN + b_{10}INV + \mu_t \dots\dots\dots E(1)$$

apriori,  $b_1 > 0, b_2 > 0, b_3 > 0, b_4 < 0, b_5 > 0, b_6 < 0, b_7 > 0, b_8 > 0, b_9 > 0, b_{10} > 0$

Where:

- \* CAB = CAPITAL ADEQUACY BASE
- TL = TOTAL LOANS.
- MS = MONEY SUPPLY
- DIR = DOMESTIC INTEREST RATE (REAL)
- INFL = INFLATION RATE
- DL = DEMAND DEPOSIT
- POL = POLITICAL INSTABILITY DUMMY = 1 MILITARY REGIME AND TURBULENT YEARS, 0 OTHERWISE
- ER = EXCHANGE RATE

LQR	=	LIQUIDITY RISK
OPEN	=	OPENNESS OF THE ECONOMY (TOTAL TRADE /GDP RATIO)
INV	=	INVESTMENT (proxied by long US interest rate)

Capital adequacy being the dependent variable is the total asset of banks deflated by total number of capitalize banks operating in the economy while the independent variables such as demand deposit is total deposits including private and public, investment include both local and foreign direct investment while others variables includes total loans, money supply and interest rate (real), exchange rate, inflation rate (nominal), political instability –including civilian and military regime.  $U_t$  = Captures other variable not included in the model and it takes care of other factors that cannot be observed or computed due to lack of data.  $U_t$  is referred to as error term, residual or stochastic term.

“The Data Analysis technique consists of an approach designed to capture the long-run relationship between the dependent and independent variables, while avoiding spurious influences. This is the co-integration and error correction techniques which have received prominent attention in literature (see Adam, 1992, Engle and Granger, 1987, Gilbert, 1986, Hendry and Richard 1983 and Thomas 1993).

The aim of the new framework was to ascertain the time characteristics of data, overcome the problems of spurious correlation often associated with none —stationary time series data, and generated long —run variable relationship simultaneously. Within this dispensation, an important starting point for research is an assessment of the degree of integration of the relevant variables and to check whether they are co-integrated or not. It should be noted that an important issue in econometrics is the need to integrate short-run dynamics with long-run equilibrium. The analysis of short-run dynamics is often done by first eliminating trends in the variables, usually by differencing. The theory of co-integration development in Granger (1981) and elaborated in Engle and Granger (1987) addressed this issue of integrating short-run dynamics with long-run equilibrium.

Similarly, it is important to note that the usual starting point of ECM modeling is to assess the order of integration of both the dependent and independent variables in the model. The order of integration ascertains the number of time a variable will be differentiated to arrive at stationary. Dickey-fuller (DF), Augmented Dickey-Fuller (ADF) and Sargan - Rhargava Durbin-Watson (SRDW) are the widely used test for stationary for both individual time series and residual from OLS regressions. Co-integration is based on the properties of the residuals from regression analysis when the series are individually non-stationary.

The original co integration regression is specified as follows:

$$A_t = \alpha_0 + \alpha_1 \beta_t + \ell_t \quad (1)$$

Where A represents the dependent variables,  $\beta$  stands for the independent variable, and  $\ell$  e is the random error term.  $\alpha_0$  and  $\alpha_1$  are intercept and slope coefficients respectively. To include the possibility of bi-directional causality, the reverse specification of equation 1 is considered.

To provide a more defensive answer to the non-stationarity in each time series, the Dickey-Fuller (1979) regression is estimated as follows for a unit root:

$$\Delta e_t = -\lambda e_{t-1} + w_t \quad (2)$$

If X Equals zero e is non-stationary. As a result, A and B are not co-integrated. In other words, if X is significantly different from zero A and B are found integrated individually.

Given the inherent weakness of the root test to distinguish between the null and the alternative hypothesis, it is desirable that the Augmented Dickey-Fuller (ADF) (1981) test be applied. The desirability is warranted because it corrects for any serial correlation by incorporating logged changes of the residuals. To be co-integrated, both A and B must have the same order of integration (Eagle and Granger, 1987 and Granger, 1986).

The ADF regression is specified as follows:

$$\Delta \ell_t = \beta_0 \ell_{t-1} + \sum_{j=1}^m \beta_j \Delta \ell_{t-1} + \mu_t \quad (3)$$

Where  $\Delta$  is the first different operator and  $\mu_t$  is the new random error term. M is the optimum number of lags needed to obtain “white noise”. This is approximated when the DW value approaches 2.0 numerically. The null hypothesis of non co-integration is rejected, if the estimated ADF statistics is found to be larger than its critical value at 1 or 5 or 10 per cent level of significance.

if  $A_t$  and  $B_t$  are found to be co-integrated, then there must exist an associated error-correlation Model (ECM), according to Engle and Granger (1987). The usual ECM may take the following form:

$$\Delta G_t = \sigma_0 e_{t-1} + \sum_{j=1}^T \sigma_1 \Delta A_{t-j} + \sum_{j=1}^T \theta_j \Delta B_{t-j} + V_t \quad (4)$$

Where  $\Delta$  denotes the different operator  $e_{t-1}$  is the error correction term,  $T$  is the number of lags necessary to obtain white noise and  $V_t$  is another random disturbance term. If  $\sigma_0 e_{t-1}$  is significantly different from zero, then  $A$  and  $B$  have long-Run relationship. The error-correction term ( $e_{t-1}$ ) depicts the extent of disequilibrium between  $A$  and  $B$ . The ECM, reveals further that the change in  $A_t$  not only depends on lagged changes in  $B_t$ , but also on its own lagged changes. It is appealing due to its ability to induce flexibility by combining the short-run and long-run dynamics in a unified system. Also, the estimates of the parameters of the ECM are generally consistent and efficient (Ilendry and Richard, 1983).

Insert Table 1, Table 2, Table 3, Table 4 & Table 5 Here

### 1.1.1 Analysis Result

It was discovered through this study that, there were long run relationship between Exchange rate, Inflation rate, Political Instability, and Money Supply. Also, all the variables employed in this study were all stationary at their first difference except rate of real domestic interest rate and return on investment that were stationary at their levels. There are some major findings that this study has revealed.

These findings include:

1. From the result of the study, one could see that money supply is an important determinant of capital adequacy base in Nigeria. Its high coefficient and very strong level of significance even at one percent suggests that increase in Money leads to an increase in Bank capital base. The increase in CAB could also have a feedback effect on economic growth.
2. The real domestic interest rate is also an important determinant of Bank capital adequacy base in Nigeria, since it is statistically significant at one percent level of significance, although it is inversely related to CAB which suggests that the rise in real cost of capital, informed by an increase in real interest rate would tend to dampen CAB especially those requiring some degrees of domestic capital.
3. The real exchange rate is another significant determinant of CAB in Nigeria. Although, the coefficient is not as expected, but existing literature emphasized an inverse relationship which implies that an increase, in the real exchange rate will reduce the flow of Foreign direct investment and so reducing CAB in Nigeria and vice versa.
4. The return on investment in the rest of the world proxied by long- run US interest rate is not a strong or significant determinant of CAB in Nigeria while Inflation rate erodes CAB but existing literature has shown that foreign direct investment has negative impact in developing economy during period of financial crisis.
5. The Deposit liabilities and liquidity risk variables are not correctly signed and are not statistically significant but may increase CAB via increase in money supply.
6. As can be seen, the coefficients that appears on the INV have his theoretically predicted signs and in general are statistically significant. The, result indicated that Investment increases CAB via inflow of Foreign direct investments into Nigeria.
7. Lastly, the political dummy used as proxy for political instability was appropriately signed indicating that intermittent coup d'etat and incessant political upheaval may serve to scare away potential foreign investors thereby, reducing CAB in Nigeria.

The aim of this empirical study is to investigate the determinants of capital adequacy patterns in the Banking sub-sector in Nigeria. The study applied the Error Correction Model (ECM) and found empirical support for some conjectures made in the literatures. Given the importance of Capital adequacy in any economy and the likely economic effects on banks' capital on growth and development, it becomes expedient to examine how Capital adequacy in Nigeria can better be improved if attention is given to some macroeconomic variables.

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Table 1. Stationary Test

Variables	ADF Test	Order of Integration
Log CAD	0.04925 (-29969)	1(1)
Log CAD	-3.7333 (-3.0114)	1(0)
Log INV	-3.6876 (-2.9798)	1(0)
Log ER	-2.0299 (-2.9798)	1(1)
A Log ER	-3.5063 (-2.9850)	1(0)
Log DIR	-4.2833 (-2.9798)	1 (0)
Log INV	-3.3697 (-2.9798)	1 (0)
Log INFL	-1.3068 (-2.9969)	1(1)
A Log INFL	-40706 (-3.0038)	1 (0)
Log OPEN	0.8224 (-2.9798)	1(1)
A Log OPEN	-4.1436 (-2.9850)	1(0)
Log MS	-1.1022(-2.9798)	1(1)
A Log MS	-3.0994 (-2.9850)	1(0)

Source: Authors' computation (2012)

Table 2. Johansen Co-integration Test Results

Sample: 1980 – 2010				
Series: Log CAB, Log ER, Log INFL, Log OPEN, Log MS				
Eigen value	Likelihood Ratio	5%	1%	Hypothesized
		Critical	Critical	No. of CE(s)
		Value	Value	
0.84	114.3228	94.15	103.18	None**

Note: \* (\*\*) ( denotes rejection of the hypothesis at 5% (1%) significance level.

L. R. test indicates 2 co-integration equation(s) at 5% significance level.

Lags interval: 1 to 1

Source: Authors' computation (2012)

Table 3. Long-run Capital Adequacy Determinants Model Estimates

Modeling Log (CAB) by OLS		
Sample: 1980 – 2010		
Variable	Co-efficient	t-value
Log ER	0.6772	3.4397***
Log INFL	-0.1325	-1.2558
Log OPEN	0.2896	5.1303
Log MS	0.6427	30.9551***

Notes: Adj. R<sup>2</sup> = 0.72      F = 21.327      a = 0.45  
 R<sup>2</sup> = 0.75      Prob (F--Statistic) = 0.00000

Dw = 1.87    Schwarz information criterion 1.561

\* Significant at 1% Level

\*\* Significant at 5% Level

\*\*\* Significant at 10% Level

a = S. E. of regression

Source: Authors' computation (2012)



Table 4. Short-run over — parameterized Capital Adequacy Determinants Model

Model Estimates Log (CAB) by OLS

Sample: 1980— 2010

Variables	Model	Log (CAB) by OLS
	Sample:	1980— 2010
	Co-efficient	t-value
Constant	1.2840	2.6798
$\Delta$ LogCAD(-1)	-0.5866	-3.9531***
$\Delta$ LogINFL	-0.2160	-0.8619
$\Delta$ LogINFL(-1)	0.1434	0.7085
$\Delta$ LogER	0.9177	3.5113***
$\Delta$ Log ER (-1)	0.5939	0.7142
$\Delta$ DIR	-0.0096	-0.8264
$\Delta$ DIR(-1)	-0.0175	-1.5620
$\Delta$ LogINV	-0.3253	-1.0929
$\Delta$ LogINV(-1)	0.6758	1.8781
$\Delta$ Log OPEN	-0.1542	-0.5330
$\Delta$ Log OPEN (-1)	-0.1861	-0.6258
$\Delta$ Log MS	-0.7079	-0.9319
$\Delta$ Log MS (-1)	3.7842	4.2348***
POL	-0.0933	-0.5043
TL	-0.3155	1.1369
DL	-1.4232	-3.4808
$\Delta$ Log LQR	0.3846	3.3403***
ECM(-1)	-0.5414	2.4385**

Notes:  $R^2 = 0.97$ 

F=10.61

a=0.215

Adj  $R^2 = 0.88$ 

Prob (F — Statistic) = 0.007975

DW= 1.46

Schwarz information criterion = 0.7 13

Source: Authors' computation (2012)

Table 5. Short-run Parsimonious Model Estimates

Modeling Log (CAB) by OLS		
Sample: 1980 – 2010		
Variables	Co-efficient	t-value
Constant	1.648	3.9047
Log CAD (-1)	-0.6818	-3.816***
Log INFL	0.0265	0.357
Log ER	0.8227	3.1236***
Log DIR (-1)	-0.0193	-5.0554***
Log INV	-0.1811	-0.5548
Log OPEN (-1)	-0.2630	-1.3896**
Log MS (-1)	2.7025	3.3876***
POL	-0.2672	-1.4278
TCL	0.44711	2.2388**
DL	-1.2350	-4.7628***
Log LQR	0.3498	3.5534***
ECM (-1)	-10.5611	-2.9942***

Notes:

 $R^2 = 0.92$ 

F = 10.09

a = 0.26

\*\*\* Significant at 1% Adj  $R^2$  :0.83 Prob (F-statistic) = 0.000277

\*\* Significant at 5% DW=2.08 Schwarz information criterion = 1.10

\* Significant at 10%

Source: Authors' computation (2012)

# Foreign Direct Investment and Export Performance of Pharmaceutical Firms in India: An Empirical Approach

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## Abstract

This paper presents an empirical analysis of how foreign direct investment impact on the export performance of pharmaceutical firms in India. The hypothesis is examined using panel data analysis. The results show that foreign ownership has a negative impact on export performance. Unlike other industries, it is observed that in pharmaceutical industry foreign owned firms export less and focus more on domestic demand and host country specific advantages. Our findings provide rich source of information to policy makers, researchers and the management of both foreign and domestic owned firms.

**Keywords:** Foreign Direct Investment, Export performance, Pharmaceutical industry, Panel data, India

## 1. Introduction

There is a huge competition among the various countries of the world to get export oriented Foreign Direct Investment (FDI). This is essentially true among developing countries like India, China, Brazil and Russia. FDI may be considered as a means for developing countries to get capital inflows, access to foreign technology, management skills and marketing networks. It promotes export activities by providing access to global markets and facilitating export oriented production with an inflow of capital and access to modern technology. The main channel for multinational firm's expansion strategy is FDI. Thus, FDI encourages exports of host country economies by way of enhancing their domestic capital for exports, facilitating in transfer of technology and new products and services for exports, providing linkages with new and large global markets, and lastly, helps in training the host country workforce in improving their both technical and management capabilities. Hence, FDI is pursued as a tool for export promotion.

According to the theory of internationalization, it is argued that FDI is an alternative mode for exporting. A multinational corporation, as a first step, enters into foreign markets by exporting its product. Then, based on the outcome, it may set up its production facilities in the foreign market—via FDI—and start serving the local customers from these facilities. In this regard, 'product life cycle theory' proposed by Reymond Vernon (1966) is the first paper to discuss such patterns, then huge theoretical and empirical research followed. Lu and Beamish

(2001) found that exporting is the first step to enter into global markets which provides an opportunity for future international expansions. Further, Lutz and Talavera (2004) support the argument and proved that the firm exports are regarded as the sign of comparative advantage. Rob and Vettas (2003) found that given the demand uncertainty and irreversibility, firms both exports their products and undertake FDI. Interestingly, Aulakh et al. (2000) observed that multinational corporations build plants in those countries where they can produce goods and services for exports at lower costs. This intern helps in improving the exports through preferential access to markets in the multinational enterprise home country. In case of multinational enterprises from developing economies, Mathews (2006) found that unlike first wave of multinational enterprises, the second wave of multinational enterprises are to be required in pull factors that draw firms into global connections, rather than push factors which drove them as stand-alone players in the first wave. Thus, he observed that the rise of second-wave multinational enterprises from developing economies is less driven by cost factors per se, but more by search for international markets and technological improvements and innovations to compete efficiently in the global markets.

FDI and exports are like two sides of a coin of the globalization process which not only complementary to each other but also mutually supportive. In recent years, several papers have appeared linking export performance and FDI (Abdel-Malek, 1974; Sun, 2001; Mai, 2001; Rasiah, 2003; Zheng et. al., 2004). However, empirical findings are 'inconsistent and contradictory', particularly for developing economies for whom exports are the most important. In case of developing economies, it is argued that foreign owned firms play a main role in exports. They have an edge over domestic owned firms due to their access to key resources, location specific capabilities of countries and regions in which they operate, and their ability to organize and integrate these resources. Thus, given the monopolistic advantages of foreign owned firms and their desire to please the host government, they may demonstrate a higher export performance. On the other hand, it can be argued that given the regulatory restrictions and the presence of several more attractive production bases in other developing economies, it will be plausible to argue that foreign owned firms export performance would be lower. Thus, for a long, the role of FDI in promotion of exports of manufacturing sector has been a topic of interest for both policy makers and academicians. Further theoretical and empirical research would be valuable for a better understanding of the impact of FDI on export performance of firms. This paper attempts to work in this direction by using the pharmaceutical firm's data in emerging market setup.

India was regulated and restricted for FDI until 1990. The new economic policy introduced by Government of India (GOI) in July 1991 include the removal of industrial licensing policy, removal of restrictions on FDI, abolishing of the Monopolies and Restrictive Trade Practices (MRTP) Act and opening up of reserved sectors for foreign investment. Thus, since 1991, the Indian economy has transformed from a closed economy to an open economy. Initially, GOI allowed FDI up to 51% through an automatic route, Reserve Bank of India (RBI) and foreign technology agreements in all bulk drugs and formulations barring only a few items. Subsequently, in the second-generation economic reforms introduced in 1998, FDI was allowed up to 100 percent in many sectors including Drugs and Pharmaceuticals. The main objective of such liberalization of FDI regime is to attract multinational corporations to invest in India. Majority of these policies and procedures, which were liberalized across sectors or activities that require approval from the Foreign Investment Promotion Board (FIPB), are given automatic approval by the RBI. Overall, the FDI inflows have grown notably over a period of 15 years that is from Rs 409 crores in the year 1991-92 to Rs.24,613 crores in 2005-06. (see Figure I). However, post Asian crisis of 1997-98, they have decreased markedly and increased thereafter. Similarly, FDI inflows have decreased in fiscal year 2003-04 and increased thereafter.

With the introduction of new economic reforms, the inflow of FDI across industries has gradually increased over a period of time. Table 1 ranks the sectors based on inflow of FDI, where the Drugs and Pharmaceutical industry occupies the eighth position and accounts for 3.2 percent of total inflows of FDI during 1991 to 2006 (see Table 1). Though, the FDI flows to manufacturing sector in India has increased in the last few years, foreign investors have not yet recognized India as the most important manufacturing destination for labour-intensive exports as compared to its counter parts like China, Vietnam and other Asian countries. Among the various industries, the drugs and pharmaceutical industry has an important place in the Indian economy because of its positive technological spillovers to other sectors of the economy. Unlike other industries, one can examine all the components of FDI in pharmaceutical industry like capital flows, access to international markets, technology transfer and change in management. One of the objectives for further liberalizing FDI policies in India in general and allowing 100 percent FDI in pharmaceutical industry in particular is to attract more of an export-seeking FDI.

In India, the pharmaceutical industry is one of the emerging industries with enormous opportunities for both the domestic and multinational companies. Due to the changes in the international patent laws, now the focus is on India for contract research, joint ventures and alliances. Among over 23,000 Indian pharmaceutical units, organized sector

covers only 250 units and rest of the units are in the unorganized sector. The present study made an analysis based on the firms in the organized sector. The industry is characterized as a high growth industry (Chadha, 2006). To promote the sector, GOI had abolished product Patents Act 1970 and limited the patent term to recognize only process patents for pharmaceuticals. Being India is a member of the WTO and party to the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs), it introduced product patents from January 1, 2005 through the passage of the Patents (Third Amendment) Act in March 2005 (Linton and Corrado, 2007). In response to this, in India, some of the multinational pharmaceutical companies are focusing on increasing the quantity and quality of FDI in the areas of pharmaceutical R&D and manufacturing. However, in the short run, product patents in India may be less harmful. But, in future, it may be sever because of many off-patented therapeutic equivalents are accessible to the Indian consumer and only around 3 percent of the drugs marketed in India are patented (Panchal, 2005).

In this paper, an attempt is made to examine the impact of FDI on export performance of pharmaceutical firms in India. A panel or longitudinal data analysis is employed using the firm level data for a period of 8 years from 1998 to 2005 to reflect the effects of second generation economic reforms in India. In the present study, the terms like FDI and multinational enterprise (MNEs) are interchangeably used to refer the foreign ownership proportion of a firm. Our findings show that foreign ownership has a negative impact on the export performance of foreign owned firms in pharmaceutical industry in India. The main contribution of this paper is examining how FDI impacts the export performance of firms operating in one particular manufacturing industry in an emerging economy setup with firm level data.

The paper is organized as follows. Section two presents a review of literature pertaining to the impact of FDI on export performance and the choice of variables. Section three indicates the research methodology including data collection and model specification, and list of variables. Section four presents results and discussion. Section five concludes by pointing to a future research direction.

## 2. Review of Literature and Variables

Most of the existing studies on the relationship between FDI and exports fall under the domain of the macroeconomics mainly in the ares ofinternational trade and investment and the microeconomics specially in the areas of the firm and industrial behavior in the globalization process. The literature observed that multinational enterprises are likely to be more outward oriented. They are provided with more competitive technology, efficient management techniques and marketing skills in a globalised world (Aggarwal, 2002). Firm-level studies in Malaysia and Thailand found that foreign ownership participation had transformed the local environment in facilitating the manufacturing exports in technological industries (Rasiah, 2003). On the contrary, Abdel-Malek (1974) found that there was no significant difference in export performance between foreign and Canadian owned firms. In the case of Vietnam, Mai (2001) found that FDI facilitated in making use of the countries comparative advantage in terms of cheap labour and rich natural resources in producing export products. The empirical results on export performance indicate that, on average, the exports of foreign owned firms are much higher than comparable domestic firms (Willmore, 1986; Zhang and Song, 2000; Thangavelu and David, 2003). Very few studies have found that the effect of FDI on the export performance of firms in emerging markets is positive (Willmore, 1992; Filatotchew et al., 2001). Aggarwal (2002) found that such positive effect of FDI on export performance is present in high technology industries, but not in other industries. Greenaway and Kneller (2007) provided a critical review on firm heterogeneity, exporting and FDI.

In Indian context, very few studies, have analyzed the impact of FDI on export performance. In India, Lall and Mohammad (1983) found that FDI in large businesses were positively associated with export propensities. Aggarwal (2002), with firm level data, found relatively weak support for the hypothesis that the export performance of multinational corporation was greater than that of domestic companies, and that multinational corporation had a greater competitive advantage over domestic companies in high-tech industries than in low and medium-tech industries. At macro level, Sharma (2003) found that FDI has statistically no significant impact on India's export performance. Banga (2003) examined the hypothesis that FDI has not played any significant role in export-promotion across the various industries in India. He found that FDI has to some extent result in to diversification of the nation's exports. Further, regarding the impact of source-country of FDI, Banga (2003) found that US FDI has a positive and statistically significant effect on export performance of industries in the non-traditional export sectors, while Japanese based FDI has no significant impact. Siddharthan and Nollen (2004) examined that the export performance of multinational enterprises was determined differently from that of domestic companies in high-technology industries, and found that, in case of the Indian information-technology industry, the export performance of multinational enterprises were greater when they had higher FDI that brought more implied knowledge transfer and complementary of FDI advantages.

From the above, it is observed that there are mixed results on the impact of FDI on export performance of firms. Lall and Mohammad (1983) recommended the need for testing a model which would effectively consider all the factors that may affect inter-industry variations in FDI and export performance. Some of the studies (Kumar and Siddharthan, 1994; Sun, 2001; Zheng, et. al., 2004) also suggested that additional investigations at the firm level or industry-specific studies will throw further light on the extent to which FDI affects export performance. In India, second generation economic reforms were introduced in 1998, which introduced further liberal FDI policies. Due to the differences in regulatory environment, the FDI policies and procedures across various industries, there is a need to examine the impact of FDI on firms operating in one particular industry. Siddharthan and Nollen (2004) suggested that future studies of exporting need to be analyzed specific to one particular industry. The results and analysis provided in the past may not reflect the current export competitiveness of firms in a changed regulatory environment. Thus, empirical studies which examine the impact of FDI on a particular industry are limited. In this study, an attempt is made to examine the impact of FDI and the export performance of firms operating in pharmaceutical industry in India. In analyzing the determinants of inter-firm differences in export behavior, the present study considers the standard determinants which are explained below.

### 2.1 Exports Performance (EXPORT)

This is measured as the exports to sales ratio. FDI provides various benefits to the host country firm. It is believed that with the inflow of FDI, the firm's exposure to exports is assumed to exert pressures on the firm to attain a superior export performance. It is argued that, due to easy access to the proprietary technology of their parents, multinational firms are likely to be more competitive in export performance. Thus, multinational enterprises can be powerful agents of export growth. They are generally world leaders in innovation and product differentiation, have direct access to the world's largest markets, as well as the managerial, entrepreneurial and financial resources to seek and commercially exploit viable international markets. Firms that have been relatively high exporters are also likely to be more progressive and risk oriented, with relatively better performance patterns. In this study, Export to Sales ratio is introduced as a dependent variable. It is hypothesized as

*Hypothesis: Foreign direct investment has a positive impact on export performance of pharmaceutical firms in India*

### 2.2 FDI Ownership (FDI)

As compared to domestic owned firms, foreign owned firms are found to be better placed to explore export markets, in light of their captive access to information and marketing networks for their parent enterprises. Thus, foreign owned firms are expected to do better than domestic owned firms in terms of export performance. However, most of them in India were set up primarily to explore the domestic or local markets in response to the import substitution programme. Few of the studies presented a positive relationship between foreign ownership and export performance (Lall and Mohammed, 1983; Willmore, 1992; Filatotchev et al., 2001). They observed that multinational enterprises prefer to control their export-oriented affiliates through high FDI, treating their marketing network as their proprietary asset. Kumar (1990) found, across various industries, that there is no significant difference between the export performance of foreign and domestic owned firms. Similarly, Banga (2003) examined the impact of FDI on exports performance with respect to the source-country of FDI and his empirical results found that US FDI has a positive and significant effect as compared to Japanese FDI. Sun (2001) investigate the regional effect of FDI on export performance in three macro-regions of china and consider provincial FDI inflows as a measure of FDI variable. In the present study, foreign direct investment proportion in total capital of a firm is considered as independent variable because the study focuses on firm level analysis where we are examining the impact of FDI ownership on export performance of a unit of firm (Buch and Lipponer, 2006). Hence, it will be interesting to see the impact of FDI on export performance of firms.

### 2.3 Other Variables

In addition to above dependent and independent variables, various other control variables are considered to examine how FDI impact the export performance of pharmaceutical firms in an emerging economy like India. The detailed description of all other variables is presented in Table 2. All the variables are selected based on extant review of literature. They represent firm specific characteristics which influence the export performance. Some of the prominent variables are described here. Siddharthan and Nollen (2004) found that technology imports have a negative impact on exports due to the substitution relationship among the two variables. Literature on industrial organization and the new trade theory propose a positive relationship between firm size and exports. In case of multinational corporations, firm size provides some advantages to them like access to technical expertise, best management practices, information, risk bearing and to brand name which helps for higher exports. Thus, firm size is proposed to have a positive impact on export performance. Basant and Fikkert (1996) observed that FDI flows to labour intensive industries will stimulate high exports due to its comparative advantages to those industries. The

relationship between age as a control variable and export performance is ambiguous. It is argued that older firms are expected to enjoy greater experiential and tacit knowledge, which helps in improving their export performance. On the contrary, new firms are expected to export more because they use relatively modern technology which increases productivity and product quality and operate in new economic environment. Table 3 presents the proposed nature of relationship of all the independent and control variables with dependent variable.

### 3. Research Methodology

#### 3.1 Data Collection

The firm level data for the present study is obtained from the Department of Statistical Analysis and Computer Services, Company Finance Division, RBI. To maintain confidentiality, the data set was released without company identifiers. The sample consists of 103 pharmaceutical firms. The data is collected for a period of 8 years from 1997-98 to 2004-05. The sample selection criterion generated 824 observations. The existing data set has provided only sixty three percent of data density, and a unique technique for handling missing data, namely imputation models was applied to retrieve the remaining thirty seven percent data beyond the existing data.

Among the various methods of handling missing data, we use one of the multiple imputation models like EMis for preparing our panel data setup (King et. al., 2001). It is observed that about fifty percent more information than is currently possible for the model estimation would be available if the expected maximization importance sampling algorithm (EMis) is used for handling missing data. Further, the data is analyzed all the panel data set using a Tobit fixed effects model. For analysis, the results were combined as suggested by King et al. (2001). The model estimator accounts for heteroscedasticity and a first-order serial correlation in the regression residuals. The econometrics model procedure uses Within-OLS to obtain first-step consistent estimates. The serial correlation coefficient is then estimated from the first step residuals. The regression is further transformed to eliminate serial correlation, and is re estimated by fixed effects, applying White's procedure to obtain heteroskedasticity-robust standard errors. A standard specification test for panel data regressions like Durbin-Watson test is employed to test for the presence of first-order serial correlation. For the purpose of panel data analysis, 'EViews' statistical package is used.

#### 3.2 Model Specification

Most of the existing studies attempting to examine how FDI impacts the export performance of firms through Export to Sales Ratio is used a linear specification, and estimated the equation using ordinary least squares. In this process, these studies depend upon the standard assumptions of an absence of serial correlation and heteroscedasticity. In this study, we applied panel data analysis to measure the impact across the firms and over a period of time in pharmaceutical industry. It estimates the following Tobit fixed effect model with 'firm' and 'year' effects to analyze the determinants of Export performance.

$$Y_{it}(\text{EXPORT}) = \alpha + \mu_i + \lambda_t + \beta X_{it} + \varepsilon_{it} \quad (1)$$

Where  $i = 1, 2, \dots, n$  (number of firms) and  $t = 1, 2, \dots, t$  (number of years). Here,  $Y_{it}$  is the dependent variable,  $X$  is the vector of explanatory variables,  $\beta$  is the vector of regression coefficients,  $\varepsilon_{it}$  is the disturbance term,  $\mu_i$  represents the firm effect and  $\lambda_t$  represents the year effect.

The detailed econometric model for the dependent variable Export performance using the above equation is as follows.

$$\begin{aligned} (\text{EXPORT})_{it} = & \alpha + \mu_i + \lambda_t + \beta_1 (\text{FDI})_{it} + \beta_2 (\text{TECHIMP})_{it} + \beta_3 (\text{CAPIMP})_{it} + \beta_4 (\text{MATIMP})_{it} + \beta_5 (\text{CAPOUT})_{it} \\ & + \beta_6 (\text{SIZE})_{it} + \beta_7 (\text{R\&D})_{it} + \beta_8 (\text{SKILLS})_{it} + \beta_9 (\text{ADV})_{it} + \beta_{10} (\text{PROFIT})_{it} + \beta_{11} (\text{TAX})_{it} \\ & + \beta_{12} (\text{LABOUR})_{it} + \beta_{13} (\text{AGE})_{it} + \varepsilon_{it} \end{aligned}$$

### 4. Results and Analysis

Table 4 presents descriptive statistics for all the variables as mentioned in the study and assists in the interpretation of the panel data regression results. The average export performance over the entire sample was 27.84 percent of sales revenue. Table 5 indicates correlation matrix among all the variables used in this study. As per Table 5, the SIZE variable is highly correlated with R&D expenditure (where  $r=0.84$ ). The CAPOUT and PROFIT variables are highly negatively correlated ( $r=-0.76$ ). On the other hand, FDI ownership has no correlation with the import of raw material ratio ( $r=0$ ). The SIZE and AGE variables are negatively correlated (see  $r=-0.02$ ). Though Table 5 suggests the existence of collinearity among the few independent variables, sensitivity tests reveal that the essential results are not sensitive to the exclusion of such independent variables.

The results based on the fixed-effects estimates of the coefficients of Equation 1 are presented in Table 6. The hypothesis is not proved. The empirical results suggest that foreign ownership has a negative impact on the export

performance of pharmaceutical firms. The empirical evidence is statistically significant at a 5 percent confidence interval level. It implies from further analysis that foreign owned pharmaceutical firms focus more on domestic markets than exports sales.

In the past, most of the studies during pre-1990s period in India found that foreign owned firms have either the same or even lower in export performance than that of domestic firms (Lall and Streeten, 1977; Subramanian and Pillai, 1979). Aradhana Jain (1998) in her unpublished thesis analyzed selected industries and found that the impact of foreign holdings on the export performance of firms was not significant in the early 1980s in any industry. But, in the late 1980s it is improved in some industries. Sharma (2003) empirically proved that foreign investment has no significant impact on overall exports in India. Overall, some of the studies like Lall, 1986; Kumar, 1990; Pant, 1993; and Kumar and Siddharthan, 1994; found that foreign owned firms have not performed better than domestic owned firms. The results of the present study support the findings of some of the previous studies on impact of FDI on export performance in India.

In this context, findings of the present study in Indian pharmaceutical industry appear to support some of the previous studies observations on the relationship between foreign ownership and export performance. The present study shows that foreign ownership has a negative impact on export performance of pharmaceutical firms in India. Based on this, it is not enough to suggest that India is attracting export-oriented FDI inflows on a significant scale, particularly in the pharmaceutical industry. Thus, the findings of the empirical analysis should be viewed with caution; they do show that foreign owned firms focus more on domestic markets and host country specific advantages like opportunities for R&D, innovation and lower cost of manufacturing than on export markets. Due to the cost-effective process innovations and reverse-engineering of brand name drugs, Indian firms have emerged as competitive suppliers in the global market for a large number of generic drugs. Smith (2005) found that opening up of Indian economy since 1991 has significantly increased the global competitiveness of Indian pharmaceutical industry, where domestic firms have been forced to compete alongside foreign owned or multinational firms in the domestic market. In India, multinational corporations focus more on domestic demand and host country specific advantages. On one hand, they make an investment to carryout research and development activities and the other hand, they try to grab the share of domestic market. Thus, the Indian market becomes more crowded and highly fragmented, domestic firms are increasingly pressured to look elsewhere to expand their revenues. Due to these reasons, it is observed that majority of the domestic firms have taken specific steps to boost exports and major portion of their revenues come from exports. Before generalization of these results, future research studies can be carried out to examine the impact of FDI on the export performance of other industries, and the results can be compared for making strategic decisions and directing towards policy formulation. This is recommended due to variations in the nature of businesses, regulatory environment, FDI policies and procedures across the various industries in India.

As per Table 6, the control variables exhibit an interesting effect on export performance, and deserve some mention and discussion. As advocated by trade theory, the results indicate that the variable CAPOUT ratio is found to have a negative and statistically significant impact on the export performance of firms. As proposed, TECHIMP has a negative impact on the export performance of firms due to the existence of a substitution relationship between FDI and technology imports. Interestingly, as discussed, larger firms being market leaders have a disincentive to export if profitability in the domestic market is high and their higher domestic market share has not yet matured. In this study, the SIZE variable is found to have no impact on the export performance. ADV variable is found to have a negative impact on export performance of pharmaceutical firms in India. It implies that in case of international markets, advertisement does not contribute to an increase in exports; instead, there are other factors like the quality of the product and skills of the labour force which contribute to export sales.

As expected and observed in Table 5, SKILLS and R&D indicate a positive and statistically significant impact on the export performance of firms. Our results support the argument that skill creation is the most important requirement for creating competitiveness in knowledge based sectors like the pharmaceutical industry. In this regard, Porter (1999) found a one-to-one relationship between the R&D workforce and the innovative capacity. As proposed, MATIMP has a positive impact on exports due to low tariffs and easy importability of raw materials which makes firms cost competitive. Belying expectations, TAX has a negative and statistically significant impact on export performance. This could be due to a reduction in tax benefits for exporting firms. One of the determinants of FDI is the availability of low labour cost which in turn provides competitive advantage to firms. Hence, high labour cost is expected to have negative impact. The results found that LABOUR has a significant negative impact on exports. As discussed, AGE variable is found to have a positive impact on export performance of firms.

## 5. Conclusions

The present study examines the impact of FDI on export performance of pharmaceutical firms in India. The objective of the study is to test the hypothesis that FDI has a positive impact on export performance of firms. For the

empirical analysis, firm level data for 103 firms for a period of 8 years from 1998 to 2005 is drawn from the pharmaceutical industry in India. A novel and robust method of handling missing data is applied which makes us available thirty seven percent more data for analysis than is otherwise possible. The hypothesis is tested using pooled cross sectional time series analysis. The results show that FDI has a significant negative impact on export performance of firms. The results of the study provide useful insights for reviewing the current policies and take necessary actions. Unlike other industries, it is observed that in pharmaceutical industry foreign owned firms export less and focus more on domestic demand and host country specific advantages. It is observed that opening up of India economy has substantially increased the global competitiveness of Indian pharmaceutical industry, where Indian market provides scope for potential growth on demand side. The domestic firms are increasingly pressured to take specific measures to operate in domestic markets and boost exports. Given the changing FDI regulations across the countries and sectors, the main contribution of the present study is to examine the impact of FDI on export performance of firms operating in one particular manufacturing industry in an emerging economy with firm level data. The present study provides rich source of information to policy makers, researchers and the top management of pharmaceutical firms. It also confirms the findings of earlier research studies. Before generalizing the above results, it would be useful to replicate the similar methodology across various industries due to varying regulatory environment like FDI caps and policies.

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Table 1. Sectors attracting highest FDI inflows in India

(US \$ in illions)

No.	Sector	Cumulative Inflows	Percentage
(August 1991 – March 2006)			
1	Electrical Equipment	5,496	17.49
2	Telecommunications	3,372	10.58
3	Transportation Industry	3,178	9.82
4	Services Sector	3,091	9.45
5	Fuels (Power + Oil Refinery)	2,581	8.10
6	Chemicals	2,143	6.33
7	Food Processing	1,179	3.47
8	Drugs & Pharmaceuticals	1,007	3.18
9	Cement and Gypsum	747	2.38
10	Metallurgical industries	655	2.08

Source: Department of Industrial Policy & Promotion, Ministry of Commerce & Industry, Government of India

Table 2. Description of Variables

Variables		Description
<b>Dependent Variable</b>		
EXPORT	Export performance	Export performance is measured as export sales divided by sales
<b>Independent Variables</b>		
FDI	FDI ownership	Foreign direct investment proportion in total capital
TECHIMP	Technology import	Ratio of total technology payments abroad, royalties and license fees to sales
CAPIMP	Imports of capital goods	Ratio of import of capital goods to sales
MATIMP	Imports of raw materials	Ratio of import of raw materials and components to sales
CAPOUT	Capital output ratio	Ratio of fixed assets to sales revenue
SIZE	Firm size	Sales revenue
R&D	Research & Development expenses	Ratio of research and development expenditure to sales revenue
SKILLS	Skills of labour force	Ratio of proportion of high income employees to total wage bill
ADV	Advertising & promotion	Ratio of advertisement expenditure to sales revenue ratio
PROFIT	Operating profit	Ratio of operating profit to sales revenue
TAX	Tax provision	Ratio of tax provision to sales revenue
LABOUR	Total labour	Ratio of total salaries and wages to sales revenue
AGE	Age	Number of years for which the firm is in operation

Table 3. Proposed nature of relationship of Independent variables with Dependent variable

	Independent Variables	Export Intensity
FDI	FDI ownership	+/-
TECHIMP	Technology import	-
CAPIMP	Imports of capital goods	+
MATIMP	Imports of raw materials	+
CAPOUT	Capital output ratio	-
SIZE	Firm size	+
R&D	Research & Development expenses	+
SKILLS	Skills of labour force	+
ADV	Advertising & promotion	+
PROFIT	Operating profit	+
TAX	Tax provision	+
LABOUR	Total labour	-
AGE	Age	+/-

Table 4. Pooled Sample Descriptive Statistics\*

Variables	Mean	Stand. dev.	Minimum	Maximum
EXPORT	27.84	25.56	0.00	95.20
FDI	6.22	15.78	0.00	92.00
TECHIMP	10.90	15.18	0.00	335.38
CAPIMP	1.08	3.01	0.00	68.70
MATIMP	10.56	9.86	0.00	63.30
CAPOUT	65.53	175.03	0.80	2397.16
SIZE <sup>†</sup>	12969.30	17436.90	1.60	53140.30
R&D	2.34	2.67	0.00	21.18
SKILLS	7.41	7.93	0.00	73.91
ADV	2.99	3.28	0.00	23.31
PROFIT	3.82	58.46	-1227.77	98.17
TAX	3.23	11.15	0.00	240.00
LABOUR	10.50	6.44	0.31	52.33
AGE	30.65	21.04	0.00	99.00

\* Data for the 103 firms for 8 years in the sample

(<sup>†</sup>) indicates data in millions of Indian rupees.

Table 5. Correlation Matrix

	FDI	TECHIMP	CAPIMP	MATIMP	CAPOUT	SIZE	R&D	SKILLS	ADV	PROFIT	TAX	LABOUR	AGE
FDI	1.00	-0.01	-0.06	0.00	-0.06	-0.25	-0.23	-0.11	-0.09	0.05	0.04	0.10	0.20
TECHIMP		1.00	0.11	0.47	-0.08	0.16	0.17	0.05	0.01	0.09	-0.01	-0.16	-0.08
CAPIMP			1.00	0.24	-0.01	0.20	0.18	0.09	0.05	0.07	0.01	-0.08	-0.05
MATIMP				1.00	-0.11	0.40	0.39	-0.02	0.12	0.16	0.08	-0.25	-0.08
CAPOUT					1.00	-0.13	-0.14	0.09	-0.12	-0.76	0.28	0.05	-0.15
SIZE						1.00	0.84	0.02	0.42	0.20	0.08	-0.25	-0.02
R&D							1.00	0.12	0.40	0.20	0.07	-0.20	-0.02
SKILLS								1.00	-0.06	0.02	0.03	-0.27	-0.20
ADV									1.00	0.14	0.03	-0.04	0.10
PROFIT										1.00	-0.04	-0.08	0.09
TAX											1.00	0.08	0.02
LABOUR												1.00	0.20
AGE													1.00

Table 6. Results of Fixed-Effects Regression Analysis

Variables	EXPORTS			
	Coefficient	Std. Error	t-Statistic	Probability
FDI	-0.0931	0.0125	-12.7140	0.0003
TECHIMP	-0.0016	0.0053	-0.1582	0.3303
CAPIMP	0.2144	0.2798	0.5222	0.3186
MATIMP	0.4851	0.0999	6.1612	0.0822
CAPOUT	-0.0018	0.0010	-3.8930	0.0371
SIZE	0.0000	0.0000	3.4200	0.0826
R&D	0.2502	0.0828	9.7999	0.0819
SKILLS	0.0342	0.0172	5.9319	0.0305
ADV	-0.1057	0.0327	-14.8021	0.0006
PROFIT	-0.0022	0.0030	-23.3784	0.1279
TAX	-0.0331	0.0105	-31.4354	0.0057
LABOUR	-0.0941	0.0171	-9.9161	0.0148
AGE	0.0683	0.0215	1.9702	0.0040
R <sup>2</sup>		0.98		
Adjusted R <sup>2</sup>		0.98		
Number of observations		824*		

• 103 firms over a period of 8 years

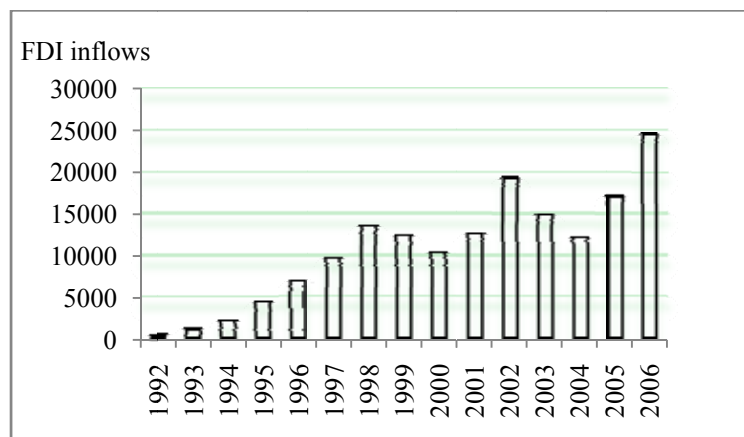


Figure 1. Foreign Direct Investment inflows during 1992 to 2006 (Rupees in crores)

Source: Department of Industrial Policy & Promotion, Ministry of Commerce & Industry, Government of India

# Demand for Generic Competences in the Labour Market: Reliability of Workers' Perception

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## Abstract

This study deals with the question of reliability of assessment of required competences. Required competences have been assessed by young knowledge workers in the labour market. Question is 'to what extent their assessment of required competences is reliable, if it is reliable'. We used the data set of Reflex project which was carried out under the 6<sup>th</sup> framework programme of European Union. We employed ordered probit, and OLS regression. The analyses have been realised in SPSS and Stata. We employed coherence and consistency parameters in order to draw conclusions from our findings. We found nothing contradictory to our reliability hypothesis. We feel confident to say that knowledge workers' assessment of (required) competences is found to be, in Popperian terms, reliable to a modest extent. The fact that the respondents knew, at the time of survey, that they will not be harmed, could be regarded as a limitation to this study. We have explored only the required level of competences in this study.

**Keywords:** Reliability, Assessment, Generic competence, Labour market, Knowledge workers, Ordered probit

## 1. Introduction

The aim of higher education is to sustain learning society, [1] where labour market relevant knowledge and skills as well as a set of personal competences are considered as crucial [2]. The reason is that workers with sufficient and up-to-date competences are more productive and have more potential to remain employed [3]. Labour market oriented competences are highly required and highly remunerated. Recent literature demonstrates heightened interest to study (acquired as well required) competences.

Although strong demand of competence in the labour market has been confirmed [4], yet there are some concerns over the assessment of required competences. For a detailed account we would like to invite the inquisitive readers to consult the Reflex Working Paper 2 [5]. This document discusses various aspects of acquired as well as required competences' assessment. We find a dual advantage to study the assessment of required competences. First, the main reason to support this method is a conviction that self-reported skill requirements are less prone to response bias than self assessments of own skills [6] (quotes [7]). Second, researchers alike [8] think that it helps studying the self assessment of acquired competences. Some researchers have therefore proposed the use of self reported skill *requirements* in jobs as indicators of the actual skills of the holder of those jobs (see e.g. [9]).

This study examines the reliability of assessment of required competences by the young knowledge workers. We would like to mention that the *higher education graduates* and the *young knowledge workers* are the same individuals in our data set. This is only the preferred use of the two expressions. We prefer to call individuals the *higher education graduates* while addressing the problem of self assessment of acquired competences; and the *young knowledge workers* while studying assessment of the required competences. We will be studying the reliability of assessment of required competences by the *young knowledge workers*. Following is the research question: *To what extent is knowledge workers' assessment of required competence reliable?*

Reflex data set comprising about 40,000 graduates from fifteen countries is available for the analysis in order to provide the substance of statistical analyses for this paper.

## 2. Selecting the Variables

First step in this endeavour is to identify the subcategories upon which knowledge workers are distributed. More precisely, it is "missing word" to find some common characteristics (*nature* and/or *experience*) in order to classify young knowledge workers. The *experience* concerning with their profession, we think, could be a reasonable criterion to categorise the young knowledge workers. We identify three variables directly related to this *experience* criterion. These are:

1. Total Monthly Income (in Euros)
2. Appropriate Education Level for Current Job
3. Time to be Expert in Current Job

These three variables provide us young knowledge workers' categorisation criteria. Total Monthly Income (in Euros) is a continuous variable. We categorise this into eight subcategories. Appropriate Education Level for Current Job has four subcategories. Time to be Expert in Current Job has six categories but we merged first three categories (thus making total four subcategories) in order have more clear picture. The details we will discuss in the ensuing paragraphs. We also include *gender* and *country* as control variables in this list.

The variable of main focus is *competence* which is considered as dependent variable. We have 19 competences in the data set. We select twelve of them. Young knowledge workers were asked to rate their competence level on a rating scale of seven. Next step is to describe all these variables. For the detailed description of the variables of interest is given in the Appendix A.

## 3. Basic Statistics

The above mentioned variables are described here through descriptive statistics. These variables are: Country, Total Monthly Income (in Euros), Appropriate Education Level for Current Job and Time to be Expert in Current Job and Gender. Table 1 contains percentage participation of the knowledge workers being included in the analyses. We have excluded invalid observations. Total 28690 *knowledge workers* from all fifteen countries are included in the analyses. The male-female ratio is 45-55 percent respectively. The numbers of observations for rest of variables are about 28000.

Insert Table 1 Here

Table 2 describes the relevant variables through their basic statistics. For example, the average income is about 2300 Euros with a standard deviation of 1500 Euros and mean time to be expert is observed to be 3 years with a standard deviation one year.

Insert Table 2 Here

## 4. Required Level of Competences

On the bases of young knowledge workers' responses we calculated the mean values of competences for the whole data. This table keeps mean values of all nineteen competences for the total sample in descending order.

Insert Table 3 Here

The mean values for the required level of competences are recorded in Table 3. Competences have been rearranged in descending order of their mean values. We observe a cut point of four in the order of mean values in this table which is dividing the whole set of 19 competences into two subsets. One subset has its means more than, and the other less than, the cut point of five. Although there are eleven competences which have their mean values above the cut point but we select first 12 competences and name this as Subset-I. The other one is named as the Subset-II. We will use the Subset-I for further analyses.

## 5. Research Hypothesis

We assume that *young knowledge workers* with similar characteristic (i.e. *knowledge worker experience*) are homogeneously assigned to their respective subcategories. We expect that the *Knowledge workers* of the same subcategory will also reflect homogeneity in their independent individual responses concerning their assessment of required competences. Statistically speaking, their inter-group variances should be larger than that of the intra-group. The null hypothesis states that there is no difference among groups' variances.

$H_0$ : *Knowledge workers of different subcategories do not differ in their assessment of required competence level*

Whereas the alternative hypothesis states that

$H_A$ : *Knowledge workers of different subcategories do differ in their assessment of required competence level*

Subcategories of *knowledge workers* are homogeneous in the sense that they are distinct from other subcategories upon certain predefined criteria (i.e. *knowledge worker experience*). Subcategories do have possessed of *knowledge workers* with similar characteristics within their respective subcategory. *Knowledge workers* of similar *knowledge worker experience* should have declared similar required level of competence. *Knowledge workers* in each subcategory are distinct and if their assessment of required competences is homogeneous within that very subcategory, then we can consider their assessment as a reliable source of information, until it is falsified.

## 6. Analyses

The variables described above to be used in the analyses in this study are of the nature that they do not permit us to go to calculate neither parametric nor nonparametric ANOVA. We will mention here the resulting coefficient estimates of ordered probit in comparison to the ordinary least squares (OLS) regression coefficient estimates. We will not be extending our analyses to the analyses of variances. Ordered probit is run 12 times for each competence separately with same independent variables. Parallel to this OLS regression is employed for the same set of variables. The outputs of the two are presented in the following tables.

Insert Table 4 and Table 5 Here

The signs of the coefficient estimates allow the direction of change in the probabilities of the extreme outcomes only. Probabilities are relative to the corresponding reference category. The monthly Income has been reconstructed as an ordinal variable; previously it was continuous variable. As it is an objective parameter so we can rely upon this more (compared with the other two variables included in the analysis) for the required level of competences declared by the young knowledge workers. We select a subcategory with lowest income i.e. *Monthly Income 1* as a reference. Young knowledge workers from all the subcategories i.e. from *Monthly Income 2* to *Monthly Income 8*, ceteris paribus, have higher probability of having declared a requisition of and a lower probability of not having declared a requisition of greater level of almost all 12 competences in current job. This is exactly what we were expecting. By and large, the monthly income coherently corresponds to the required level of competences. Theoretically, it is believed that higher requirement of competence level is better remunerated. Our results are in agreement to this belief. We have found coherence in theory and practice, which promotes also the suitability of the methodology we have employed. Unexpectedly, required level of competence 8 i.e. Mastery of your own field or discipline, contrary to other competences, reflected uneven coefficient estimates. This could be the case if job demands transversal (generic) competences more than the specific ones; and/or where higher salaries are not necessarily defined on the basis of specific competence [10] and [11].

Highest income (more than four thousand Euros) group reflects that the competence 9 (Ability to write reports, memos or documents), competence 10 (Ability to come up with new ideas and solutions), competence 11 (Analytical thinking), and competence 12 (Willingness to question your own and others' ideas) are not necessarily required in higher levels as compared to their immediate lower income groups. Although it appears strange that these competences, which are undoubtedly, higher in order are lacking in higher income brackets, nevertheless, we can't help reporting this as this is what we observed in our analyses of the data set we are using herein this study.

We have observed similarity in the levels of significance of the coefficients of ordered probit and OLS regression for "Total Monthly Income (in Euros)".

Variable of "Appropriate Sublevel of Education for Current Job" has four subcategories. We chose "Same Education Level" as the reference category. Highly regular and coherent patterns (in theory and practice) are observed for this variable i. e. *Appropriate Sublevel of Education for Current Job*. Young knowledge workers of subcategory "Higher Education Level", ceteris paribus, have higher probability of having declared a requisition of and a lower probability of not having declared a requisition of greater level of almost all 12 competences in current job. Young knowledge workers of both subcategories "Low Education Level" and "Lower Education Level", ceteris paribus, have lower

probability of having declared a requisition of and a higher probability of not having declared a requisition of greater level of almost all 12 competences in their current job. In rather simple words we can say that young knowledge workers, who considered that higher education level (compared with reference category i.e. same education level) was appropriate for their current job, declared higher requirement of competence levels accordingly and vice versa.

“Appropriate Sublevel of Education for Current Job” is subjective in its nature. Because these are the young knowledge workers who are supposed to express what is the appropriate required level of education for their current job. However, young knowledge workers are found consistent in their two assessments at two different places. Their first assessment is about the appropriate education level and the second is the required level of competences. Nevertheless, this assessment, which seems subdued with subjectivity, backs up their assessment’s reliability.

Similarity in the levels of significance of the coefficients of ordered probit and OLS regression is observable for “Appropriate Education Level for Current Job”.

We had six subcategories in the variable “Time to be Expert in Current Job”. We reduced first three subcategories into one thus making four subcategories. We leave out the subcategory “2 Years to be Expert” for reference. This variable, although it is with subjective impression, is reflected also highly regular and coherent patterns (in theory and practice). Young knowledge workers from subcategory “5 Years to be Expert”, *ceteris paribus*, have higher probability of having declared a requisition of and a lower probability of not having declared a requisition of greater level of almost all 12 competences in current job with respect to the reference category i.e. 2 Years to be Expert. Similar trends are observed for the rest of two subcategories ‘10 Years to be Expert’ and ‘More Years to be Expert’.

This variable is also subjective like the previous one. These are the young knowledge workers who are to report the required time to get hold of in their current job. In another section of the questionnaire they are rating the required level of the competences. This assessment is also considered subjective. When scrutinized in isolation, both of these questions could be considered as deprived of reliability on account of biasness likelihood. But the intrinsic subjectivity of their responses is minimised when they are juxtaposed. Their responses are found mutually consistent; and in addition to this their responses are coherent in theory and practice. In other words, novices believe in a fewer requirements of competence level compared with the old hands.

We have observed similarity in the levels of significance of the coefficients of ordered probit and OLS regression for “Time to be Expert in Current Job”.

These findings are, *ceteris paribus*, are coherent to what is expected theoretically and what we observe through our analyses.

Although a good discussion can be provoked regarding the interpretation of country and gender estimates mentioned in the tables, but we leave this for they are included in the model as control variables. The reader may look into them for their own interest.

The pseudo  $R^2$  (often referred to as [12] pseudo  $R^2$ ) varies between 0 and 1. According to many authors (for example Greene, 2000) there is not natural interpretation of this statistic. However it is observed to be increasing as the fit of the model improves [13]. The  $\chi^2$  value, with excellent significant difference, helps us to reject the null hypothesis that our model does not have greater explanatory power than an “intercept only” model. We have not mentioned the cutoff points simply because here we do not intend to discuss them as we are not interested in them. We just overlooked this and come to compare ordered probit and OLS regression.

Most of the cases in the tables above are evident that corresponding coefficient estimates of ordered probit and OLS regression resemble each other to a high extent. They do differ sometimes, but this difference is restricted to their immediately next significance levels. We have defined four levels of significance just to give more illumination to the scene. Prime difference between ordered probit and OLS regression is that of cardinal and ordinal values of the numbers which are used to rate the dependent variable. The former considers the ordinal values of the numbers whereas the later takes their cardinal values into consideration in their operations. Although, we have discussed this in some earlier paragraphs of this section prior to discussing the results, however, some deeper insight could be more productive.

We, as rational beings, are convinced to believe (or at least, consider) more in exactitude; and are attracted towards numbers’ cardinal value. Moreover, as we know that their cardinal value includes the ordinal (too), we are, intrinsically, dragged more to believe in cardinality of numbers. Since the set of young knowledge workers we are investigating in this study does belong to same population of rational beings, therefore, has no exception. As a researcher we believe (this belief has been intensified through the above analyses) that despite (an imposed) restriction to consider numbers’ ordinal value only, we could not help considering their cardinality. Thus young knowledge workers’ ordinal consideration of numbers, we suspect, may have a tinge of cardinality. This could be the possible



reason of startling resemblance in the significance levels of estimates of two different analyses mentioned above in the tables of ordered probit and OLS regression. This subconscious shift of young knowledge workers towards exactitude (ordinal cardinality of numbers) may have some positive conviction to what we intend to investigate (i.e. to what extent young knowledge workers' assessment is reliable?).

A resemblance of highest degree regarding the levels of significance (in coefficient estimates in the two models) is remarkable. Logically, it permits us to rely upon the outputs given by the OLS regression as well, which is not advised to rely upon under customary circumstances i.e. the type and the set of variables we are dealing with. Hence, the uniqueness of our case is statistically proven and established. This surprising similarity in the levels of significance of the two analyses encourages us to rely upon the results of OLS regression with relatively greater confidence. We can proceed to calculate ANOVA; and we think, apparently, there is no harm at all in doing so. Anyhow, we are looking forward for some insight from other researchers who might have interest in such analyses.

We think that some deeper insight is required to compare coefficient estimates of ordered probit and OLS regressions. This is not our main concern here. This could be of interest for statisticians and econometricians. Any contribution in this regard will be of high value, we believe. We propose this venture to the adventurous researchers.

## 7. Discussion

Monthly Income has been reconstructed as an ordinal variable; initially, it was continuous variable. As it is an objective parameter so we can rely upon it more confidently (compared with the other two variables included in the analysis) for required level of competences declared by the young knowledge workers. We select a subcategory with lowest income i.e. *Monthly Income 1* as a reference. The signs of the coefficient estimates allow the direction of change in the probabilities of the extreme outcomes only. Probabilities are relative to corresponding reference category. This subcategory contains young knowledge workers with lowest monthly income in our data set. The young knowledge workers who earn more than that of those in the reference category, ceteris paribus, have higher probability of having declared requisition of and a lower probability of not having declared requisition of greater level of almost all 12 competences in current job. By and large, monthly income coherently corresponds to the required level of competences. Theoretically, it is believed that higher requirement of competence level is better remunerated. Our results are in agreement to this belief. We have found coherence in theory and practice, which promotes also the suitability of the methodology we have employed. Unexpectedly, required level of competence 8 i.e. Mastery of your own field or discipline, contrary to other competences, reflected uneven coefficient estimates. This could be the case if job demands transversal (generic) competences more than the specific ones; and/or where higher salaries are not necessarily defined on the basis of specific competence [14] and [15].

Highly regular and coherent (in theory and practice) patterns are observed for the variable "Appropriate Education Level for Current Job". Young knowledge workers who declared that higher level education is required, ceteris paribus, have higher probability of having declared requisition of and a lower probability of not having declared requisition of greater level of almost all 12 competences in current job. Young knowledge workers who believe in lower education level as appropriate, ceteris paribus, have lower probability of having declared requisition of and a higher probability of not having declared requisition of greater level of almost all 12 competences in current job. In rather simple words we can say that young knowledge workers, who considered that higher education level (compared with reference category i.e. same education level) was appropriate for their current job, declared higher requirement of competence levels accordingly and vice versa.

Similarity in the levels of significance of the coefficients of ordered probit and OLS regression is observable for "Appropriate Education Level for Current Job".

Highly regular and coherent (in theory and practice) patterns are observed for the variable "Time to be Expert in Current Job". Young knowledge workers from subcategory '5 Years to be expert', ceteris paribus, have higher probability of having declared requisition of and a lower probability of not having declared requisition of greater level of almost all 12 competences in current job with respect to reference category i.e. 2 Years to be expert. Similar trends are observed for rest of two categories '10 Years to be expert' and 'More Years to be expert'.

We detect similarity in the levels of significance of the coefficients of ordered probit and OLS regression for "Time to be Expert in Current Job".

There is another side of the picture. Coherence could be marked easily in young knowledge workers' assessment at two different points of enquiry. This marked coherence lends reliability to young knowledge workers' responses all through the process of enquiry. If we take this subjective opinion reliable, it is interesting, however, that the young knowledge workers who followed more demanding study programmes have required higher level of certain competences. Truthfulness of this finding is favoured by virtue and convention.

These observations are articulating what it is in theory as well as practice. We can say that veracity of these observations could be reliable as these are found consistent to what is expected theoretically and what is observed practically. These results *ceteris paribus* are coherent to what is expected theoretically and what we observe through our analyses.

Although a good discussion can be provoked regarding the interpretation of country and gender estimates mentioned in the tables, but we leave this for they are included in the model as control variables. Reader may look into them for their interest.

In fact we run two different models, namely, OLS and ordered probit regression, retaining same variables to see the explained variance by the independent variables. Unfortunately, the suitable estimation model, i.e. ordered probit model, according to the nature of the data, is mute to tell us the required information. Juxtaposition of the two outputs better help us to decide which direction we should move in. We find surprising similarity between the outputs of ordered probit regression and OLS regression. We are least concerned with the interpretation of the coefficient estimates of the later model; however, a resemblance of highest degree regarding the levels of significance (of coefficient estimates in the two models) is remarkable. Logically, it permits us to rely upon the outputs given by OLS regression as well, which is not advised to rely upon under usual circumstances with the type and set of variables we are dealing with. Hence, the uniqueness of our case is statistically proved and established. This surprising similarity between the levels of significance of two analyses encourages us to rely upon the results of OLS regression with relatively greater confidence.

## 8. Conclusion

This study discusses the reliability of assessment of required competences in the labour market by the young knowledge workers. We used Reflex data this study. We have exercised SPSS and Stata for statistical analyses.

We select three variables (income, time to be expert and appropriate education level) which appear to be closely related to the required competences. Assortment of competences has also been judiciously made. In order to see the effect of these three variables upon the requisition of competences we run ordered probit (and OLS regression as well for making a comparison).

We find coherence as well as consistency in the results. Momentarily, there was no contradiction traced. 'Appropriate education level' and 'time to be expert' reflected hierarchical order in the required levels of competences. Although these variables are subjective, yet, express a very regular behaviour in our analyses. As there is not oddity found, we may maintain that the young knowledge workers have rightly assessed their required levels of competences. It is true if we apply the criterion of falsifiability.

Income as an independent variable in our analyses offered an objective measure to respond to our question. It mirrored a highly regular hierarchical pattern. We may say that high required competence level corresponds to high income and vice versa. We found this through knowledge workers assessment of their required competences which is true in practical situation in the labour market. Again, applying the parameters of coherence and consistency, these findings relate that the assessment of required competences by the knowledge workers is reliable at least in Popperian terms. However we suggest further investigating this study competence-earning relationship in more detail with greater care. This is what we are going to present in the next study. Coming to our concern in this study, we are not reluctant to accept our alternative hypothesis because we cannot accept its null counterpart at all.

*H<sub>4</sub>: Knowledge workers of different subcategories do differ in their assessment of required competence level*

In conclusion, young knowledge workers' assessment of competence, modestly speaking, has been proved to be reliable. We could think and propose competence as a measure of Human Capital (HC). We encourage some investigation in this direction and we ourselves would like to do this, subjected to the opportunity. We do invite researchers for this venture. We think that competence could be a valid measure of HC, but it is a long run objective. Anyhow it will be interesting to take the 'road not taken'.

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Table 1. Percentages of variables of interest

S. No.	Variable	<i>n</i>	Percentage
<b>Country</b>			
1.	Austria	1122	3.91
2.	Belgium	1049	3.66
3.	Czech Republic	5141	17.92
4.	Estonia	703	2.45
5.	Finland	1815	6.33
6.	France	1046	3.65
7.	Germany	1132	3.95
8.	Italy	1453	5.06
9.	Japan	1799	6.27
10.	Netherlands	2460	8.57
11.	Norway	1653	5.76
12.	Portugal	501	1.75
13.	Spain	2796	9.75
14.	Switzerland	4882	17.02
15.	United Kingdom	1138	3.97
<b>Total</b>		<b>28690</b>	<b>100.00</b>
<b>Total Monthly Income (in Euros)</b>			
1.	Monthly Income 1	5796	20.81
2.	Monthly Income 2	4140	14.86
3.	Monthly Income 3	3924	14.09
4.	Monthly Income 4	3453	12.40
5.	Monthly Income 5	3028	10.87
6.	Monthly Income 6	2268	8.14
7.	Monthly Income 7	1543	5.54
8.	Monthly Income 8	3699	13.28
<b>Total</b>		<b>27851</b>	<b>100</b>
<b>Appropriate Education Level for Current Job</b>			
1.	Higher education level	2680	9.51
2.	Same education level	20765	73.65
3.	Low education level	2577	9.14
4.	Lower education level	2171	7.70
<b>Total</b>		<b>28193</b>	<b>100.00</b>
<b>Time to be Expert in Current Job</b>			
1.	2 Years to be expert	15713	55.73
2.	5 Years to be expert	9140	32.41
3.	10 Years to be expert	2463	8.73
4.	More Years to be expert	881	3.12
<b>Total</b>		<b>28197</b>	<b>100.00</b>
<b>Gender</b>			
1.	Male	12799	44.81
2.	Female	15761	55.19
<b>Total</b>		<b>28560</b>	<b>100.00</b>

Table 2. Basic statistics of variables of interest

S. No.	Variable	<i>n</i>	$\bar{x}$	$\sigma$
1.	Country	28690	8.774	4.828
2.	Total Monthly Income (in Euros)	27851	2348.418	1552.624
3.	Appropriate Education Level for Current Job	28193	2.150	0.687
4.	Time to be Expert in Current Job	28197	3.180	1.259
5.	Gender	28560	1.552	0.497

Table 3. Decreasing mean values with respect to “Required Level of Competence”

S. No.	Variable	<i>n</i>	$\bar{x}$	$\sigma$
1.	Ability to use time efficiently	25846	5.578	1.326
2.	Ability to perform well under pressure	25851	5.553	1.403
3.	Ability to use computers and the internet	25851	5.449	1.453
4.	Ability to work productively with others	25846	5.414	1.436
5.	Ability to make your meaning clear to others	25843	5.382	1.371
6.	Ability to rapidly acquire new knowledge	25856	5.356	1.366
7.	Ability to coordinate activities	25842	5.350	1.435
8.	Mastery of your own field or discipline	25862	5.312	1.461
9.	Ability to write reports, memos or documents	25846	5.167	1.588
10.	Ability to come up with new ideas and solutions	25838	5.159	1.471
11.	Analytical thinking	25841	5.107	1.454
12.	Willingness to question your own and others' ideas	25843	4.942	1.474
13.	Ability to mobilize the capacities of others	25839	4.772	1.626
14.	Ability to negotiate effectively	25850	4.708	1.771
15.	Ability to present products, ideas or reports to an audience	25842	4.692	1.777
16.	Alertness to new opportunities	25817	4.659	1.636
17.	Ability to assert your authority	25845	4.650	1.662
18.	Knowledge of other fields or disciplines	25845	4.231	1.495
19.	Ability to write and speak in a foreign language	25386	3.894	2.132

**Reference Categories:**

The Netherlands (for countries);

'Monthly Income 1 (up to € 1000.99)' for “*Total Monthly Income (in Euros)*”;

'Same education level' for “*Appropriate education level for current job*”;

'2 Years to be expert' for “*Time to be expert in current job*”; and

'Female' young knowledge workers for “*Gender*”

Table 4. Coefficient estimates from *ordered probit* and OLS Regression

	Competence 1		Competence 2		Competence 3		Competence 4	
	$\beta_{oprobit}$	$\beta_{OLS}$	$\beta_{oprobit}$	$\beta_{OLS}$	$\beta_{oprobit}$	$\beta_{OLS}$	$\beta_{oprobit}$	$\beta_{OLS}$
Austria	0.320 <sup>††</sup>	0.324 <sup>††</sup>	0.560 <sup>††</sup>	0.616 <sup>††</sup>	0.693 <sup>††</sup>	0.842 <sup>††</sup>	0.348 <sup>††</sup>	0.355 <sup>††</sup>
Belgium	<b>0.030</b>	<b>0.022</b>	0.071 <sup>†</sup>	<b>0.065</b>	0.104 <sup>†</sup>	0.129 <sup>**</sup>	<b>-0.021</b>	<b>-0.054</b>
Czech Republic	0.392 <sup>††</sup>	0.424 <sup>††</sup>	0.530 <sup>††</sup>	0.634 <sup>††</sup>	0.924 <sup>††</sup>	1.141 <sup>††</sup>	0.365 <sup>††</sup>	0.401 <sup>††</sup>
Estonia	0.223 <sup>††</sup>	0.227 <sup>††</sup>	0.486 <sup>††</sup>	0.597 <sup>††</sup>	0.589 <sup>††</sup>	0.799 <sup>††</sup>	0.349 <sup>††</sup>	0.407 <sup>††</sup>
Finland	0.129 <sup>††</sup>	0.126 <sup>†</sup>	0.171 <sup>††</sup>	0.191 <sup>††</sup>	0.387 <sup>††</sup>	0.501 <sup>††</sup>	<b>0.020</b>	<b>-0.012</b>
France	0.147 <sup>††</sup>	0.141 <sup>†</sup>	-0.072 <sup>*</sup>	-0.198 <sup>††</sup>	0.074 <sup>*</sup>	<b>0.023</b>	-0.093 <sup>**</sup>	-0.205 <sup>††</sup>
Germany	0.288 <sup>††</sup>	0.301 <sup>††</sup>	0.518 <sup>††</sup>	0.583 <sup>††</sup>	0.359 <sup>††</sup>	0.436 <sup>††</sup>	0.186 <sup>††</sup>	0.180 <sup>††</sup>
Italy	0.284 <sup>††</sup>	0.271 <sup>††</sup>	0.405 <sup>††</sup>	0.423 <sup>††</sup>	0.526 <sup>††</sup>	0.666 <sup>††</sup>	0.317 <sup>††</sup>	0.324 <sup>††</sup>
Japan	0.229 <sup>††</sup>	0.214 <sup>††</sup>	<b>0.038</b>	<b>-0.011</b>	0.301 <sup>††</sup>	0.375 <sup>††</sup>	0.159 <sup>††</sup>	0.141 <sup>†</sup>
Norway	-0.162 <sup>††</sup>	-0.226 <sup>††</sup>	<b>-0.028</b>	<b>-0.053</b>	<b>-0.012</b>	<b>-0.053</b>	-0.258 <sup>††</sup>	-0.428 <sup>††</sup>
Portugal	0.218 <sup>††</sup>	0.233 <sup>††</sup>	0.323 <sup>††</sup>	0.358 <sup>††</sup>	0.612 <sup>††</sup>	0.786 <sup>††</sup>	0.208 <sup>††</sup>	0.245 <sup>††</sup>
Spain	0.202 <sup>††</sup>	0.208 <sup>††</sup>	0.206 <sup>††</sup>	0.210 <sup>††</sup>	0.299 <sup>††</sup>	0.388 <sup>††</sup>	0.219 <sup>††</sup>	0.198 <sup>††</sup>
Switzerland	-0.056 <sup>*</sup>	-0.136 <sup>††</sup>	0.189 <sup>††</sup>	0.195 <sup>††</sup>	0.243 <sup>††</sup>	0.296 <sup>††</sup>	<b>-0.031</b>	-0.100 <sup>**</sup>
United Kingdom	0.371 <sup>††</sup>	0.395 <sup>††</sup>	0.285 <sup>††</sup>	0.325 <sup>††</sup>	0.374 <sup>††</sup>	0.441 <sup>††</sup>	0.321 <sup>††</sup>	0.347 <sup>††</sup>
Monthly Income 2	0.082 <sup>††</sup>	0.104 <sup>††</sup>	0.139 <sup>††</sup>	0.192 <sup>††</sup>	0.077 <sup>††</sup>	0.105 <sup>††</sup>	0.125 <sup>††</sup>	0.176 <sup>††</sup>
Monthly Income 3	0.074 <sup>†</sup>	0.103 <sup>††</sup>	0.174 <sup>††</sup>	0.239 <sup>††</sup>	0.112 <sup>††</sup>	0.165 <sup>††</sup>	0.143 <sup>††</sup>	0.207 <sup>††</sup>
Monthly Income 4	0.132 <sup>††</sup>	0.184 <sup>††</sup>	0.281 <sup>††</sup>	0.392 <sup>††</sup>	0.193 <sup>††</sup>	0.295 <sup>††</sup>	0.200 <sup>††</sup>	0.295 <sup>††</sup>
Monthly Income 5	0.151 <sup>††</sup>	0.210 <sup>††</sup>	0.315 <sup>††</sup>	0.446 <sup>††</sup>	0.226 <sup>††</sup>	0.334 <sup>††</sup>	0.229 <sup>††</sup>	0.335 <sup>††</sup>
Monthly Income 6	0.147 <sup>††</sup>	0.199 <sup>††</sup>	0.351 <sup>††</sup>	0.483 <sup>††</sup>	0.240 <sup>††</sup>	0.356 <sup>††</sup>	0.227 <sup>††</sup>	0.335 <sup>††</sup>
Monthly Income 7	0.179 <sup>††</sup>	0.238 <sup>††</sup>	0.354 <sup>††</sup>	0.492 <sup>††</sup>	0.322 <sup>††</sup>	0.462 <sup>††</sup>	0.208 <sup>††</sup>	0.307 <sup>††</sup>
Monthly Income 8	0.260 <sup>††</sup>	0.345 <sup>††</sup>	0.446 <sup>††</sup>	0.609 <sup>††</sup>	0.371 <sup>††</sup>	0.529 <sup>††</sup>	0.278 <sup>††</sup>	0.416 <sup>††</sup>
Higher education level	0.058 <sup>†</sup>	0.050 <sup>*</sup>	<b>0.020</b>	<b>0.020</b>	0.111 <sup>††</sup>	0.135 <sup>††</sup>	<b>0.017</b>	<b>0.015</b>
Low education level	-0.131 <sup>††</sup>	-0.170 <sup>††</sup>	-0.105 <sup>††</sup>	-0.160 <sup>††</sup>	-0.110 <sup>††</sup>	-0.151 <sup>††</sup>	-0.142 <sup>††</sup>	-0.200 <sup>††</sup>
Lower education level	-0.349 <sup>††</sup>	-0.501 <sup>††</sup>	-0.237 <sup>††</sup>	-0.366 <sup>††</sup>	-0.425 <sup>††</sup>	-0.657 <sup>††</sup>	-0.275 <sup>††</sup>	-0.423 <sup>††</sup>
5 Years to be expert	0.104 <sup>††</sup>	0.132 <sup>††</sup>	0.104 <sup>††</sup>	0.138 <sup>††</sup>	-0.054 <sup>††</sup>	-0.065 <sup>††</sup>	0.073 <sup>††</sup>	0.101 <sup>††</sup>
10 Years to be expert	0.189 <sup>††</sup>	0.219 <sup>††</sup>	0.195 <sup>††</sup>	0.236 <sup>††</sup>	-0.134 <sup>††</sup>	-0.174 <sup>††</sup>	0.144 <sup>††</sup>	0.185 <sup>††</sup>
More Years to be expert	0.220 <sup>††</sup>	0.214 <sup>††</sup>	0.251 <sup>††</sup>	0.276 <sup>††</sup>	-0.205 <sup>††</sup>	-0.297 <sup>††</sup>	0.203 <sup>††</sup>	0.240 <sup>††</sup>
Male	-0.316 <sup>††</sup>	-0.372 <sup>††</sup>	-0.174 <sup>††</sup>	-0.202 <sup>††</sup>	<b>0.005</b>	<b>0.007</b>	-0.231 <sup>††</sup>	-0.287 <sup>††</sup>
<i>n</i>	28028	28028	28033	28033	28033	28033	28028	28028
(Pseudo) <i>R</i> <sup>2</sup>	0.0158	0.0478	0.0140	0.0437	0.0253	0.0761	0.0116	0.0356
<i>LR</i> $\chi^2(26)/F$	1382.26 <sup>††</sup>	50.22 <sup>††</sup>	1249.12 <sup>††</sup>	45.73 <sup>††</sup>	2316.79 <sup>††</sup>	82.39 <sup>††</sup>	1069.67 <sup>††</sup>	36.89 <sup>††</sup>

Values in bold - ( $p > 0.100$ ) - No; \* - ( $p \leq 0.100$ ) - Marginal; \*\* - ( $p \leq 0.050$ ) - Fair; † - ( $p \leq 0.010$ ) - Good; †† - ( $p \leq 0.001$ ) - Excellent

Table 4. (continued) Coefficient estimates from *ordered probit* and OLS Regression

	Competence 5		Competence 6		Competence 7		Competence 8	
	$\beta_{oprobit}$	$\beta_{OLS}$	$\beta_{oprobit}$	$\beta_{OLS}$	$\beta_{oprobit}$	$\beta_{OLS}$	$\beta_{oprobit}$	$\beta_{OLS}$
Austria	<b>-0.021</b>	-0.100**	<b>-0.021</b>	-0.100**	0.516††	0.634††	0.583††	0.632††
Belgium	-0.147††	-0.211††	-0.147††	-0.211††	<b>-0.026</b>	<b>-0.070</b>	0.097**	0.092*
Czech Republic	0.259††	0.271††	0.259††	0.271††	0.644††	0.818††	0.596††	0.671††
Estonia	0.398††	0.453††	0.398††	0.453††	0.373††	0.469††	0.173††	0.209††
Finland	<b>-0.001</b>	<b>-0.026</b>	<b>-0.001</b>	<b>-0.026</b>	0.150††	0.181††	-0.157††	-0.264††
France	0.255††	0.256††	0.255††	0.256††	<b>-0.041</b>	-0.093*	-0.094**	-0.183††
Germany	<b>-0.043</b>	-0.112**	<b>-0.043</b>	-0.112**	0.408††	0.500††	0.491††	0.541††
Italy	-0.059*	-0.161††	-0.059*	-0.161††	0.300††	0.325††	0.332††	0.375††
Japan	0.348††	0.358††	0.348††	0.358††	0.328††	0.392††	-0.819††	-1.315††
Norway	0.123††	0.121†	0.123††	0.121†	<b>-0.051</b>	<b>-0.068</b>	-0.064*	-0.081*
Portugal	0.369††	0.412††	0.369††	0.412††	0.231††	0.277††	0.117**	0.129*
Spain	0.367††	0.408††	0.367††	0.408††	0.248††	0.307††	0.098††	0.109†
Switzerland	-0.261††	-0.394††	-0.261††	-0.394††	0.098††	0.104†	0.097††	0.087**
United Kingdom	0.345††	0.357††	0.345††	0.357††	0.363††	0.432††	<b>-0.030</b>	<b>-0.071</b>
Monthly Income 2	0.075††	0.094††	0.075††	0.094††	0.099††	0.134††	<b>0.035</b>	0.056*
Monthly Income 3	0.086††	0.110††	0.086††	0.110††	0.120††	0.172††	0.068†	0.116††
Monthly Income 4	0.075†	0.107†	0.075†	0.107†	0.191††	0.268††	0.078†	0.146††
Monthly Income 5	0.163††	0.217††	0.163††	0.217††	0.238††	0.337††	0.066**	0.135††
Monthly Income 6	0.187††	0.253††	0.187††	0.253††	0.287††	0.403††	0.064**	0.122†
Monthly Income 7	0.188††	0.257††	0.188††	0.257††	0.283††	0.393††	0.096†	0.165††
Monthly Income 8	0.188††	0.266††	0.188††	0.266††	0.348††	0.490††	0.117††	0.192††
Higher education level	0.072††	0.078†	0.072††	0.078†	0.045**	<b>0.047</b>	0.180††	0.210††
Low education level	-0.199††	-0.257††	-0.199††	-0.257††	-0.158††	-0.228††	-0.350††	-0.498††
Lower education level	-0.528††	-0.750††	-0.528††	-0.750††	-0.461††	-0.700††	-0.731††	-1.111††
5 Years to be expert	0.144††	0.176††	0.144††	0.176††	0.103††	0.141††	0.207††	0.263††
10 Years to be expert	0.244††	0.286††	0.244††	0.286††	0.139††	0.184††	0.264††	0.331††
More Years to be expert	0.380††	0.418††	0.380††	0.418††	0.209††	0.241††	0.390††	0.467††
Male	-0.166††	-0.188††	-0.166††	-0.188††	-0.251††	-0.319††	-0.140††	-0.156††
<i>n</i>	28025	28025	28025	28025	28024	28024	28044	28044
(Pseudo) $R^2$	0.0226	0.0720	0.0226	0.0720	0.0187	0.0617	0.0465	0.1627
$LR \chi^2(26)/F$	2054.37††	77.54††	2054.37††	77.54††	1734.66††	65.69††	4336.22††	194.47††

Values in bold - ( $p > 0.100$ ) - No; \* - ( $p \leq 0.100$ ) - Marginal; \*\* - ( $p \leq 0.050$ ) - Fair; † - ( $p \leq 0.010$ ) - Good; †† - ( $p \leq 0.001$ ) - Excellent

Table 4. (continued) Coefficient estimates from *ordered probit* and OLS Regression

	Competence 9		Competence 10		Competence 11		Competence 12	
	$\beta_{oprobit}$	$\beta_{OLS}$	$\beta_{oprobit}$	$\beta_{OLS}$	$\beta_{oprobit}$	$\beta_{OLS}$	$\beta_{oprobit}$	$\beta_{OLS}$
Austria	0.429 <sup>††</sup>	0.583 <sup>††</sup>	0.189 <sup>††</sup>	0.193 <sup>††</sup>	0.401 <sup>††</sup>	0.460 <sup>††</sup>	-0.087 <sup>**</sup>	-0.182 <sup>††</sup>
Belgium	<b>0.059</b>	<b>0.074</b>	- <b>0.023</b>	- <b>0.056</b>	<b>0.039</b>	<b>0.025</b>	-0.075 <sup>**</sup>	-0.130 <sup>**</sup>
Czech Republic	0.737 <sup>††</sup>	1.042 <sup>††</sup>	0.260 <sup>††</sup>	0.303 <sup>††</sup>	0.566 <sup>††</sup>	0.736 <sup>††</sup>	0.374 <sup>††</sup>	0.468 <sup>††</sup>
Estonia	0.331 <sup>††</sup>	0.447 <sup>††</sup>	0.322 <sup>††</sup>	0.392 <sup>††</sup>	0.525 <sup>††</sup>	0.681 <sup>††</sup>	-0.107 <sup>**</sup>	-0.187 <sup>†</sup>
Finland	0.067 <sup>**</sup>	<b>0.067</b>	0.091 <sup>†</sup>	0.090 <sup>**</sup>	-0.064 <sup>**</sup>	-0.112 <sup>†</sup>	-0.071 <sup>**</sup>	-0.134 <sup>†</sup>
France	<b>0.007</b>	- <b>0.031</b>	-0.219 <sup>††</sup>	-0.369 <sup>††</sup>	0.198 <sup>††</sup>	0.243 <sup>††</sup>	-0.204 <sup>††</sup>	-0.329 <sup>††</sup>
Germany	0.397 <sup>††</sup>	0.545 <sup>††</sup>	0.153 <sup>††</sup>	0.151 <sup>†</sup>	0.194 <sup>††</sup>	0.206 <sup>††</sup>	- <b>0.054</b>	-0.124 <sup>**</sup>
Italy	0.458 <sup>††</sup>	0.636 <sup>††</sup>	0.169 <sup>††</sup>	0.157 <sup>††</sup>	0.360 <sup>††</sup>	0.444 <sup>††</sup>	0.150 <sup>††</sup>	0.138 <sup>†</sup>
Japan	0.488 <sup>††</sup>	0.703 <sup>††</sup>	0.304 <sup>††</sup>	0.345 <sup>††</sup>	0.325 <sup>††</sup>	0.400 <sup>††</sup>	0.158 <sup>††</sup>	0.169 <sup>††</sup>
Norway	0.142 <sup>††</sup>	0.219 <sup>††</sup>	-0.242 <sup>††</sup>	-0.363 <sup>††</sup>	-0.487 <sup>††</sup>	-0.720 <sup>††</sup>	-0.242 <sup>††</sup>	-0.358 <sup>††</sup>
Portugal	0.312 <sup>††</sup>	0.472 <sup>††</sup>	<b>0.068</b>	<b>0.063</b>	0.170 <sup>††</sup>	0.221 <sup>††</sup>	- <b>0.034</b>	- <b>0.069</b>
Spain	0.423 <sup>††</sup>	0.607 <sup>††</sup>	0.212 <sup>††</sup>	0.263 <sup>††</sup>	0.095 <sup>†</sup>	0.108 <sup>†</sup>	- <b>0.025</b>	- <b>0.068</b>
Switzerland	0.262 <sup>††</sup>	0.371 <sup>††</sup>	-0.050 <sup>†</sup>	-0.116 <sup>†</sup>	0.119 <sup>††</sup>	0.131 <sup>††</sup>	-0.146 <sup>††</sup>	-0.238 <sup>††</sup>
United Kingdom	0.278 <sup>††</sup>	0.369 <sup>††</sup>	-0.097 <sup>†</sup>	-0.188 <sup>††</sup>	- <b>0.015</b>	- <b>0.053</b>	- <b>0.023</b>	- <b>0.075</b>
Monthly Income 2	0.053 <sup>**</sup>	0.088 <sup>†</sup>	0.069 <sup>†</sup>	0.101 <sup>††</sup>	0.119 <sup>††</sup>	0.160 <sup>††</sup>	0.057 <sup>**</sup>	0.089 <sup>†</sup>
Monthly Income 3	0.089 <sup>††</sup>	0.147 <sup>††</sup>	0.080 <sup>††</sup>	0.122 <sup>††</sup>	0.206 <sup>††</sup>	0.274 <sup>††</sup>	0.111 <sup>††</sup>	0.167 <sup>††</sup>
Monthly Income 4	0.182 <sup>††</sup>	0.298 <sup>††</sup>	0.104 <sup>††</sup>	0.167 <sup>††</sup>	0.228 <sup>††</sup>	0.316 <sup>††</sup>	0.133 <sup>††</sup>	0.208 <sup>††</sup>
Monthly Income 5	0.265 <sup>††</sup>	0.424 <sup>††</sup>	0.161 <sup>††</sup>	0.239 <sup>††</sup>	0.305 <sup>††</sup>	0.424 <sup>††</sup>	0.180 <sup>††</sup>	0.270 <sup>††</sup>
Monthly Income 6	0.287 <sup>††</sup>	0.466 <sup>††</sup>	0.203 <sup>††</sup>	0.304 <sup>††</sup>	0.365 <sup>††</sup>	0.520 <sup>††</sup>	0.210 <sup>††</sup>	0.314 <sup>††</sup>
Monthly Income 7	0.206 <sup>††</sup>	0.348 <sup>††</sup>	0.200 <sup>††</sup>	0.295 <sup>††</sup>	0.458 <sup>††</sup>	0.636 <sup>††</sup>	0.217 <sup>††</sup>	0.319 <sup>††</sup>
Monthly Income 8	0.192 <sup>††</sup>	0.324 <sup>††</sup>	0.160 <sup>††</sup>	0.247 <sup>††</sup>	0.438 <sup>††</sup>	0.620 <sup>††</sup>	0.179 <sup>††</sup>	0.271 <sup>††</sup>
Higher education level	0.187 <sup>††</sup>	0.245 <sup>††</sup>	0.158 <sup>††</sup>	0.203 <sup>††</sup>	0.190 <sup>††</sup>	0.229 <sup>††</sup>	0.149 <sup>††</sup>	0.194 <sup>††</sup>
Low education level	-0.278 <sup>††</sup>	-0.428 <sup>††</sup>	-0.286 <sup>††</sup>	-0.400 <sup>††</sup>	-0.269 <sup>††</sup>	-0.365 <sup>††</sup>	-0.269 <sup>††</sup>	-0.381 <sup>††</sup>
Lower education level	-0.740 <sup>††</sup>	-1.206 <sup>††</sup>	-0.647 <sup>††</sup>	-0.980 <sup>††</sup>	-0.727 <sup>††</sup>	-1.067 <sup>††</sup>	-0.622 <sup>††</sup>	-0.935 <sup>††</sup>
5 Years to be expert	0.111 <sup>††</sup>	0.171 <sup>††</sup>	0.106 <sup>††</sup>	0.142 <sup>††</sup>	0.149 <sup>††</sup>	0.202 <sup>††</sup>	0.141 <sup>††</sup>	0.196 <sup>††</sup>
10 Years to be expert	0.156 <sup>††</sup>	0.227 <sup>††</sup>	0.122 <sup>††</sup>	0.160 <sup>††</sup>	0.188 <sup>††</sup>	0.250 <sup>††</sup>	0.187 <sup>††</sup>	0.256 <sup>††</sup>
More Years to be expert	0.214 <sup>††</sup>	0.278 <sup>††</sup>	0.157 <sup>††</sup>	0.179 <sup>††</sup>	0.200 <sup>††</sup>	0.237 <sup>††</sup>	0.280 <sup>††</sup>	0.360 <sup>††</sup>
Male	-0.140 <sup>††</sup>	-0.172 <sup>††</sup>	-0.044 <sup>††</sup>	-0.052 <sup>†</sup>	0.082 <sup>††</sup>	0.122 <sup>††</sup>	-0.061 <sup>††</sup>	-0.073 <sup>††</sup>
<i>n</i>	28028	28028	28020	28020	28023	28023	28025	28025
(Pseudo) <i>R</i> <sup>2</sup>	0.0252	0.0898	0.0171	0.0608	0.0314	0.1106	0.0189	0.0670
<i>LR</i> $\chi^2$ (26) / <i>F</i>	2459.82 <sup>††</sup>	98.65 <sup>††</sup>	1640.77 <sup>††</sup>	64.66 <sup>††</sup>	3008.87 <sup>††</sup>	124.34 <sup>††</sup>	1840.52 <sup>††</sup>	71.80 <sup>††</sup>

Values in bold - ( $p > 0.100$ ) - No; \* - ( $p \leq 0.100$ ) - Marginal; \*\* - ( $p \leq 0.050$ ) - Fair; † - ( $p \leq 0.010$ ) - Good; †† - ( $p \leq 0.001$ ) - Excellent

**Appendix A. Description of the Variables**

**Description of the Variables of Interest**

Required level of competences as a variable is our major concern in this study. This variable has been recorded on a 7-point rating scale ranging from very low (represented by 1) to very high (represented by 7). It is discrete and ordinal. Young knowledge workers were inquired to rate the level of competences required for their current job. It is pertinent to mention that they were inquired a few years after their graduation. Since the selected subset-I comprising 12 competences showed the required level of competences declared or believed by the young knowledge workers in their current job. The variables mentioned above are characteristic to current job.

**Total Monthly Income**

Total Monthly Income (in Euros) was continuous variable. We made the following eight subcategories.

Monthly Income 1 (up to € 1000.99), Monthly Income 2 (€ 1001.00 - 1500.99), Monthly Income 3 (€ 1501.00 - 2000.99), Monthly Income 4 (€ 2001.00 - 2500.99), Monthly Income 5 (€ 2501.00 - 3000.99), Monthly Income 6 (€ 3001.00 - 3500.99), Monthly Income 7 (€ 3501.00 - 4000.99), Monthly Income 8 (€ 4001.00 - 4500.99)

Following is the excerpt from the Reflex Master Questionnaire asking about monthly income of the individuals.

**F7 What are your gross monthly earnings?**

---

From contract hours in main employment      about |\_\_\_\_\_| EURO per month

From overtime or extras in main employment      about |\_\_\_\_\_| EURO per month

From other work      about |\_\_\_\_\_| EURO per month

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**Appropriate Education Level for Current Job**

Appropriate Education Level for Current Job has four subcategories.

Higher education level , Same education level, Low education level (lower level of tertiary education), Lower education level (below tertiary level)



We present here the excerpt from the Reflex Master Questionnaire which is related to this variable.

<b>F8</b>	<b>What type of education do you feel is most appropriate for this work?</b>	<input type="checkbox"/>	PhD
		<input type="checkbox"/>	other postgraduate qualification
		<input type="checkbox"/>	master
		<input type="checkbox"/>	bachelor
		<input type="checkbox"/>	lower than higher education

**Time to be Expert in Current Job**

Time to be Expert in Current Job was categorised into following four subcategories. We have merged first three subcategories into one: 2 Years to be expert (up to 2 years of experience), 5 Years to be expert (up to 5 years of experience), 10 Years to be expert (up to 10 years of experience), More Years to be expert (more than 10 years of experience)

Following is the excerpt from the Reflex Master Questionnaire for ‘Time to be Expert in Current Job’.

<b>F10</b>	How much time would it take for an average young knowledge worker with the relevant educational background to become an expert in this kind of work?	<input type="checkbox"/>	6 months or less
		<input type="checkbox"/>	7 to 12 months
		<input type="checkbox"/>	1 to 2 years
		<input type="checkbox"/>	3 to 5 years
		<input type="checkbox"/>	6 to 10 years
		<input type="checkbox"/>	more than 10 years

**Gender**

Here is the question about gender.

<b>K1</b>	Gender	<input type="checkbox"/>	male
		<input type="checkbox"/>	female

**Country**

We have young knowledge workers from 15 countries in the data set we are using. Next section contains basic statistics concerning these variables.

**Competences**

Here is the list of 19 competences in section H1 of the Reflex Master Questionnaire (see the excerpt below). We are concerned with the B part of this question where required level in current work has been asked. Find the original excerpt of the questionnaire in the following.

**H1 Below is a list of competencies. Please provide the following information:**

. How do you rate your required level of competence?

. What is the required level of competence in your current work?

*If you are not currently employed, only fill in column A*

	A Required level							B Required level in current work							
	Very low	←————→					very high	Very low	←————→					very high	
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	
a	Mastery of your required field or discipline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b	Knowledge of other fields or disciplines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c	Analytical thinking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d	Ability to rapidly acquire new knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e	Ability to negotiate effectively	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f	Ability to perform well under pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g	Alertness to new opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h	Ability to coordinate activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i	Ability to use time efficiently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j	Ability to work productively with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k	Ability to mobilize the capacities of others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l	Ability to make your meaning clear to others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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m	Ability to assert your authority	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n	Ability to use computers and the internet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o	Ability to come up with new ideas and solutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
p	Willingness to question your required and others' ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
q	Ability to present products, ideas or reports to an audience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
r	Ability to write reports, memos or documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
s	Ability to write and speak in a foreign language	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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# Measures to Improve the Competitiveness of Hong Kong Taxation System in the Aftermath of the Recent Crisis

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## Abstract

This paper addresses key tax issues and suggests measures to improve the competitiveness of the Hong Kong taxation system. With the enactment of new legislation, Hong Kong is now able to adopt the latest internationally agreed standard of exchange of information by concluding comprehensive double taxation agreements with its trading partners. The expanded treaty network provides added clarity and certainty to the allocation of taxing rights and the tax treatment for international transactions. To broaden the current narrow tax base, we suggest the following measures: introduce a land-related taxation, modify the scope of charge in profits tax, promulgate detailed statutory source-of-profits rules, and implement a mini capital gains tax. By so doing, the Hong Kong government revenue will be less susceptible to economic cycles, and tax efficiency will be enhanced as most controversial tax dispute areas will have been removed.

**Keywords:** Exchange of information, Comprehensive double taxation agreements, Tax base, Territorial source, Capital gains tax

## 1. Introduction

This paper addresses key tax issues and suggests measures to improve the competitiveness of the Hong Kong taxation system in the aftermath of the 2007-2009 economic crisis. With the enactment of new legislation in 2010, Hong Kong is now able to adopt the latest internationally agreed standard of exchange of information by concluding comprehensive double taxation agreements (CDTAs) with its trading partners. The expanded treaty network in Hong Kong provides added clarity and certainty to the allocation of taxing rights and the tax treatment for international transactions. To broaden the current narrow tax base, we suggest the following measures: introduce a land-related taxation, modify the scope of charge in profits tax, promulgate detailed statutory source-of-profits rules, and implement a mini capital gains tax. By so doing, the Hong Kong government revenue will be less susceptible to economic cycles, and tax efficiency will be enhanced as most controversial tax dispute areas will have been removed. The following sections discuss the rationale for our observations and suggestions.

## 2. Expand Treaty Network

Double taxation arises when the same item of income or profit is subject to tax in more than one tax jurisdictions because these jurisdictions overlap. Hong Kong residents generally do not suffer from double taxation. Under the source basis of taxation, income/profit sourced in Hong Kong is subject to tax, and that derived from a source outside Hong Kong is generally not taxed. In addition, non-Hong Kong residents operating businesses in Hong Kong do not generally suffer from double taxation problems. There are two reasons for this. First, many jurisdictions that tax their residents on a worldwide basis often provide their residents operating businesses in Hong Kong with unilateral tax credit relief for any Hong Kong tax paid on income/profit derived from Hong Kong. Second, the Hong Kong Inland Revenue Department (IRD) allows a deduction for foreign tax paid on a turnover basis in respect of an income that is also subject to tax in Hong Kong. There are, however, merits for Hong Kong to

conclude CDTAs with its trading partners. A CDTA provides certainty to investors on the taxing rights of the contracting parties, helps investors to better assess their potential tax liabilities on economic activities and provides an added incentive for non-resident companies to do business in Hong Kong and for Hong Kong companies to do business overseas (Note 1).

Since the handover of sovereignty in 1997, Hong Kong has signed CDTAs with Belgium in 2003, Thailand in 2005, mainland China in 2006 (Note 2), Luxembourg in 2007 and Vietnam in 2008. Compared with Singapore, Japan and Thailand, which have entered into more than 50 tax treaties each, the Hong Kong treaty network is extremely limited. More importantly, all these five pre-2010 CDTAs have only adopted the restrictive exchange of information (EoI) clause that is based on the 1995 Organization for Economic Co-operation and Development (OECD) standard. It has been argued that the pre-2010 CDTA negotiation processes with other jurisdictions have been delayed mainly because Hong Kong does not adopt the more liberal 2004 OECD EoI clause (Note 3). With the passing of the Inland Revenue (Amendment) Ordinance 2010 and the Inland Revenue (Disclosure of Information) Rules in March 2010, the major negotiation hurdle of adopting a more liberal EoI clause has been resolved. Since then, Hong Kong has proceeded quickly to expand and update its treaty network as swiftly as possible, with a total of seventeen CDTAs concluded (2 CDTAs and 13 CDTAs are newly signed in 2011 and 2010 respectively, and 2 existing CDTAs are upgraded to new standard) at the time of writing. All these seventeen CDTAs have adopted the 2004 OECD model EoI article, with certain modifications providing additional safeguards against abuse of the article. Not only will it promote more inbound and outbound investments, an expanded tax treaty network in Hong Kong will enhance the existing tax system in terms of clarity, certainty and consistency for strengthening its competitive edge.

### 3. Broaden Tax Base

Hong Kong has a narrow tax base. It is a source-based jurisdiction where only Hong Kong source income/profit is subject to tax. It does not impose taxes on capital gains and dividends. It has no goods and services tax (GST) or value added tax (VAT). The main source of government revenue is from profits tax, salaries tax, stamp duty, land selling and reserve investment. In addition, the International Monetary Fund (IMF) has stated that "Hong Kong SAR has one of the lowest overall tax burdens in the world and its tax base is remarkably narrow by any standard. Indeed, it is the only territory in the Asian and Pacific region that does not have some form of a broad-based tax on consumption" (Advisory Committee, 2001).

We agree that the Hong Kong tax base is too narrow and volatile, and it must be broadened so that Hong Kong government revenue is less susceptible to economic cycles. Although the GST may be a good broad-based tax to broaden the Hong Kong tax base in the long run, we suggest the introduction of land-related taxation during the transitional period. We consider that the land-related taxation is equivalent to a broad-based tax because there has been a heavy reliance by the Hong Kong government on revenue producing through land sales and related transactions (Note 4). In addition, a land-related taxation can help to control the somewhat overheated immovable property market in Hong Kong.

#### 3.1 Modify the Scope of Charge in Profits Tax

The tax structure of Hong Kong is relatively straightforward, and there are three distinct and separate headings under which tax is levied: property tax, salaries tax and profits tax. Profits tax is charged on every person who is carrying on a trade, profession or business in Hong Kong in respect of his assessable profits *arising in or derived from Hong Kong* from such trade, profession or business [section 14(1) of the Inland Revenue Ordinance (IRO)]. Hence, the fact that a taxpayer has carried on business in Hong Kong does not automatically mean that the profits from the business were 'profits arising in or derived from Hong Kong'. The source of profits is not always identical to the place where the business is carried on. In general, there is no distinction between resident and non-resident persons for Hong Kong tax purposes.

If a person can arrange his business operations outside Hong Kong, it is possible that the profit is sourced outside Hong Kong and is exempt from Hong Kong profits tax. Whether a profit is sourced in or outside Hong Kong is a question of facts. Each case is determined on its own merits and different rules are applicable to different types of business.

##### 3.1.1 Profits 'Arising in or Derived from Hong Kong'

The only statutory definition of 'profits arising in or derived from Hong Kong' is in section 2(1) of the IRO. It states that 'profits arising in or derived from Hong Kong' includes all profits from business transacted in Hong Kong, whether directly or through an agent. Determining the source of profits has been one of the most contentious issues in Hong Kong because source is an easy concept to understand, but difficult to apply in practice. There are a growing number of disputes in this area, and the source of profits is largely ascertained in accordance with case law

principles. The broad guiding principle for determining the source of a taxpayer's profit is that 'one looks to see what the taxpayer has done to earn the profit in question and where he has done it'. This principle originated in the decisions of the Privy Council in *Hang Seng Bank* (1990) and was expanded in the *TVBI* (1992) to mean that 'one was to ascertain what were the operations which produced the relevant profits and where those operations took place'. However, it is not always easy to apply the broad guiding principle in solving disputes between taxpayers and the IRD. It appears that subsequent cases (e.g. *Orion Caribbean* (1997) and *ING Baring* (2007) have looked increasingly to a wider range of activities or even the whole operations of a taxpayer's business to identify the source of the taxpayer's profits. The question of profit source remains contentious and uncertain.

### 3.1.2 Principles on Which Locality of Profits Is Determined

After the first version of Departmental Interpretation and Practice Note No. 21 (DIPN 21) was released in 1992, the IRD revised its practice note in 1996 and 1998. The 2009 version was the fourth revision to incorporate the legal principles established in court cases handed down since 1998. Compared to the 1998 version, the DIPN 21 (Revised 2009) suggests that the IRD is taking a more strict and restrictive approach when determining the source of profits (RSM Nelson Wheeler Tax Advisory Limited, 2010). In addition, the IRD's interpretation of the legal principles established in the recent court cases seems to be somewhat selective and imbalanced (PricewaterhouseCoopers, 2010a). As the DIPN 21 (Revised 2009) only provides a guideline and has no legal binding effect, the source of profits will inevitably continue to be a major area of uncertainty to taxpayers (PricewaterhouseCoopers, 2010a).

### 3.1.3 "Residence" Basis of Taxation v. Detailed Statutory Source Rules

To minimise the disputes on source of profits, the Hong Kong profits tax regime can be changed from territorial taxation to taxation of profits from all sources by persons carrying on a trade, profession or business in Hong Kong. This is similar to adopt "residence" as the basis of taxing profits from all sources. If such a "residence" basis of taxation is adopted in Hong Kong, a unilateral tax relief can be made available to exclude the profits attributable to an overseas permanent establishment of a Hong Kong resident company from the charge of tax. However, the "residence" basis of taxation may overly complicate Hong Kong's renowned simple and efficient tax system and make Hong Kong less competitive and attractive internationally. Since no tax system is purely "source" or "residence" based, we suggest that the unclear or arbitrary problems on the current source rules may be better addressed by enacting detailed statutory source rules.

## 4. Capital Gains Tax

Capital gains tax is levied on the profit or gain made from the disposal or sale of a capital asset. Unlike most other countries, Hong Kong does not impose a capital gains tax.

### 4.1 Trading or Not

Profits tax is charged on every person who is carrying on a trade, profession or business in Hong Kong in respect of his assessable profits arising in or derived from Hong Kong from such trade, profession or business. *Profits arising from the sale of capital assets* are excluded from the charge (section 14(1) of the IRO). The terms 'capital' and 'capital asset' are not defined in the IRO. However, there is a significant body of case law concerned with whether a taxpayer's profits are exempt from profits tax. If a person can prove to the satisfaction of a tax assessor that he does not carry on a trade or business in Hong Kong, or the gain made from the sale of an asset is of a capital nature rather than a trading nature, such income is exempt from Hong Kong profits tax.

### 4.2 Revenue versus Capital Receipts

Profits tax is usually levied only on 'revenue profits' and not income of a capital nature. As a general rule, the commonly accepted accounting principles would be applied in drawing a distinction between revenue and capital receipts, but in many cases it is an extremely thin line and there are no hard and fast rules. Whether an asset is a capital asset is a question of facts and the six badges of trade are often employed for the determination of a capital asset or a trading stock. Among Hong Kong tax disputes, trading-versus-investment cases are common and are regularly the subject of appeal cases. Two typical instances in which these disputes occur involve the buying and selling of shares and immovable property.

The Commissioner of Inland Revenue (CIR) does apply the badges of trade to determine whether a person trades in shares and immovable property. Yet, in the case of *individuals* buying and selling shares, the benchmarks concerning the level of organisation, system and frequency of transactions are so high that a finding for a person who has carried on a trade (or business) is rare (Note 5). One of the reasons the IRD has not aggressively sought to tax share trading gains is the impact of revenue losses when the markets turn.

### 4.3 Mini Capital Gains Tax

Due to the recovery and booming of the shares and immovable property markets in Hong Kong, we can expect the

argument on trading-versus-investment cases to intensify as it is still one of the problematic issues in Hong Kong revenue law. To maintain an efficient tax system and broaden its tax base, the Hong Kong profits tax charge could be amended to include capital receipts as taxable income. Alternatively, Hong Kong could implement a separate capital gains tax at a relatively low rate (say 10%) that covers all taxpayers. However, the capital gains tax might overly complicate or make less attractive Hong Kong's simple taxation system. To this end, we suggest that a mini capital gains tax which targets at short swing sales of key items of property (such as residential immovable property). The mini capital gains tax compares well with the Special Stamp Duty on resale of residential immovable property which was proposed by the Financial Secretary in November 2010. This will contribute to income re-distribution, narrow the gap between the rich and the poor and lessen the bubble effect in the markets of key property items in Hong Kong.

## 5. Conclusion

The expanded treaty network in Hong Kong provides added clarity and certainty to the allocation of taxing rights and the tax treatment for international transactions (PricewaterhouseCoopers, 2010b). Specifically, the treaty network with major economies would help reduce tax burdens on individuals and enterprises, and would eliminate uncertainties over tax liabilities (Inland Revenue Department, 2010). Together with Hong Kong's existing competitive edge (e.g., being one of the freest economies in the world, having a quality workforce and respected legal system, and its proximity to mainland China), Hong Kong will become an attractive gateway for foreign investors in the contracting states with which Hong Kong has concluded CDTAs because they may take advantage of the available treaty benefits (PricewaterhouseCoopers, 2010b). The expanded treaty network improves the business environment and facilitates flows of investment and individuals between Hong Kong and other economies, which in turn enhances the Hong Kong's position as an international business and financial centre (Inland Revenue Department, 2010).

It is generally agreed that the Hong Kong tax base is too narrow and volatile, and it must be broadened. Our suggestions are to introduce a land-related taxation, to enact detailed statutory source of profits rules, and to introduce a mini capital gains tax. By so doing, the Hong Kong government revenue will be less susceptible to economic cycles, and tax efficiency will be enhanced as some controversial tax dispute areas will have been removed.

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## Notes

- Note 1. Adapted from Hong Kong IRD's discussion of double taxation. Available at: <http://www.ird.gov.hk/eng/pol/dta.htm> (Accessed on 2 March 2012).
- Note 2. A "mini" CDTA between Hong Kong and mainland China was signed in 1998. The scope of the 2006 CDTA is wider than that of 1998 and covers passive income such as dividends, interest, royalties and capital gains.
- Note 3. For discussion on the reasons for Hong Kong's failure to meet the OECD's February 2010 deadline to substantially implement a liberalised tax information exchange regime, see Pheny, M. and Wong, P. W. Y. (2010), 'Why was Hong Kong unable to substantially implement tax information exchange in time?', *International Tax Journal*, 36(5), September – October, pages 71 -80.

Note 4. See the work of Cullen, R. and Krever, T. (2005), *Taxation and Democracy in Hong Kong*, Civic Exchange. Also the work of Littlewood, M. (2010), *Taxation Without Representation: The History of Hong Kong's Troublingly Successfully Tax System*, Hong Kong University Press, Hong Kong.

Note 5. See, for example, *Lee Yee Shing v CIR* (2008) 3HKLRD 51; FACV 14/2007 (January 2008) and *CIR v Chang Liang-jen* (1977) 1 HKTC 975 where the purchase and sale of many parcels of shares over a period of several years was held not to be trading but rather speculative (or gambling) transactions (in *Lee Yee Shing*) or turning over an investment portfolio (in *Chang*).

# Effect of Interest, Moving Average, and Historical Volatility in Forecasting Exchange Prices of Major International Currencies

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## Abstract

Forecasting foreign exchange prices drives the concerns of financial investors and occupies the minds of financial analysts as well. Most Current forecasting formulas used to employ individual financial factors, either fundamental or technical. The purpose of this study is to test the effect of combined financial factors in forecasting future exchange prices of world currencies. This study used one fundamental factor and two technical factors merged in one mathematical formula. Researchers have merged interest rate, historical volatility, and moving average in one formula. Empirical tests included correlation, Covariance tests to measure the magnitude of the linear relation between historical and computed exchange rates; F.Test aimed to show whether the two sets of historical and computed data have the same standard deviation at the specified confidence levels. Data included historical and computed sets of exchange prices of Swiss Franc, Sterling Pound, European Euro, and Japanese Yen against U.S.Dollar. Study period extended for ten years, i.e. 2000-2008. Results reflected high correlation and low covariance and accepted F.test; there were some biases due to extraneous factors which had affected the exchange rates for certain times during the testing period.

**Keywords:** Interest rate parity, Historical volatility, Exchange rates

*JEL Classification Codes:* E43, E52, G14, WP\07\03

## 1. Introduction

Until the recent past, foreign exchange markets were confined to meet the demands of exporters and importers of goods and services. But these markets have flourished and diversified to include financial and investment companies, as well as individuals. (Ewing & Ascarelli, 2000).

Many efforts were done to study the basis under which the future exchange rates of currencies can be forecasted. Several financial theories aimed to develop financial models to understand the movements of exchange rates and their vulnerability to financial and economic developments, as well as the behaviors of investors. (Brigham et al., 2002). Financial analysts and researchers are keen to develop financial models that will give more comprehensive explanations for the foreign exchange rates movements ;However, there are gaps between the actual market prices and forecasted rates resulting from the use of mathematical models. A room for improvement still exists through introducing multi- factor models. Models composed of technical and fundamental factors are becoming of interest to researchers. Given the importance of these factors, the purpose of this study is to test a mathematical model composed of interest rate, historical volatility, and moving average, combined, to forecast the future foreign exchange rates.

## 2. Literature Review

### 2.1 Emergence of Capital Markets (Historical Review)

The exchange of currencies goes back to the reign of Egyptian Pharaohs, i.e., more than five thousand years BC, where the traders in the Middle East used to exchange coins in ancient times. Since that time and until recently currency markets were stable and were not shrouded in any speculation to remember. In 1944, i.e. aftermath World War II an international agreement was reached to govern monetary policy among nations in Bretton Woods, USA, in which U.S.



dollar was pegged with gold at \$ 35 per ounce, and most major global currencies were pegged with either gold or U.S. dollar; this agreement has made a bid to prevent any fluctuations in the prices of world major currencies. In 1971, The Bretton Woods system collapsed, partially due to economic expansion in excess of the gold standard's funding abilities on the part of the United States and other member nations. Consequently, several agreements were made between European alliances to protect their currencies, such as Snake Tunnel model aiming at limiting fluctuations between different European currencies. It was an attempt at creating a single currency band for the European Economic Community (EEC), essentially pegging all the EEC currencies to one another. The tunnel collapsed in 1973 when the US dollar floated freely. This has ushered a new era, where currencies are liberated and their exchange prices were subjected to market supply and demand forces (Abuaf & Schoess, 1988).

### *2.2 The Importance of a Sound Global Financial System*

Good Financial system supports global economic developments; Its basic role is to act as mediator between the surplus and deficit units; it increases the confidence of depositors and taxpayers of surplus money and the world's international bodies, both public and private; this will benefit individuals, groups and communities altogether to achieve well-being. Any defect affecting the international financial system will adversely affect the monetary policies of countries and thus slows investment operations, the result will be recession in the economies of these countries. The recession is rampant in any country as it will spread like an epidemic in countries that have business or financial interrelationship. The safety of the financial system is the basis for safety of related economies (Rose, 2003).

The system also offers a range of financial instruments to stimulate the surplus units to choose what suits them of financial investments depending on their nature. Financial markets act as the mechanism of distributing wealth and sources of production. The good performance of global financial markets is the most important element of a developed economy. Developed markets result in upgrading the efficiency of working capital for industrial and service establishments, and thus increase their productivity and development. Globalization has increased the reliance of World Trade on financial markets. As well, the Banking System had a key role in supporting governments and policy-makers and organizers of the economies of countries to finance their projects, while the private sector had a big role in absorbing the technology and the use of modern optimization. (Hilbers, 2000).

### *2.3 IMF's Role in the Development of the Global Financial System*

The International Monetary Fund (IMF) is an international organization that was conceived on July 22, 1944, The IMF works to improve the economies of its member countries.

IMF role is to activate the financial control at the bilateral and collective levels among the members the Fund, including assistance in providing technical advice to members. Details of such role are as follows:

- Bilateral control: it is a bilateral cooperation program between the Fund and individual countries, and in this regard, the Directors of the Fund have the right to monitor and assess the financial performance in terms of showing the strengths and weaknesses in their performance and how to overcome all the obstacles that may hinder the work of these institutions properly and effectively.
- Collective Control: It is to find programs of cooperation between the institutions of a group of countries with the same nature and the management of the Fund, aiming at exchange of information about customers and regional areas of joint interest.
- Technical support programs for financial institutions: to identify and diagnose problems of bank facilities, also to help in restructuring of banks in accordance to the economic conditions of countries and their financial policies.
- Technical assistance: it is the Fund's contribution to help its members in applying procedures and policies that serve and strengthen the infrastructure of the financial system.

### *2.4 Development of Currency Markets*

For many years financial markets were monopolized by central banks and major financial institutions, after the liberalization of global trade currencies in the late seventies, it became possible for any institution or individual to engage in this trade, currency has become the most active trading instrument to reach \$ 5 billion per day in 1977, jumped to 600 billion per day in 1987, and one trillion dollars a day in 1992, and more than three trillion dollars in 2009. Information technology development and emergence of the Internet have the major impact on the evolution of trading. Investors are now able to perform direct buying and selling of global currencies, it can be launched without barrier or over the counter (OTC); this means that transactions are done without the need for actual trading halls (Singh, 1997).

Integration and Globalization of the World's Currency Markets: That the essence of globalization is to create integration between the global financial markets, based on the financial relations and multilateral trade. The processes

of globalization and financial market integration are linked together. Globalization of markets, acknowledges the free flow of money, commodities, and information between all world states without barriers and with low costs. Integration of markets is the process of consolidating markets and returns and minimizes risks among all financial markets (González, 2010).

### 2.5 Foreign Exchange Markets

Created in 1971-1976, they started as an interbank “tool” used for operating huge monetary assets between the countries. At that time the rate of one currency to another was defined by mutually agreed exchange rate. In quite a few years Foreign Exchange markets turned into the major income sources for the banks. Such renowned banking institutions as Citibank, Chase Manhattan Bank report to get their biggest revenue from currency operations.

Modern technologies made Foreign Exchange accessible to all investors. Acceleration in transfer of monetary assets and supersonic informational exchange combined with latest technological inventions made it possible to trade on Foreign Exchange even with large and small capitals (starting from \$100). So Foreign Exchange attracted a wide wave of small and big investors and this has increased the liquidity of this market (Ross, 2003).

### 2.6 Technical and Fundamental Analysis

#### 2.6.1 Fundamental analysis

Analysis of economic indicators, social factors and government policy of a business cycle. It can forecast price movement and trends of the market. The fundamentals of any country, multinational industry, or trading bloc lie in the combination of factors like social, political, and economic influences. However, it is rather hard to stay aside from all these variable factors. Therefore, the sphere of complicated and subtle market fundamental lets the explorer know and understand more details of a dynamic global market during the analyzing. Fundamental analysts use economic data that are usually separate from the security or currency

#### 2.6.2 Technical Analysis

The development of technical trading rules from observations of past price movements of the security or currency market and the individual security or currency. Technical analysis involves the examination of past market data such as prices and volumes traded which leads to an estimate of future price trends. Technical analysts believe that using data from the market itself is a good idea as market is its own best predictor (Reily & Brown, 2003)

The practice of sound operations of financial investment is a primary factor to expand the work of capital markets and increase their efficiency; as well as building sound strategies for investment, by avoiding dangers caused by the fluctuations of world currencies.

#### 2.6.3 Importance of Fundamental and Technical Analysis

Fundamental analysis in currency trading provides information of the economic situation of concerned countries along with the statistics on how big the economic and political events of a certain country influence its currency and currency market as well. Currency specialists keep a track on the reports and the statements given by the economists, experts and politicians on the currency market moves. Technical analysis is considered as the pivot of currency trading and is important for a person to trade in successfully. The analysis has to be set on the basis of certain common parameters throughout the world. There are three arenas which need to be considered for technical analysis which are market discount, trend movement of price and the tendency of trends repetition.

The importances of these indicators are summarized as follows:

- Their impact on predicting exchange rates of world currencies.
- Enhance investors' understanding the impact of fundamental factors on currency price fluctuations.
- Ability to develop new advanced investment strategies thru using amalgamated fundamental and technical indicators.
- Improve investment efficiency and earn higher profits by using financial indicators in forecasting currency prices.
- Increase the confidence of investors in global financial markets. (Kahevci & Sayilgan, 2006).

### 2.7 Previous Studies

Malabika et al(2007), have empirically tested an implied volatility function for a selected call option from the Indian Stock Market for the period Jan.-Dec. 2006. they found that implied volatility for the in – the –money options are higher than the out of – the money options . They concluded that higher prices translate into higher implied volatility and it structure a U shape smile (Malabika et al, 2007).

Ferreira(2008) has tested an ex ante uncovered interest parity(UIP) by using a survey data of exchange rates expectations from 2001 to 2007, at the Brazilian Central Bank; he used the least square method .he found that the estimated UIP parameter is less than 1, which is a common finding of his literature( Ferreira,2008).

Grenade & Moore (2007) have tested the interest rate parity hypothesis for the case of the Easter Caribbean Currency Union (ECCU) &U.S.Dollar; their test exploit the Univariate and Multivariate tests of the interest rate hypothesis. They concluded that the main policy implication of their findings is that small open economies of the ECCU are susceptible to exogenous changes in the U.S. Monetary policy (Grenade & Moore, 2007).

Oberlechner (2001) in his study of foreign currency traders in Frankfurt, London, Vienna, and Zürich, he found that that most traders use charts and conduct fundamental and technical analysis to forecast for European currencies; this supports the belief that investors use technical and fundamental analysis to help them in the forecast of foreign currency prices (Oberlechner,2001).

Aysoy & Balaban (1996) have compared between realized and implied volatility. They studied the Turkish currency prices against the U.S. dollar and German mark, for the period from 1981-1995. Study has proven that the volatility increases by less than the square root of the time factor for short periods, and increases by more than the square root of the time factor for long periods. This result is inconsistent with the random walk hypothesis, and is considered as a rejection of the model of weak market efficiency (Aysoy & Balaban ,1996)

Lui & Mole(1998) studied the use of fundamental and technical analyses by foreign exchange dealers in Hong Kong, study showed that 85% of dealers rely on both the fundamental and technical analysis, for both mid and medium terms. Also Study showed that there is reliance by dealers on technical analysis over fundamental for the short term, while this reliance disappears in the medium and long terms. The study proved that the interest rate is important in predicting future currency prices (Lui & Mole, 1998).

Doran, (2009), studied the structural relationship between implied volatility world currency prices and their currency options. Study showed that the rate of change of implied volatility of options for the short term is higher than the rate of change of implied volatility for the long term for these options (Doran, (2009).

Dumitrescu, and Dumitrescu, (2009) studied the relationship between exchange rates and interest rate differences, using the model of uncovered interest parity ("UIP"), by taking degrees of volatility of currency exchange markets and capital markets. Researchers found that the interest rate parity is not an absolute factor for the entire study period. They found that exchange rates follow the model of interest parity, and found that the relationship between interest parity rate. Research also revealed that high the degree of market volatility raises the exchange rates of low-yielding currencies and lowers the exchange rates of the high yielding currencies (Dumitrescu, H. and Dumitrescu, D.2009).

### *2.8 Importance of Study*

Study the combined effect of fundamental and technical factors combined, the factors are: interest rate, historical volatility, and moving average combined. An empirical test had been conducted to test the validity of these factors.

## **3. Methodology**

### *3.1 Sample*

Many studies on financial factors aimed to explore their effect on future prices of currencies and other financial instruments; this study is a complementary to these studies. Researchers have used and compiled data of historical exchange prices for four world currencies against U.S.Dollar, these currencies were: Swiss Franc (CH), Sterling Pound (GBP), European Euro (EUR), and Japanese Yen (JPY) for the period 2000- 2008. Exchange rates and interest rates were retrieved from Bank of Canada files. Data were compiled and segregated into four sub groups; first subgroup was of 30 day period, second subgroup was of 90 days, third subgroup was of 182 days, and the last subgroup of 365 days. These subgroups were used to calculate expected exchange rates. Sub groups of historical and calculated data were paired and empirically tested; correlation coefficient; covariance factor and F.test were measured.

### *3.2 Test Hypotheses*

Ho-1: There is no significant statistical relationship between moving average and forecasted exchange rates of international currencies.

Ho-2: There is no significant statistical relationship between interest parity and forecasted exchange rates of international currencies.

Ho-3: There is no significant statistical relationship between historical volatility and forecasted exchange rates of international currencies.

Ho-4: There is no significant statistical relationship between the factors: historical volatility, moving average and interest rate parity, combined, and forecasted exchange rates of international currencies.

### 3.3 Variables: Two Sets of Variables Are Used

#### 3.3.1 Independent Variables

- Interest rate parity:

It is interest rate differential between two countries; it is equal to the difference between forward exchange rate and spot exchange rate. It plays an essential role in foreign exchange markets; it connects interest rates, spot exchange rates and foreign exchange rates.

The interest rate parity describes how the market compensates for arbitrage, which is investors' ability to take advantage of price differences of the same things in different markets. In this case, it refers to the different prices of currency and different exchange rates. Interest parity is two types:

Covered interest parity: It refers to a condition where the relationship between interest rates and the spot and forward currency values of two countries are in equilibrium. As a result, there are no interest rate arbitrage opportunities between those two currencies.

Uncovered interest parity: A parity condition stating that the difference in interest rates between two countries is equal to the expected change in exchange rates between the countries' currencies. If this parity does not exist, there is an opportunity to make a profit.

The interrelationship between currency exchange forward rates and spot rates that result from interest rate differentials. It is given by the formula:

$$F = (1 + ib) / (1 + io) * S, \quad (1)$$

Where:

F: Future exchange rate; ib: Interest rate for base currency; io: Interest rate for other currency

S: Current exchange rate (Wei, 1991).

- Volatility

It is defined as the standard deviation of the continuously compounded return of the financial instrument, it is an unobservable variable. Volatility can help sort through the layers of analysis and guidance that pundits, proffer with regard to foreign exchange markets.

- Historical volatility is a method of measuring volatility of an underlying asset price, or relative value for a currency pair. Its estimate is based on the assumption that the volatility that prevailed over the recent past will continue to hold in the future (Chance, 2004).

It is calculated by determining the average deviation from the mean price of a financial instrument in the given time period. Standard deviation is the most common method to calculate historical volatility. It is given by the formula:

$$F = S * (1 \pm S.D/M), \quad (2)$$

Where S.D. is the standard deviation; M is the mean (Malabika et al, 2008).

- Moving Average:

It is a technical indicator used to measure the average price or exchange rate of a currency pair over a specific time frame. Moving average is used to emphasize the direction of a trend and to smooth out price and volume fluctuations that can confuse interpretation. A moving average (MA) is an average of data for a certain number of time periods. It "moves" because for each calculation, we use the latest x number of time periods' data. There are two major types of Moving Averages: "Simple" and "Exponential". For this study, simple moving average has been used; it is given by the following equation:

$$M = (S1 + S2 + \dots + Sn) \div n, \quad (3)$$

Where: S1, S2...Sn, are exchange rates for time n.

It is worth to note that the length of time calculated in a moving average is very important. Moving averages with shorter time periods normally fluctuate and are likely to give more trading signals. Slower moving averages use longer time periods and display a smoother moving average. The slower averages, however, may be too slow to enable you to establish a long or short position effectively.

- Combined Formula (Proposed):

$$F = S * \{1 \pm \sigma/M\} * (1 + ib) / (1 + io), \quad (4)$$

Where: S: is the price of base currency (U.S.Dollar)

$\sigma$ : is the standard deviation, it measures implied volatility.

M: is the moving average for the set of currency prices for the interval n.

ib: Interest rate for base currency.

io: Interest rate for other currency

F: is the forecasted exchange rate for other currency.

3.2.2 Dependent Variables: Sets of exchange prices of world currencies evaluated in U.S.Dollar, computed by using formula number (4).

#### 4. Tests

##### 4.1 Test Results

##### 4.1.1 Data Analysis

Following is a set of tables of prices of the world's currencies against the U.S. dollar, these tables show the results of using the combined model proposed, the researchers tested the average prices for periods: 360 days, 180 days, 90 days, and 30 days.

##### 4.1.1.1 Swiss Franc

Study of the Swiss franc prices of the period 30 days (CH30), 90 days (CH-90), 182 days (CH-182), 365 days (CH-365):

Table below shows prices of Swiss franc, columns show the movement of prices of Swiss Franc against the U.S. dollar, we notice the price changes with the change in moving average factor:

Insert Table 1 Here

As shown Table 1, the impact of factors, historical volatility, and interest rate factors combined on price movements of world currencies. We notice that the impact of these factors in the third period was matching what is expected, as they have improved the degree of convergence, i.e. least covariance (CH-182); Also F.Test has advocated that the third period has the highest effect of forecasted prices.

##### 4.1.1.2 Euro Currency

Study of the Euro prices for the periods 30 (EUR-30), 90 (EUR-90), 182 (EUR-182), and 365 days (EUR-365), Table (2) shows the movement of prices of EU against the U.S. dollar.

Insert Table 2 Here

As shown in table 2, we notice the impact of historical volatility and the interest rate in the price movements of the Euro currency, the degree of historical currency rates are close to those calculated. Table down shows close correlations for corresponding periods; Covariance measures show the degree of deviation from the real prices and calculated ones. For the F.Test, results show significant results except for EUR-182, so it is most probably that there were certain setbacks in this period which caused historical prices to be skewed due to certain financial instabilities or extraneous factors. There were certain swings in the degree of convergence and divergence for the four periods. Researchers think that this swing is due to the effect of extraneous factors that had negatively affected the momentum of subject factors. In reviewing the degree of correlation and co variation, two sets of prices we find that the impact of these extraneous factors had minimized the effect of the prime factors under study. Table above shows that longer periods have more coherent prices and less deviated ones which indicates that the influence of extraneous factors is minimized.

##### 4.1.1.3 GBP

Study of GBP prices for the periods 30 (GBP-30), 90 (GBP-90), 182 (GBP-182), and 365 (GBP-365)

Insert Table 3 Here

Table 3, shows the movement of prices of GBP against the U.S. dollar. Table shows correlation coefficients, ranging from 0.99412 to 0.989138; we find that the correlation for GBP-90 is the highest, while GBP-365 is the lowest. F. test also shows significant results except for GBP-365 which has low F.test result; it is most probably that there were certain setbacks in this period which caused historical prices to be skewed due to certain financial instabilities, setbacks, or some extraneous factors.

## 4.1.1.4 JPY

Study of the JPY prices for the periods 30(JPY-30), 90(JPY-90), 182(JPY-182), and 365(JPY-365):  
Table 4.shows movement of prices of JPY against the U.S.

Insert Table 4 Here

Table 4, shows a degree of convergence for the groups of historical and calculated prices. It is evident that correlation coefficient of sub-periods is higher than the full period, the same for the covariance; table shows higher readings in sub-periods more than for the full period. By comparing the degree of convergence in the above table, we can demonstrate the impact of the factors, historical volatility and the interest rate, in the price movements of world currencies, and we found that the degree of historical currency rates are close to those calculated. Above readings are likely to be more random than being ordered; i.e. the degrees of convergence and degrees of deviation fluctuate up and down in no system, we think that some extraneous factors had effected the result, it is worth mentioning that these measures were not affected by moving average factor as it is an independent factor.

## 5. Conclusions

The analyses of the study had shown a general relation between historical and calculated exchange rates of currencies: Swiss Franc, Euro, Pound Sterling and Japanese Yen against U.S. Dollar. However, there were some variations in some sub groups, i.e. moving average periods had shown more significant results than others. Tests results of were positive for most time periods, however, results included some abnormalities of covariance and correlation coefficients due to certain financial or political conditions in the countries concerned, or the intrusion of some extraneous factors that had affected the results. Examples are: F.test result for GBP-365 and EUR-182, correlation coefficient for JPY-365. Researchers noticed that the impact of financial factors included the study did not have the same impact in forecasting future currency prices; this has been noticed in some parts of study period.

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Table 1. Aggregate factors for CH-30, 90,182,365

	CH-30	CH-90	CH-182	CH-365
Correlation	0.97823	0.9897	0.99101	0.97203
Covariance	0.040588	0.03995	0.03835	0.03306
F.Test	0.22315	0.00747	0.78936	0.30179

Source: these tables were compiled by the researcher using Excel program

Table 2. Aggregate factors for EUR-30, 90,182,365

	EUR-30	EUR-90	EUR-182	EUR-365
Correlation	0.9997	0.99457	0.99637	0.99177
Covariance	0.022461	0.02318	0.022272	0.019091
F.Test	0.035842	0.02819	0.0005651	0.861147

Source: these tables were compiled by the researcher using Excel program

Table 3. Aggregate factors for GBP-30, 90,182,365:

	GBP-30	GBP-90	GBP-182	GBP-365
Correlation	0.99267	0.99412	0.99191	0.989138
Covariance	0.00491	0.004892	0.00461	0.000395
F.Test	0.06623	0.02308	0.39172	0.004398

Source: these tables were compiled by the researcher using Excel program

Table 4. Aggregate factors for JPY-30, 90,182,365

	JPY-30	JPY-90	JPY-180	JPY-365
Correlation	0.96881	0.96323	0.95252	0.6184
Covariance	51.815	51.208	48.968	34.423
F.Test	0.64768	0.51779	0.108055	0.40586

Source: these tables were compiled by the researcher using Excel program

# Determinates of Women Micro-entrepreneurship Development: An Empirical Investigation in Rural Bangladesh

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## Abstract

The paper investigates the influencing factors of women micro-entrepreneurship development in rural Bangladesh. The analysis based on empirical investigation carried out in northern part of Bangladesh. Data were collected from 248 women micro-entrepreneurs and 132 non-entrepreneurs. Present study adopts three basic aspects such as personal attributes, family affairs and external environment to evaluate their contribution towards women entrepreneurship. Applying “probit” model, the study finds among various personal attributes, freedom of work and desire for higher social status significantly influenced to participate in micro-entrepreneurship. Family hardship also turns likely to be involved in micro-entrepreneurship. Among various external factors, access to credit, access to entrepreneurship training, membership with development organizations, access to information and favorable infrastructure depicts inspiring factors in participating micro-entrepreneurship. Study also indentifies several challenging factors toward smooth development of women micro-entrepreneurship. The paper provides suggestions for strengthening women entrepreneurship development process in rural Bangladesh.

**Keywords:** Women micro-entrepreneurship, Determinates, Development, Bangladesh

*JEL Classification:* M21 O31 and J 16

## 1. Introduction

Women “entrepreneurship development” is one of the crucial issues of contemporary development agenda in many developing countries. Entrepreneurship development and empowerment are complementary to each other. Women entrepreneur can be defined as a person who has alone or with one or more partners started or inherited a business eager to take financial, administrative, and social risks and responsibilities, and participating day-to-day management activities (UNDP, 2004). Women involvement in various entrepreneurial activities has empowered them in social, economic and cultural fields. The power of and access to taking decisions has increased for women within as well as outside the family (Nawaz, 2009).



In Bangladesh, women constitutes about half of total population. The smooth development can not be attained bypassing women participation in the economic mainstreams. Realizing the importance, government of Bangladesh has distinctly provided some guidelines to strengthening women entrepreneurship development in the National Action Plan (NAP). It is noticeable that the Millennium Development Goal (MDG), the goal three (3) has proposed to promote gender equality and empower women in respect to education, employment and political empowerment. With the combined efforts of government and non-government organizations (NGOs), rural women's come forward to set up micro and small enterprises such as dairy raising, poultry rearing, petty business, handicrafts, daily hawker and so on. It is well recognized that women involvement in micro-enterprises depends on personal, socio-cultural and economic factors of a particular society. The gender discrimination that often prevails most of the societies have greater influence on women entrepreneurship development.

Concerning the matter a good number of studies have been carried out around the world focusing on micro enterprise development and women entrepreneurship. A study (as quoted in Das, 2000) of women entrepreneurs in the western world proposes three factors that influence entrepreneurship- antecedent influences (i.e., background factors such as family influences and genetic factors that affect motivation, skills and knowledge), the "incubator organization" (i.e., the nature of the organization where the entrepreneur was employed) and environmental factors (e.g., economic conditions, access to venture capital and support services, role models). These challenges are inherent in many countries some of them are more feasible in South and East Asian countries. Literature from Asian developing countries have attributed three aspects of women entrepreneurs such as "chance", "forced" and "created" (Raju, 2000; Seymour, 2001; Sharma and Dhameja, 2002; and Sinha, 2003). Chance entrepreneur means start a business without any clear goals or plans, forced entrepreneurs compelled by circumstances (e.g., death of a spouse, the family facing financial difficulties) and created entrepreneurs means "located, motivated, encouraged and developed" through entrepreneurship development programs. More importantly, Habibullah (1987) identifies training is an effective tool for entrepreneurship development in Bangladesh. Aktaruddin (1999) finds personal attributes are key factors for entrepreneurial success or failure, while Aktaruddin (2000) focuses on the socio-economic background of the entrepreneurs. Afrin et al (2008) finds that financial management skills and the group identity of the women borrowers have significant relationship with the development of rural women entrepreneurship in Bangladesh. On the other hand, Saleh (1995) study depicts, inadequate cash flows, marketing deficits and discriminating treatment from supportive service agencies create obstacles to women entrepreneurship development in Bangladesh.

Giving concentration on previous literatures, present paper aims to determine the influencing factors of women entrepreneurship development in rural Bangladesh. It is regarded that women entrepreneurship development has a close connection with entrepreneur personal attributes, family affairs and other external environment. Therefore, the study empirically investigates the catalyst of women micro-entrepreneurship development in the selected villages of Bangladesh. The article also identifies several hindering factors that create an obstacle at the beginning of women micro-entrepreneurship. The paper begins with providing some descriptive information then it determines the influencing factors of women entrepreneurship development applying econometric model and finally it identifies some challenging factors that hinder smooth development of women micro-entrepreneurship.

## **2. Methods**

### *2.1 Study Site Selection*

The foremost important part of socio-economic research is the selection of an appropriate study area and follows suitable sampling technique and data collection. The study area was selected in the northern part of Bangladesh, where agriculture is the dominating sector in the economy and women are involved in agricultural farming as well as non-farming activities. The study area comprises of twelve adjacent villages namely Chandipur, Jharuadanga, Kalkabari, Dangga, Bazarpara, Chitapara, Bara-horipur, Soto-horipur, Basirbania, Uttar-shalander, Dokhin-salander, and Dariapara of Bara-Chandipur union under Parbatipur Upazilla of Dinajpur district. The selected villages are nearby villages of the upazilla head-quarter and have a good history of micro-enterprises or non-farm activities.

### *2.2 Sampling Techniques, Sample Size and Data Collection Procedure*

Both women micro-entrepreneurs and non-entrepreneurs were chosen as samples for this study. Complete survey technique was used for selecting women micro-entrepreneurs. Two hundred sixty women micro-entrepreneurs were found in the selected villages. Out of 260 micro-entrepreneurs, data were collected from 253. In fact, it was not possible to collect data from seven entrepreneurs because they were not available during data collection period. Among 253 samples five were found incomplete; hence 248 samples were used for analysis. On the other hand, a total 132 non-entrepreneur women were interviewed from the selected cluster villages. The primary data were collected through an interview schedule from micro-entrepreneurs and non-entrepreneurs. The field investigation

was conducted in February and March, 2011. The secondary data were collected from Bangladesh Bureau of Statistics (BBS), Bangladesh Economic Review (BER), and Bangladesh Microfinance Statistics etc.

### 2.3 Analytical Techniques

Both descriptive and econometric analysis was comprehended to interpret the data. To find out the influencing factors toward women micro-entrepreneurship, the following probit regression function was fitted. Probit model helps to understand the impact of explanatory variables (personal attributes, family affairs and external environment) on the probability of participation in micro-entrepreneurship. The model was used by Panda (2009), Roodman and Morduch (2009), ADB (2007), Cheng and Ahmed (2010) and found suitable to explain the probability of participation as explanatory variables. Probit model can be written as follows:

$$Y_i = f(X_1, X_2, X_3) + e_i$$

Y= Type of women (if owner of micro-enterprise= 1, otherwise=0)

X<sub>1</sub>= Personal attributes of women

X<sub>2</sub>= Family situation

X<sub>3</sub>= External/supportive environment

Insert Table 1 Here

## 3. Results and Discussions

### 3.1 Profile of the Sample Respondent

Basic information for women micro-entrepreneurs and non-entrepreneurs are shown in Table 2. It is depicted from Table 2 that the respondents were coming from young generation, the average age was roughly 34 years in both category (entrepreneur and non-entrepreneur). Similarly, average year of schooling was also found more or less similar for both categories. On the other hand, the family size for the non-entrepreneurs household was found little bit higher compared to entrepreneur households. The average family size had 3.58 and 3.80 for entrepreneurs and non-entrepreneurs household respectively.

Table 2 shows that women were involved in five categories of micro-enterprises such as dairy/livestock raising, poultry rearing, petty business, handicrafts and daily hawker. Among various micro-enterprises, livestock/dairy raising dominated in the selected villages consisting 35 per cent, afterwards poultry rearing (19 %), petty business (18%), daily hawker (17%) and handicrafts (11 %). It is evident from the empirical study that women were involved in micro-entrepreneurship at young stage of their life (Table 2). The average age of starting micro-entrepreneurship found roughly 27 years and the standard deviation value was 0.21, justified that they were young entrepreneurs.

Insert Table 2 Here

### 3.2 Determinates of Women Entrepreneurship

The main objective of the study was to determine the influencing factors of women micro-entrepreneurship development in rural Bangladesh. Determinates of women entrepreneurship were measured based on three selected indicators such as personal attributes, family affairs and external environment. It was assumed that the mentioned three factors are main contributors toward involving micro-entrepreneurship. Among personal attributes- education, freedom of work, desire for higher income, desire for higher social status were assumed as influencing factors for participation in women micro-entrepreneurship. It was hypothesized that higher level of education, freedom to work, desire for higher income and desire for higher social status may have induced rural women to take micro-entrepreneurship as means of self employment. Similarly, family size, family hardship, death of husband/earners and motivation of family/friends may have connection with taking micro-entrepreneurship. Meanwhile, the external factors such as access to credit, access to entrepreneurship training, government policy support, membership with entrepreneur organization, access to business information and favorable business infrastructure may also have led to involve in micro-entrepreneurship. With these assumptions present study adopted binary 'probit' model to determine the influencing factors for women micro-entrepreneurship development.

The log likelihood function and the proportions of samples correctly predicted for their likely status in terms of participation indicate a good fit of the equation (Table 3). It is apparent from the coefficient value of freedom of work and desire for higher social status that women got motivation to take micro-entrepreneurship (Table 3). Those family faced hardship were likely to be involved in micro-entrepreneurship. Among various external factors, access to credit, access to entrepreneurship training, membership with development organizations, access to information and favorable infrastructure encouraged in participating women in micro-entrepreneurship. However, formal education level, desire for profit, family size, death of husband/earners, motivation of family/friends and

government policy supports were not found significant level of influence towards women entrepreneurship development although it was assumed to have somehow influence. The previous study conducted by Khan (2000) identifies following factors as influencing factors of rural entrepreneurship development in Bangladesh. These are- familial business demonstrations, training for entrepreneurial skill development, technical knowledge, fortunate in getting good advisers, fortunate in obtaining sympathetic suppliers, abundant supply of local well wishers, blessed with all types of institutional facilities & supports, availability of seed as well as working capital, favorable market contacts, Intimacy with some existing entrepreneurs. Almost similar findings of previous study obviously demonstrated the significance of present empirical study outcomes on selecting determinates of women micro-entrepreneurship development.

Insert Table 3 Here

### *3.3 Obstacles and Challenges of Women Entrepreneurship Development*

Following Table 4 shows the obstacles and challenges that women faced at starting their micro-enterprises. The standard question was asked “when you started your business, what were the main obstacles/challenges you faced?”. Ten questions related to the obstacles and challenges were asked such as lack of self-confidence, lack of start up finance, lack of information, finding the right contacts for business venture, access to business support, management skills, entrepreneurial skills, combining family and enterprise works, gender discrimination and worried about societal acceptance. The collected responses are presented in the Table 4 including priority rank.

Among various obstacles lack of entrepreneurial skills were identified most challenging factors for starting micro-enterprises by the respondents (Table 4). The remaining challenges are presented based their ranks- lack of start up finance (rank- II), gender discrimination (rank-III) management skills (rank-IV), lack of information (rank-V), access to business support (rank-VI), lack of self-confidence (rank-VII) and finding the right contacts for your business venture (rank-VIII) while combining family & enterprise works and worried about societal acceptance were jointly ranked IX. Similarly, Bhuiyan and Rubab (2007) empirical study in Bangladesh also identify following factors as challenging for women entrepreneurship development. The identified challenging factors were lack of awareness, excessive burden of work and responsibility, inadequate credit orientation, excessive tensions and managerial activities etc (Bhuiyan and Rubab, 2007). Therefore, it can be concluded that above mentioned factors are creating obstacles on smooth development of women entrepreneurship.

Insert Table 4 Here

## **4. Conclusions**

Women entrepreneurship plays a vital role in economic development. Development of women entrepreneurship largely depends on internal as well as external factors such as personal attributes of the entrepreneurs, family affairs, government and other supportive organizational involvements. Main objective of the study was to determine the influencing factors of women micro-entrepreneurship development in rural Bangladesh. Applying binary Probit model, the study found among various personal attributes, freedom of work and desire for higher social status were significantly influenced women to participate in micro-entrepreneurship. Family hardship also turned likely to be involved in micro-entrepreneurship. Among various external factors, access to credit, access to skill training, membership with development organizations, access to information and favorable infrastructure were demonstrated as inspiring factors in participating micro-entrepreneurship. On the other hand, lack of entrepreneurial skills, lack of start up finance, gender discrimination, management skills, lack of information, access to business support, lack of self-confidence, finding the right contacts for business venture, combining family and enterprise works and worried about societal acceptance were identified as major challenges that women entrepreneurs faced at starting micro-entrepreneurship as means of self-employment.

Noticeably, Bangladesh government along with non-government organizations have taken several initiatives to encourage women getting involved in various micro, small and medium enterprises. However, considering greater importance of women entrepreneurship development towards balance socio-economic development there should have rights policy adjustment, their proper implementation and others necessary initiatives. These policy supports will not only contribute significantly to national economy but will economically and socio-culturally empower women. It will also create an opportunity for rural disadvantaged to maintain their livelihood through engaging in various micro-entrepreneurships. Therefore, government and development agency should come forward to facilitate women entrepreneurs' development.

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Table 1. Description of the variables

Type of variable	Description of the variables
Dependent Variables	Ownership of microenterprise, if yes= 1 ,otherwise= 0
<b>Explanatory variables</b>	
<b>Personal attributes (X<sub>1</sub>)</b>	
Education	Continues, year of schooling
Freedom of work	Dummy, if yes= 1, otherwise=0
Desire of higher income	Dummy, if yes=1, otherwise=0
Desire of higher social status	Dummy, if yes=1, otherwise=0
<b>Family situation (X<sub>2</sub>)</b>	
Family size	continues
Family hardship	Dummy, if family having hardship=1, otherwise=0
Death of husband/wage earners	Dummy, if yes=1, otherwise=0
Motivation of family members/friends	Dummy, if yes=1, otherwise=0
<b>Supportive environment (X<sub>3</sub>)</b>	
Access to credit	Dummy, if yes=1, otherwise=0
Access to entrepreneurship training	Dummy, if yes=1, otherwise=0
Access to business information	Dummy, if yes=1, otherwise=0
Government policy supports	Dummy, if yes=1, otherwise=0
Membership with organizations	Dummy, if yes=1, otherwise=0

Table 2. Descriptive statistics of the sample household

Particulars	Type of micro-enterprise Observations=248						Non-enterprise Observations =132
	Dairy raising	Poultry rearing	Petty business	handicrafts	Daily Hawker	Total	
Respondent age	34.51 (6.58)	34.00 (6.22)	32.44 (7.28)	30.96 (8.68)	32.04 (6.24)	33.24 (6.91)	33.97 (6.53)
Respondent Education	6.76 (2.84)	6.62 (2.44)	6.53 ( 2.38)	5.29 (1.53)	6.22 (2.06)	6.44 (2.46)	6.67 ( 2.42)
Family size	3.53 (1.08)	3.68 (0.80)	3.53 (1.09)	3.59 (1.21)	3.61 (0.99)	3.58 (1.03)	3.80 ( 0.90)
Enterprise (no.)	87	48	45	27	41	248	
Enterprise (%)	35.08	19.35	18.15	10.89	16.53	100	
Enterprise starting age	28.91 (5.90)	28.97 (5.60)	25.91 (6.59)	23.70 (7.47)	24.93 (5.84)	27.15 (0.21)	

Parenthesis indicates the standard deviation

Table 3. Determinants of women micro entrepreneurship development

Variable	Coefficient	Std. Error	z-Statistic	Probability
Entrepreneur education	(0.028)	0.027	(1.035)	0.300
Freedom of work	0.151	0.294	0.512	0.608
Desire for profit	0.656	0.499	1.314	0.188
Desire for higher social status	0.081	0.189	0.432	0.665
Family size	(0.083)	0.072	(1.152)	0.249
Family hardship	0.159	0.263	0.603	0.546
Death of Husband/family member	(0.225)	0.146	(1.535)	0.124
Motivation by family members/friends	0.199	0.159	1.248	0.211
Access to credit	0.054	0.145	0.375	0.707
Access to skill training	0.048	0.142	0.338	0.735
Government support	(0.259)	0.140	(1.847)	0.064
Membership with entrepreneur organization	0.073	0.165	0.441	0.658
Access to business information	0.089	0.139	0.644	0.519
Business infrastructure	0.081	0.139	0.580	0.561
Mean dependent var.	0.652	S.D. dependent var.		0.476
S.E. of regression	0.479	Akaike info criterion		1.344
Sum squared	83.917	Schwarz criterion		1.499
Log likelihood	(240.41)	Hannan-Quinn criter.		1.406
Avg. log likelihood	(0.632)			
<b>Dependent Variable:</b> Women Micro entrepreneurship				
Method: ML - Binary Probit (Quadratic hill climbing)				
Included observations: 380				
Observations with Dep.=0	132			
Observations with Dep.=1	248			

Parenthesis indicates the negative value

Table 4. Problems and challenges of women entrepreneurship development

Problems and Challenges	Mean value	Rank
Lack of self-confidence	0.69	VII
Lack of start up finance	0.75	II
Lack of information	0.72	V
Finding the right contacts for your business venture	0.68	VIII
Access to business support	0.71	VI
Management skills	0.73	IV
Entrepreneurial skills	0.76	I
Combining family and enterprise works	0.65	IX
Gender discrimination	0.74	III
Worried about societal acceptance	0.65	IX

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