ISSN 1916-971X (Print)
ISSN 1916-9728 (Online)

International Journal of Economics and Finance

Vol. 5, No. 5 May 2013

Canadian Center of Science and Education®

Editorial Board

Contents

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

The Notion of General Value in Economics

Sergey K. Aityan[1]

[1] Lincoln University, Oakland, CA, USA

Correspondence: Sergey K. Aityan, Professor of Economics, Lincoln University, 401 15th Street, Oakland, CA 94612, USA. Tel: 1-510-628-8016. E-mail: aityan@lincolnuca.edu

Received: March 1, 2013 Accepted: March 14, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p1 URL: http://dx.doi.org/10.5539/ijef.v5n5p1

Abstract

This paper introduces the concept of general value with two components—monetary and nonmonetary. The nonmonetary component reflects individual perception of value unrelated to the monetary part of it. The fundamental difference between the concept of general value and the conventional concepts of value is in the expansion of the concept from monetary only to a more general concept by adding a distinct nonmonetary component. The paper introduces the principle of increasing general value which states that in every action or transaction the general value for each participant should increase. This principle lays the foundation for value-based decision making. To make a decision, an individual needs to assess a difference of general values before and after the action or transaction or to order values rather than to accurately calculate the values themselves. General value can be measured either rationally, similar to utility, or with "bounded rationality", as suggested in behavioral economics, or in any other way which is appropriate and convenient to use. General value in economics plays a similar role as energy in physics and can be referred to as "economic energy." General value constitutes a more comprehensive foundation of economics than traditionally used pure monetary value, and thus goes beyond the classical and neoclassical approaches.

Keywords: value, utility, bounded rationality, behavioral economics, value, theory of value, perception, choice

1. Introduction

1.1 Price and Value

Most economic theories were built on the notion of money and price. The notion of value in economics typically refers to the monetary value, i.e. money. Market demand and supply, market equilibrium, and other economic concepts typically refer to money too. Such an approach creates certain "blind spots" and "missing links" in economic theories. For example, it is commonly agreed that the general long-term strategic goal of a for-profit firm in a free market economy is the maximization of the wealth of its owners. This translates into maximization of the net present value of the firm where term "value" refers to money. (It would be a mistake to define a long-term strategic goal of a firm as profit maximization. Such a goal is quite nearsighted and could lead to wrong decisions. Profit maximization is an operational goal that indicates the value growth rate.) However when the same question is asked about not-for-profit organizations, an accurate and measurable answer is no longer available. Even in case of a for-profit firm, such a general goal of the firm looks extremely money-centric and it seems that the firm should not do anything that may not increase its monetary value because its goal is considered only from the perspective of monetary values—there is no room in this approach for charity or any free services to individuals or community.

Market models describe idealized markets with certain parameters. On the other hand, real-world markets are more diverse and their variety may not fit the constraints of idealized models. It is unfeasible to develop a model for each particular real-world market. For this reason, market models are supposed to serve reference points to approximate the behavior of the real-world markets. For example, the model of perfectly competitive market is an abstraction and such idealized markets do not exist in the real world in its pure form. However some markets are quite close to the perfectly competitive market model though somehow deviate from it. Among real-world markets farmers market is one of the closest to the model of perfect competition. According to the model of perfect competition, sellers and buyers in such a market are small enough not to influence the market equilibrium and all sellers offer uniform products with no differentiation, so buying decisions are based exclusively on price. Therefore firms in a perfectly competitive market are price takers and have to charge a uniform price. However

products or services offered by any real-world firm are different—maybe slightly but different—from products or services of other firms on the same market and for this reason may be sold at slightly different prices. For this reason the model of perfect competition works only for theoretically perfectly competitive firms and cannot be extended to a near-perfectly competitive markets without losing it meaning. Thus the model of a perfectly competitive market may become practically unusable because real-world firms cannot use its conclusions for pricing decision because every products of each firm may show slight differentiation.

Decisions on pricing strategies in different markets, analysis of consumer behavior, assessment of balance and equilibrium between different markets, and many other problems in economics, which are pursued with the traditional price-quantity approach, face significant challenges and lack of clarity.

1.2 Major Theories of Value

The notion of value plays the central role in economics. Generations of economists have developed the appropriate theories tried to define and better understand the notion of value and economic implications from it. The term "theory of value" refers to all such theories rather than to a certain specific approach in theory of value. Value is typically understood as an exchange measure and sometimes simply a price of goods and services. The variety of the theories of value can be divided into two major categories:

- Intrinsic or objective theories
- Subjective theories

Intrinsic theories are based on the classical theory of value that, following Adam Smith publication of 1776 (Smith, 2012) and David Ricardo publication of 1817 (Ricardo, 2004), suggests that prices of goods and services come from objective parameters, say, production cost rather than from subjective considerations (Hollander, 1979). Classical economics follows the labor theory of value. On the other hand, subjective theories presume that price is determined by subjective and perceptional judgments based on satisfaction of consumer desires, utility of the appropriate products or services, and the limitations in their supply. Subjective theories in neoclassical economics originated from marginalism, introduced independently by William Jevons in 1879 (Jevons, 2010), Carl Menger in 1871 (Menger, 2007), and Leon Walras in 1874 and 1877 (Walras, 2010) in the 70s of nineteenth century. Marginalism suggests that value of a good or service is determined by an additional satisfaction (marginal utility) from the most recently added unit of the good or service. Thus value represents the most recent rate of exchange. The concept of marginal utility can be easily illustrated with a diamond-water paradox which was first introduced in 1880s. In normal conditions water has a much higher practical utility for a human than diamonds, but diamonds have a higher value because marginal utility of diamonds is much higher than a marginal utility of water (Rhoads, 2007). However value of water in case of water shortage may significantly exceed the value of diamonds in terms of marginal utility because humans cannot survive without water.

Marginalism laid foundations for neoclassical economics in late nineteenth century that related market demand, supply, and equilibrium to rationality of individuals to maximize their profits or utility. The principles of neoclassical economics have become the major platform for majority of economic theories of the twentieth century. The major criticism of neoclassical approach in economics relates to the presumption of the exclusively rational behavior of market participants. A comprehensive review of neoclassical economics and its view on the concept of value is provided in recent publications (Kahn, 1979; McKenzie & Tullock, 1981; Pollis & Koslin, 1962).

Among many directions in economics, neoclassical Austrian and Chicago schools of economics made significant contributions to the development of the modern theory of value. The Austrian school traces its origin to late nineteenth century and is associated with such names as Friedrich von Wieser, Carl Menger, Eugen von Böhm-Bawerk, and Ludwig von Mises. Friedrich von Wieser in his famous book "Natural Value" (1889, 2012) introduced the imputation theory. The imputation theory argues that the price of output determines the prices of input factors. This approach is inverse to the classical labor approach (Smith, 2012; Ricardo, 2004; Hollander, 1979; Marx, 1992) by which prices of production inputs determine the price of the output. In 1871, Carl Menger argued that there was always a difference of values of present goods and future goods of equal quality, quantity, and form (Menger, 2007). According to Böhm-Bawerk (1890) there are three reasons for this difference of values: (a) in a growing economy, the supply of goods will grow with time, so it will always be higher in the future than at the present time; (b) people normally underestimate their future needs due to carelessness and shortsightedness; (c) and entrepreneurs prefer to produce with inputs currently available rather than postpone their production to wait until the inputs become available in the future. A comprehensive review of the cornerstones of the Austrian school of economics is presented by Šimon Biľo (2005).

The Chicago school of economics can be traced back to the Milton Friedman's paper "Essays in Positive Economics" (Friedman, 1953). Though both Austrian and Chicago schools agree on most major concepts of free market and capitalism, the Chicago school is known for its focus on monetarism and emphasizes the role of government in controlling amount of money in circulation. This implies that national output is affected by money supply. The Chicago school, built with a strong overlap between law and economics, has considered economic processes to be tightly related to other aspects of the society (Baker, 2003) and believed macroeconomics to be tightly related to microeconomics (Lucas, 1988). According to Ronald Coase (1937) firms are formed to reduce their costs by producing goods or rendering services internally rather than purchasing them on the market. The major commonalities and differences between the Austrian and Chicago schools and their concepts of value are clearly presented and discussed in the review published by Ludwig von Mises Institute (Murphy, 2011).

It would be quite unrealistic to expect humans to be perfectly rational in their judgments and choices. Herbert Simon (1955) brought this issue up as the major criticism of the neoclassical economic approaches and models. He suggested that market participant have "bounded rationality." Humans tend to act suboptimally and irrationally by using rules of thumb, hopes, and beliefs rather than accurate calculations. All this gave rise of a new approach called ***behavioral economics*** (Kahneman et al., 1982; Kahnemann et al, 2000; Kahnemann, 2011). According to this approach, human psychology and behavioral patterns play the major role in making judgments, choices, and decisions.

1.3 A Missing Link

Typically, fiat money, may have none or a very low commodity value but is commonly accepted only because of explicit or implicit common perception of money as value. However money is not the only value and there are other values of a nonmonetary nature which are specific to an individual, or a community, or a country, or to the entire mankind. Such nonmonetary values are completely subjective and given consideration at a time of choice, decision on action or transaction in addition to the monetary values. Though certain considerations on subjective perception of value have been given in the neoclassical economics, most discussions were focused on the perception of money and price. The notion of utility was introduced in neoclassical economics to account for perception of money but this attempt fell short of perception of nonmonetary values (Schulak & Unterkofler, 2011; Skousen, 2005; Gale & Swire, 2006).

The approach of compensating variations was introduced by Hicks (1939) as a measure of utility change in terms of additional money an individual needs to compensate for a change in price or product quality to keep the same level of satisfaction. With this approach consumer's surplus can be used as a welfare measure (Chipman & Moore, 1980). The theory of hedonic prices (Rosen, 1974) addresses the spatial equilibrium for differentiated product in which the entire set of implicit prices guides both consumers and producers locational decisions in characteristics space. This theory utilizes the hedonic hypothesis that goods are valued for their utility-bearing attributes or characteristics on the bases of the theory of equalizing differences. The theory of compensating differences has addressed the changes in utility with price, but still was confined within the concept of monetary utility.

The theory of equalizing differences (Brown, 1980; Rosen, 1986) made a step towards a separation of monetary and nonmonetary perception in labor market stated that "workers receive compensating wage premiums wben they accept jobs with undesirable nonwage characteristics, holding the worker's characteristics constant" (Brown, 1980). Dispite its attempt to separate monetary and nonmonetary perception, the theory of equalizing differences could not go beyond the labor market due to its conceptual limitations.

The principles of behavioral economics are based on human "bounded rationality" (Kahneman et al., 1982; Kahnemann et al., 2000; Kahnemann, 2011). Behavioral economics has implicitly addressed nonmonetary values by engaging subjective rules of thumb, beliefs, and hopes as major driving forces in economic decisions but still kept it closely tied up with the monetary values.

The purpose of this paper is to introduce the concept of general value that includes both, monetary and nonmonetary components as separate parts of general perception of value which could be applied to any specific market or it segment as well as to the economy in general.

2. Monetary and Nonmonetary Components of Value

2.1 General Value

According to the classical and neoclassical views, goods and services are assigned certain values. In classical economics value is understood in terms of production cost (labor theory of value) while neoclassical economics

defines value in terms of human perception of the level of satisfaction which is referred to as utility. Behavioral economics argues that humans make their decisions with limited rationality by using rules of thumb, hopes, and beliefs rather than with rational assessment of value. However there is no contradiction between those views on value. Actually humans do not need to calculate value accurately but use it only for comparison of goods or services when make decisions about exchange. An individual really needs to order the values of different goods or services to find out which one brings up a better satisfaction rather than accurately calculate the values. Such ordering is based on personal perception and is specific to each individual under given conditions. To do so, individuals may use their own subjective rules, beliefs and hopes, or quantify of the difference—rather than absolute quantity—of values of the compared goods or services.

The use of differences of values in economics is similar to the use of differences in potential energy in physics. Such an interpretation of the notion of value eliminates the apparent philosophical conflict between neoclassical and behavioral views on economic value. Thus the only reason for introduction of the notion of value is to use the difference of values for making decisions on preferences. The difference of values may be assessed either rationally or with bounded rationality.

Traditionally, the notion of value has been used in economics in its monetary meaning. However there are nonmonetary values not directly related to money or its perception. Examples of such values are individual preference to certain activities, life style, music, sciences, human relationships, and many others. Nonmonetary values contribute to human decisions along with monetary values. We define the term ***general value*** as a combination of monetary and nonmonetary values. It can be assumed that the monetary and nonmonetary components are linearly related, i.e.

$$V_k = V_k^M + V_k^N \tag{1}$$

where V_k is general value, V_k^M and V_k^N are monetary and nonmonetary components respectively, and index k identifies the individual because any judgment about value is subjective and specific to an individual. Both the monetary and nonmonetary components of value may in turn include different sub-components. For the sake of shortness, we will sometimes refer to general value simply as value.

2.2 Measuring General Value

To operate with the concept of general value it is necessary to know how to measure value and its components. The monetary component of value is traditionally measured either directly in units of money or in perception of money which is referred to as utility (Wicksteed, 1910; Stigler, 1950a, 1950b; Peterson & Lewis, 1998). Measuring monetary components of value in units of utility is more appropriate than doing it directly in the units of money because the utility approach reflects subjective perception of money by an individual. Different individuals or even the same individual in different circumstances may have different perception of the same amount of money.

It is obvious that both components of value, monetary and nonmonetary, should be measured in the same units to enable comparison of both components because they are additive components of general value. Thus we could try to measure both components, monetary and nonmonetary, in the units similar the units of utility. The concept of utility for the monetary component is quite clear and has been used since the neoclassical period in economics. The nonmonetary component of value can be measured in parity with the monetary component of value. It is usually difficult to assess the nonmonetary values in terms comparable to the monetary values. "However, using the right tools, you can infer the worth of your comparative advantages and disadvantages" (Gale & Swire, 2006).

Measuring individual perception requires certain level of conceptual clarity and consistency. Economists of many generations have been engaged in pursuing this challenging task. Many different theories were introduced to measure subjective perception of values. There are two major concepts of utility: ***cardinal utility*** and ***ordinal utility***. The concept of ***cardinal utility*** assumes that utility can be mapped to a numeric scale (Strotz, 1953) while the concept of ***ordinal utility*** (Pareto, 1906) addresses the case when the perception of a particular good or service cannot be measured using a numerical scale but can be only assessed in order of priority with alternative bundles (combinations) of goods—we can call it measuring in parity with alternatives. Another approach of dealing with consumer preferences was presented in the ***revealed preference theory*** (Samuelson, 1938) which assumes that consumers purchasing habits can reveal their preferences when consumers consider choices. Consumers may consider risky choices with different possible outcomes, decisions on which can be based on risk analysis. The model of ***expected utility*** was introduced to handle such situations (Bernoulli, 1954; Neumann & Morgenstern, 1944). Bernoulli derived his approach in the analysis of St. Petersburg lottery, often called the

St. Petersburg paradox (Bernoulli, 1954). The St. Petersburg lottery is played by flipping a fair coin until it comes up tails, and the prize is equal to the total number of flips, *n*, which equals $\$2^n$ (Martin, 2011). The expected value of the game is an infinitely high. However "few of us would pay even $25 to enter such a game" (Hacking, 1980). This paradox is based on the fact that most people do not follow a naïve decision criterion that takes only the expected value into account when possible reward is very high and possible loss is very low. Before the middle of twentieth century ***expected utility*** was called ***moral expectation***. Regardless of the mathematical expected value people may make irrational decisions to avert or to seek risk. Neumann and Morgenstern (1944) applied the game theory to expected utility. The Bernoulli approach laid foundations for the theory of ***marginal utility*** which is conventionally understood as an additional utility from an additional unit of a good or service. More accurately marginal utility is defined as a derivative of utility over the quantity of goods or services as

$$MU_k(Q) = \frac{dU_k(Q)}{dQ} \tag{2}$$

where $MU_k(Q)$ is marginal utility for individual *k* at quantity Q (money, product, services), $U_k(Q)$ is the appropriate utility, and Q is quantity of the used entity.

Utility reflects individual perception of money, goods or services. Commonly accepted values in a society could be viewed as collective aggregate utility of all individuals in the society. An aggregate collective utility of a society can be represented by a ***social welfare function*** (Bergson, 1938, 1954; Samuelson, 1938). Different choices with the same perceived utility indicate the same level of satisfaction with the choices adopted by a given society.

Critics of marginal utility in ***behavioral economics*** (Simon, 1955; Kahneman et al., 1982; Kahnemann et al, 2000; Kahnemann, 2011) argues that this concept of marginal utility is applicable to rational actors while humans normally act irrationally and their behavior is mostly based on their psychology, rules of thumb, heuristics, and behavioral patterns rather than on accurate calculations. This criticism has merits and should be taken into account.

In this paper we suggest to measure nonmonetary components by indifference parity with the monetary component. It means that if an individual is equally willing to give up a certain quantity of monetary value for a certain increment of nonmonetary value or vice versa such a transaction or action does not change the total general value, i.e.

$$\Delta V_k = \Delta V_k^M + \Delta V_k^N = 0 \tag{3}$$

Thus one can say that for any indifferent transaction or action the increment of the nonmonetary value is equal to the increment of the monetary value with the opposite sign, with the conservation of the general value, i.e.

$$\Delta V_k^M = -\Delta V_k^N \tag{4}$$

We do not expect all humans to accurately or rationally calculate components of value, though it may be the case for some individuals. The components of general value could be assessed by an individual either rationally by calculating or irrationally with "bounded rationality" by applying rules of thumb, or any other human heuristics. Different individuals may make assessments differently depending on the personal choice of each individual.

The monetary and nonmonetary components of general value can be assessed in many different ways, rational or irrational. The major point of this approach is that individuals are somehow able to assess perceived differences of the components of general value, ΔV_k^M and ΔV_k^N, for the given choices in their own way. In conclusion, it should be mentioned that all components of general value are measured in units of individual perception which may be different for different individuals and even for the same individual in different circumstances.

3. Principle of Increasing Value, Transaction Power, and Efficiency

3.1 Principle of Increasing Value

Every transaction is an exchange of values between participants. However there are some other activities outside the scope of transactions, i.e. activities which are not associated with exchange, for example, a choice of action. Any activity, either associated with an exchange or not, is referred to as action. Each participant makes a decision to pursue with an action if the resultant value (the general value after the action) for this participant is higher or at least not less than the initial value (the general value before the action), i.e.

$$V_k^{after} \geq V_k^{before} \quad \text{or} \quad \Delta V_k = V_k^{after} - V_k^{before} \geq 0 \tag{5}$$

for each participant k of the action. The difference between values after and before the action ΔV_k is referred to as the added value for the action undertaken by the participant. This statement can be paraphrased as: in result of any action the added value should grow or at least stay unchanged.

Actions resulted in a positive added value are referred to as positive actions while actions resulted in a zero added value are referred to as neutral actions. Sometimes an action may result in a negative monetary value. However, it does not contradict the principle of increasing value because, if an individual decides to pursue with the action despite a loss in the monetary value, it means that the nonmonetary value of this action increases sufficiently enough to offset the loss of the monetary value in the added general value in this transaction to make the increment of the general value positive or at least zero. For example, any charity action leads to a monetary lose for the charity giver. However the entire general value in that action increases due to a high nonmonetary component of the general value.

3.2 Transaction Power and Efficiency

Any transaction increases values for all involved parties or at least not to reduce them. Let's consider a transaction between two participants and introduce the term ***transaction power*** which we define as the total added value for all participants of the transaction, i.e.

$$W = \Delta V_1 + \Delta V_2 \tag{6}$$

where W is the transaction power and ΔV_1 and ΔV_2 are the added values of participants 1 and 2 in the transaction. It is obvious from the definition in Eqs. (5) and (6) that all positive transactions have positive transaction power, i.e. $W > 0$ while all neutral transactions have zero transaction power, i.e. $W = 0$.

However the participants may receive different added values from their transaction. A fair transaction is understood as a transaction where both participants get the same added value. On the other hand, we consider a transaction unfair if the added value of one participant in much higher than the added value of another participant. The less difference between the added values of the transaction for both participants the more fair is the transaction. We introduce the term ***transaction efficiency*** which reflects a degree of fairness of a transaction. The transaction efficiency is measured in terms of closeness of the added values for both participants, i.e.

$$E = 4\frac{\Delta V_1 \Delta V_2}{(\Delta V_1 + \Delta V_2)^2} = 4\frac{\Delta V_1 \Delta V_2}{W^2} \tag{7}$$

where E is the transaction efficiency.

According to the definition in Eq. (7), transaction efficiency is a parameter in the range between zero and one, i.e. $E \in [0,1]$. If both participants of a transaction receive equal added values, then $E = 1$ and such a transaction is called perfectly efficient. It means that the transaction is considered the most fair. On the other hand, in the extreme case when one participant receives no added value while the other one receives a nonzero added value, the transaction is called extremely inefficient and its efficiency equals zero, $E = 0$, and the transaction is considered extremely unfair.

Assume that the added value of participant 1 is α-times higher than the added value of participant 2, i.e.

$$\Delta V_1 = \alpha \Delta V_2 \tag{8}$$

Then by the definition of transaction efficiency given in Eq. (7) one can conclude that efficiency of this transaction

$$E = 4\frac{\alpha}{(\alpha + 1)^2} \tag{9}$$

If $\alpha = 1$, it means that the transaction is fair, i.e. $\Delta V_1 = \Delta V_2$, the transaction is perfectly efficient, i.e. $E = 1$. If $\alpha = 0$ ($\Delta V_1 = 0$ and $\Delta V_2 > 0$) or $\alpha = \infty$ ($\Delta V_1 > 0$ and $\Delta V_2 = 0$), then the transaction is extremely inefficient. We will not apply the term efficiency to neutral transactions because no added value is produced in such transactions.

3.3 Analogy with Physics

Money in economics may play a similar role as energy in physics. (Ksenzhek, 2007; Aityan, 2011). This paper extends the analogy between general value in economics and energy in physics. To go along with this analogy, it would be reasonable to assume that each transaction or action tends to bring an economic system to a state with the highest added value similarly to a trend of physical system to get to a state with the lowest potential energy in static equilibrium. If go beyond the monetary interpretation of value, the general value may play a similar role in economics as energy in physics where money or monetary utility is just one of the components of the "***economic***

energy."

It may be the case that the current turmoil in global economy caused by certain lack and dissipation of economic energy on the global scale. This angle of view is yet to be pursued and analyzed.

4. Special Cases and Examples

The following cases and examples are intended to illustrate and clarify the concept of general value.

4.1 Job Selection

If job *A* offers compensation S^A expressed in dollars, then the general value of this job for individual *k* is

$$V_k^A = U_k(S^A) + V_k^{NA} \tag{10}$$

where $U_k(S^A)$ is the monetary value of amount S^A and V_k^{NA} is the nonmonetary value of job *A* for individual *k*. The nonmonetary value of the job is measured in the same units as the monetary value for the individual, which could be interpreted in terms of parity with the monetary value. Monetary value can be measured either in terms of utility or in any other terms convenient for the individual, rationally or with bounded rationality. In some cases for the sake of simplicity we may consider neutral monetary value similar to neutral utility, $U(W) = W$, i.e. perception of money to be equal to the amount. Suppose the same individual is offered another job *B* with compensation S^B and nonmonetary value V_k^{NB}, so the total (general) value of this job is

$$V_k^B = U_k(S^B) + V_k^{NB} \tag{11}$$

The individual will take a job which has the highest total value. The difference between values of job *A* and *B* for the individual is

$$\Delta V_k^{AB} = V_k^A - V_k^B = \left(U_k(S^A) - U_k(S^B)\right) - \left(V_k^{NA} - V_k^{NB}\right) = \Delta V_k^{MAB} + \Delta V_k^{NAB} \tag{12}$$

where $\Delta V_k^{MAB} = U_k(S^A) - U_k(S^B)$ is the difference of monetary values of jobs *A* and *B* and $\Delta V_k^{NAB} = V_k^{NA} - V_k^{NB}$ is the difference of nonmonetary values of these jobs for the individual. Note that, in general, $U_k(S^A) - U_k(S^B) \neq U_k(S^A - S^B)$. Suppose job *A* offers a lower compensation than job *B*, i.e. $\Delta V_k^{MAB} < 0$ but the nonmonetary value of job *A* is higher than the nonmonetary value of job *B*, i.e. $\Delta V_k^{NAB} > 0$ in such a way that total difference of values of jobs *A* and *B* is in favor to job *A*, i.e. $\Delta V_k^{AB} > 0$. Then the individual will choose job *A* over job *B*. If for another individual the monetary value of job *A* is not as high compare to nonmonetary value of job *B*, then that individual will chose job *B*.

An Example

Suppose business graduate is offered a job of business analyst (job *A*) with annual compensation \$60K. The same graduate is also offered another job of a garbage processing operator (job *B*) with the same annual compensation. For the sake of simplicity we do not consider other benefits offered by the employers. The graduate chooses job *A* because he likes it better. It means that

$$\Delta V_k^{AB} = \Delta V_k^{MAB} + \Delta V_k^{NAB} > 0 \tag{13}$$

where the difference between monetary values of these jobs equals zero, $\Delta V_k^{MAB} = 0$, because of equal compensations for both jobs while the difference of nonmonetary values of these jobs is in favor of job *A* for this particular individual, $\Delta V_k^{NAB} > 0$.

Suppose that the compensation for job *B* is now increased to \$100K. Assume that in this situation, the graduate is not sure which job to choose. It occurs because the difference of the monetary values of jobs *A* and *B* is high enough in favor of job *B* in the perception of the graduate, $\Delta V_k^{MAB} < 0$, to compensate for the lower nonmonetary value of job *B* in comparison to job *A*, $\Delta V_k^{NAB} > 0$, i.e. both jobs in the perception of the graduate have equal general values, so

$$\Delta V_k^{AB} = \Delta V_k^{MAB} + \Delta V_k^{NAB} = 0 \tag{14}$$

Suppose the compensation for job *B* is now \$200K. Most likely, the graduate will choose job *B* because the difference of the monetary values of jobs *A* and *B* is too high to overtake the higher nonmonetary value of job *A* in comparison with job *B*, i.e.

$$\Delta V_k^{AB} = \Delta V_k^{MAB} + \Delta V_k^{NAB} < 0 \tag{15}$$

In result, we can conclude that difference of nonmonetary values of these two jobs for that particular person is

$$\Delta V_k^{NAB} = -U_k(\$60K) + U_k(\$100K) \tag{16}$$

because according to Eq. (14) the individual is indifferent (equally satisfied) about the jobs when compensation for job *A* is \$60K and for job *B* is \$100K.

Let's assume this particular individual has a neutral perception of money, i.e. $U_k(S) = S$ at the time of choice, so the difference between nonmonetary values of job *A* and *B* is

$$\Delta V_k^{NAB} = -U_k(\$60K) + U_k(\$100K) = -\$60K + \$100K = \$40K \tag{17}$$

where $U_k(\$60K) = \$60K$ and $U_k(\$100K) = \$100K$. It means that the difference of nonmonetary values of jobs *A* and *B*, ΔV_k^{NAB}, is equal to the difference of compensations for the jobs with the opposite sign, $-\Delta V_k^{MAB}$, in case of the indifferent choice.

4.2 Transaction Decision

Individual *k* comes to a bakery to buy a loaf of bread at price *P*. Before the act of exchange (purchase), the individual has the money and the baker (denote him with index *n*) has the bread. Thus the individual and the baker have the following values before the transaction

$$V_k^{before} = U_k(P) \text{ and } V_n^{before} = V_n^{Bread} \tag{18}$$

and after the transaction their values are

$$V_k^{after} = V_k^{Bread} \text{ and } V_n^{after} = U_n(P) \tag{19}$$

The added values in this transaction for the individual and the baker are

$$\Delta V_k = -U_k(P) + V_k^{Bread} \geq 0 \text{ and } \Delta V_n = U_n(P) - V_n^{Bread} \geq 0 \tag{20}$$

Both parties, the individual and the baker, agree on the transaction if the added values for both are positive. It means that value of having the loaf of bread for the individual is higher than the value of amount of money *P* while for the baker the value of amount *P* is higher than the value of the bread. Neither the individual nor the baker agree to do the transaction if in result they lose value.

The total transaction power is

$$W = \Delta V_k + \Delta V_n = U_n(P) - U_k(P) + V_k^{Bread} - V_n^{Bread} \geq 0 \tag{21}$$

and the transaction efficiency is

$$E = \frac{\Delta V_k \Delta V_n}{\left(\Delta V_k + \Delta V_n\right)^2} = \frac{\left(-U_k(P) + V_k^{Bread}\right)\left(U_n(P) - V_n^{Bread}\right)}{\left(U_n(P) - U_k(P) + V_k^{Bread} - V_n^{Bread}\right)^2} \tag{22}$$

4.3 Buying Choice

Suppose individual *k* considers buying a pair of shoes. There are two different pairs of shoes *A* and *B* at prices P^A and P^B, respectively, available in the store. If the individual buys shoes *A* or *B* his added value will be

$$\Delta V_k^A = -U_k(P^A) + V_k^{NA} \text{ and } \Delta V_k^B = -U_k(P^B) + V_k^{NB} \tag{23}$$

The monetary part in the added value comes from the price paid by the individual for the shoes. It is included in the added value with the negative sign because it is part of the value the individual had before the transaction, i.e. the money which the individual paid for the shoes. On the other hand, V_k^{NA} and V_k^{NB} are the nonmonetary values for the individual of having shoes *A* and *B* appropriately. These components of value are added with the positive sign because it is the acquired value after transaction as shown below.

$$\begin{aligned} V_k^{A\,before} &= -U_k(P^A) \\ V_k^{A\,after} &= V_k^{NA} \end{aligned} \quad \text{and} \quad \begin{aligned} V_k^{B\,before} &= -U_k(P^B) \\ V_k^{B\,after} &= V_k^{NB} \end{aligned} \tag{24}$$

The individual makes a buying decision based on the added value rather than on the price only. For simplicity, we consider neutral monetary utility, i.e. $U_k(P) = P$ for individual *k*. Suppose shoes *A* are more expensive than

shoes B, i.e. $P^A > P^B$, but both prices are within the individual's budget for shoes. On the other hand, if the individual likes shoes A better than shoes B, that the difference of the nonmonetary values of this shoes for individual k is higher than the inverse difference of the monetary values, so the added value of shoes A as higher than the added value of shoes B, i.e. $\Delta V_k^A > \Delta V_k^B$ then the individual buys shoes A.

If the same individual has limitations of money he can spend on shoes, then a certain difference in prices $P^A - P^B$ may project to a greater difference in monetary components of value $U_k(P^A) - U_k(P^B)$, which in turn may lead to $\Delta V_k^A < \Delta V_k^B$ then individual k makes a decision to buy shoes B.

4.4 Trade Decision

Suppose party k trades with party n. Party k trades product A for product B of party n. Both products have different monetary and nonmonetary values for each parties. Products A and B could be, for instance, collectible ancient golden and silver coins which have monetary (market) values, and nonmonetary (personal collectible) values. The monetary value of the coin goes beyond just commodity value of it but is defined by the market value of the coin which includes its overall collectible value. Personal collectible value may come, for instance, from the fact that the collection of individual k is missing coin B that creates some additional value of the coin for individual k. Let's for simplicity presume that both traders, k and n have neutral utility for money, i.e. $U_k(P) = U_n(P) = P$. Before the trade the parties have the following values

$$V_k^{before} = P^A + V_k^{NA} \text{ and } V_n^{before} = P^B + V_n^{NB} \tag{25}$$

After the trade the values of these parties will be

$$V_k^{after} = P^B + V_k^{NB} \text{ and } V_n^{after} = P^A + V_n^{NA} \tag{26}$$

where V_k^{NA}, V_k^{NB}, V_n^{NA}, and V_n^{NB} are the nonmonetary values of coins A and B for parties k and n. Parties A and B will be willing to do the trade if

$$\begin{aligned} \Delta V_k &= V_k^{after} - V_k^{before} = V_k^{NB} - V_k^{NA} - \Delta P^{AB} \geq 0 \\ \Delta V_n &= V_n^{after} - V_n^{before} = V_n^{NA} - V_n^{NB} + \Delta P^{AB} \geq 0 \end{aligned} \tag{27}$$

where $\Delta P^{AB} = P^A - P^B$ represents the difference in monetary values between products A and B. Thus party k and party n are willing to pursue with the trade if both parties increase or at least keep unchanged their values, i.e.

$$\begin{aligned} V_k^{NB} - V_k^{NA} &\geq \Delta P^{AB} \\ V_n^{NA} - V_n^{NB} &\geq -\Delta P^{AB} \end{aligned} \tag{28}$$

If both coins have the same monetary (market) values, i.e. $P^A = P^B$ or $\Delta P^{AB} = 0$, then the transaction will take place if party k likes coin B better than coin A and party n likes coin B better than coin A. It may occur if party k misses coin B in his collection and party n misses coin A in his collection or for many other reasons unrelated to the market value of the coins.

4.5 My Kingdom for a Horse

In Richard III, a history play by Shakespeare, King Richard III being unhorsed in a climax of a battle cried out, "*A horse, a horse, my kingdom for a horse!*" Let's analyze this from the point of view of general value.

The general value of a horse in a perception of the king, V_k^H, is

$$V_k^H = U_k(P^H) + V_k^{NH} \tag{29}$$

where P^H is the market price of the horse, $U_k(P^H)$, is the utility of the price for the horse in a perception of the king, and V_k^{NH} is the nonmonetary value of this horse for the king. The general value of the kingdom for the king is V_k^K which is very high but limited. We will not even divide it into monetary and nonmonetary because it is not necessary for the purpose of this example.

The general value of the horse V_k^H and the general value of his kingdom V_k^K for Richard III in a normal situation are related as $V_k^H << V_k^K$ and for this reason the king does not even consider trading his kingdom for a horse. However when his life became threatened in the battle, the perceived nonmonetary value of a horse $\overline{V_k^H}$ significantly exceeded the value of his kingdom, $\overline{V_k^H} > V_k^K$, and for this reason trading the kingdom for a horse became a viable idea for him.

4.6 Gresham's Law

The well-known Gresham's law reads that "*bad money drives good money out of circulation.*" Let's analyze this law from the point of view of general value. Suppose there are two types of money, money *A* and *B*, and all people have similar perception of the both components of value. The general value V^{α} of money α (α = *A*, *B*) is

$$V^{\alpha} = V^{\alpha,Nom} + V^{\alpha,Comm} + V^{N\alpha} \tag{30}$$

where $V^{\alpha,Nom}$ is the nominal value, $V^{\alpha,Comm}$ is the additional commodity value, and $V^{N\alpha}$ is the nonmonetary value of money α. Both, nominal and commodity values belong to the monetary component of value. The nonmonetary value of money may come from its condition (a crispy bill or a shiny coin), antiquity (coin age), or collectability (rareness and show quality) or any other features.

4.6.1 Fiat Money versus Commodity Money

Suppose money *A* is paper (fiat) money and money *B* is gold (commodity) money. Both paper and commodity money have the same nominal value, different commodity values, and the same (maybe zero) nonmonetary value i.e.

$$V^{A,Nom} = V^{B,Nom};\ V^{A,Comm} < V^{B,Comm};\ V^{NA} = V^{NB} \tag{31}$$

and thus

$$V^{A} < V^{B} \tag{32}$$

The assumption of equal nonmonetary values of both kinds of money in this example is taken only for the purpose of simplicity.

According to the differences in general values of paper and gold money, we definitely prefer to use paper money and keep gold money, i.e. to use the money with the lower general value and keep the money with the higher general value. It proves the Gresham's law from the perspective of general value.

4.6.2 Crisp Bills versus Worn Bills

You may recall a situation when paying in stores you prefer to pay with worn bills and keep new crispy bills of the same nominal value. Both crisp, *A*, and worn, *B*, bills have the same nominal value, equal and actually none commodity values, and different nonmonetary values because we just prefer crispy bills in our valet. It means

$$V_k^{A,Nom} = V_k^{B,Nom};\ V_k^{A,Comm} = V_k^{B,Comm};\ V_k^{NA} > V_k^{NB} \tag{33}$$

where $V_k^{X,Nom}$, $V_k^{X,Comm}$, V_k^{NX} are the nominal, commodity, and nonmonetary values of bill *X* correspondently. The nominal and commodity values constitute the monetary component of the general value. The difference between nonmonetary values of crisp and worn bills can be explained by a simple fact that we like crisp bills better than worn bills. It makes the general value of crisp bills higher than the general value of the worn ones,

$$V^{A} > V^{B} \tag{34}$$

Thus according to the difference in general value, we keep crisp bills and pay with worn ones.

5. Isovalue

If all jobs offer considered in the example in section 4.1 above have the same general value $V_k^A = V_k^B = ... = V_k^Z$ while their monetary (offered compensations) and nonmonetary components are different, then individual *k* will be indifferent (equally satisfied) in choosing any job from the given jobs. The jobs which offer the same general value constitute an *isovalue* curve in the space of monetary and nonmonetary values. In case of linear relationship between monetary and nonmonetary components of the general value as in Eq. (1), *isovalues* form a set of parallel lines, one for each level of general value as shown in Figure 1.

For instance, if an individual equally considers two jobs, one with monetary value (annual compensation) $V_k^{MA} = U_k(S^A) = U_k(\$60K)$ and another with $V_k^{MB} = U_k(S^B) = U_k(\$100K)$, it means that the difference of monetary values of jobs *A* and *B*, $\Delta V_k^{MAB} = V_k^{MA} - V_k^{MB}$, is compensated by the difference of nonmonetary values of this jobs, $\Delta_k^{NAB} = V_k^{NA} - V_k^{NB}$, as $\Delta V_k^{NAB} = -\Delta V_k^{MAB}$. It means that we may be equally satisfied with different jobs even if one of them pays less than another just because we like the first job better. Most likely, most of us have faced a similar dilemma in our lives.

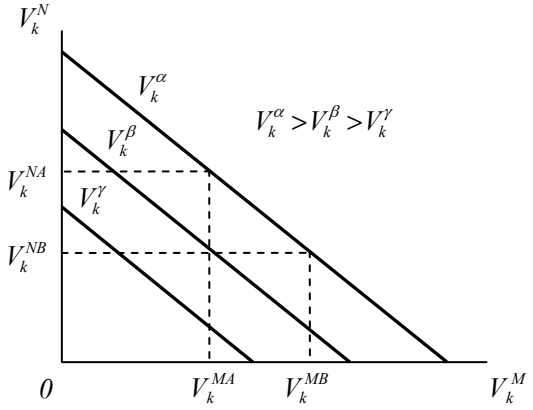

Figure 1. Isovalues in the monetary-nonmonetary space

6. Business Analysis

The concept of general value can be easily applied to business analysis.

6.1 The General Goal of a Business

6.1.1 Traditional View

The general goal of a for-profit business is typically defined as maximization of the owners' wealth which translates into maximization of the net present value of the business, where value is traditionally understood in its monetary meaning. This is a quite crisp and measurable definition. However when we talk about a not-for-profit organizations, the definition of the general goal of such an organization becomes quite vague, fuzzy, and non-measurable. Moreover, if we talk about a for-profit company, the traditional definition of the general goal gets in conflict with social and charitable activities of the company. It leads to a conclusion that as any social and charitable activity results in a monetary loss, such an activity should be avoided. It is clear that such an approach suffers serious deficiency.

6.1.2 View from General Value

Let's consider general value of a business as a combination of the monetary and the nonmonetary components, as

$$V_k = V_k^M + V_k^N \tag{35}$$

where index k identifies the perception of the company management team. The general goal of the company is defined as maximization of the net present general value of it. This definition fits all, for-profit companies, not-for-profit organization, and any combination of them. In an extreme case of a "completely greedy" for-profit company the nonmonetary component of the general value equals zero and the company should be concerned only about monetary value as in a traditional approach. In an extreme case of a pure not-for-profit organization the monetary component of the general value equals zero and the organization should maximize its net-present general value by maximizing only net present nonmonetary part of it. For a real-world for-profit company maximization of net present general value includes both components. It means that the company may give up some monetary gains for nonmonetary gains to maximize the net total general value. Most for-profit companies are engaged in free-of-charge social services and charities. The tradeoff between monetary and nonmonetary components depends on the company's perception of value. If a company believes that additional benefits for its employees, which do not directly translate into the company profit, add more to the company general value than the monetary gain given up for such benefits, the general value of the company grows and the company goes for it in accordance to its general goal and the company's perception of values. A similar consideration could be given to any company or organization regardless of whether it is a for-profit company or a not-for-profit organization.

6.2 Opportunity Decisions

Suppose individual k has to make a decision either to go to a theater or to do some work for money. If the individual goes to the theater, he has to pay \$100 for a ticket but, if the individual decides to work, he will make

$150. What does drive the individual's decision?

The general value of going to the theater is

$$V_k^T = -P^T + V_k^{NT} \tag{36}$$

where P^T is the price of a theater ticket (monetary value) and V_k^{NT} is the nonmonetary value of enjoying a play in the theater for individual *k*. On the other hand, the value of going to work is

$$V_k^W = P^W + V_k^{NW} \tag{37}$$

where P^W is the compensation (monetary value) the individual gets for that period at work and V_k^{NW} is the nonmonetary value for individual *k* of enjoying work ($V_k^{NW} > 0$) or hating it ($V_k^{NW} < 0$), or being neutral to it ($V_k^{NW} = 0$). The difference between general values of going to the theater and going to work is

$$\Delta V_k^{TW} = V_k^T - V_k^W = -P^T - P^W + V_k^{NT} - V_k^{NW} \tag{38}$$

Thus if $\Delta V_k^{TW} > 0$, then the individual makes a decision to go to the theater but if $\Delta V_k^{TW} < 0$ then the individual chooses to go to work. If $\Delta V_k^{TW} = 0$ then the individual is indifferent about the choice of action. Monetary values in Eqs. (36) – (38) for the sake of simplicity were expressed in money rather than in perception of money.

For example, many teachers are giving extra classes to their students without additional compensation, just because they see a high nonmonetary value of this activity. Very often, teachers give up their entertainment and come to schools to give their students extra classes. If a teacher does not see a sufficient nonmonetary value of this action, this teacher would not do it.

7. Difference between the Concepts of General Value and Utility

Critics of the suggested approach may argue that the concept of general value is identical to the concept of utility. Actually, both concepts address humans' individual perception. However there is a fundamental difference between these two concepts. First of all, the concept of utility applies to the perception of consumption or usage of money, goods, or services related to a transaction or an exchange while the concept of general value may apply to the monetary and nonmonetary perception regardless of usage or consumption and does not necessary imply a transaction or an exchange. Secondly, the distinction between monetary and nonmonetary components of value provides a clear approach that separates monetary perception related to a transaction or exchange from the nonmonetary perception of value. The nonmonetary component of value reflects a subjective perception independent of the monetary part. Thirdly, the approach of general value provides a more explicit and a less speculative way of assessment of subjective perception of a broader variety of entities in economics as it was illustrated in the examples in section 4 above.

8. Conclusion

This paper introduced the concept of general value that consists of two components—monetary and nonmonetary. The nonmonetary component of value reflects individual perception unrelated to the perception of monetary part of value. Both components of value can be measured in units of human perception either rationally similar to units of utility or with "bounded rationality" as suggested in behavioral economics, or in any other units which are appropriate and convenient to use. The fundamental difference between the concept of general value and conventional concept of value is in a separation of values unrelated to money from the values related to money. Both monetary and nonmonetary components of general value represent two sides of the perception of value.

To operate with the notion of general value one has to be able to compare monetary and nonmonetary components for a single actor (an individual or a group of individuals) and compare values of different actors rather than accurately measure them. To make a decision an individual needs to assess a difference or to order values rather than to accurately calculate the values themselves. Actors are not expected to be completely rational as assumed in neoclassical economics and may act with "bounded rationality" as assumed in behavioral economics.

Every action or transaction decision obeys the principle of increasing the general value of every participant. General value, is believed, constitutes a more comprehensive foundation of economics than traditionally accepted pure monetary value.

General value in economics plays a similar role as energy in physics. This analogy may be extended to the principles of equilibrium. It would be reasonable to assume that each transaction or action tends to bring an economic system to a state with the highest added value similarly to a trend of physical system to get to a state with the lowest energy in equilibrium. Thus we can call general value "economic energy."

The concept of general value goes beyond the classical and neoclassical views on value. The approach of general value helps make judgments and make decisions in a much broader scale of situations than just in market exchange.

The concept of general value provides a solid foundation for analysis of fundamental processes and decisions in economics for which the neoclassical concept of utility falls short of conceptual integrity and clarity.

Acknowledgements

The author greatly appreciates Prof. Daniel Sevall and Prof. Octavian Ksenzhek for the valuable discussions and constructive criticism of the proposed notion of general value.

References

Aityan, S. K. (2011). Price-Value Potential for Near-Perfectly Competitive Markets. *American Journal of Economics and Business Administration*, *3*(4), 623-635. http://dx.doi.org/10.3844/ajebasp.2011.623.635

Becker, G. S., & Murphy, K. M. (2003). *Social Economics: Market Behavior in a Social Environment*. Harvard University Press.

Bergson, A. (1938). A Reformulation of Certain Aspects of Welfare Economics. *Quarterly Journal of Economics*, *52*(2), 310-334. http://dx.doi.org/10.2307/1881737

Bergson, A. (1954). On the Concept of Social Welfare. *Quarterly Journal of Economics*, *68*, 233-252. http://dx.doi.org/10.2307/1884448

Bernoulli, D. (1954). Exposition of a New Theory on the Measurement of Risk. *Econometrica*, *22*(1), 23-36. (Original work published 1738). http://dx.doi.org/10.2307/1909829

Biľo, Š. (2005). *Imputation and Value in the Works of Menger, Böhm-Bawerik and Wieser*. The Ludwig von Mises Institute. Retrieved from http://nb.vse.cz/kfil/elogos/miscellany/bilo105.pdf

Böhm-Bawerk, E. (1890). *Capital and Interest: A Critical History of Economical Theory*. London: Macmillan. (first published in 1884).

Brown, C. (1980). Equalizing Differences in the Labor Market. *Quarterly Journal of Economics*, *94*(1), 113-134. http://dx.doi.org/10.2307/1884607

Chipman, J. S., & Moore, J. C. (1980). Compensating Variation, Consumer's Surplus, and Welfare. *American Economic Review*, *70*(5), 933-949.

Coase, R. (1937). The Nature of the Firm. *Economica*, *4*(16), 386-405. http://dx.doi.org/10.1111/j.1468-0335.1937.tb00002.x

Friedman, M. (1953). *Essays in Positive Economics*. Chicago: University of Chicago Press.

Gale, B. T., & Swire, D. J. (November 2006). Value-Based Marketing & Pricing. *Working Paper of Customer Value, Inc.*, 1-19. Retrieved from http://www.cval.com/pdfs/VBMarketingAndPricing.pdf

Hacking, I. (1980). Strange Expectations. *Philosophy of Science*, *47*, 562-567. http://dx.doi.org/10.1086/288956

Hicks, J. R. (1939). *Value and Capital: An Inquiry into some Fundamental Principles of Economic Theory*. Oxford: Clarendon Press.

Hollander, S. (1979). *The Economics of David Ricardo*. Heinemann Educational Publishers.

Jevons, W. S. (2010). *The Theory of Political Economy*. Kessinger Publishing. (Original work published 1879).

Kahn, A. E. (1979). Applications of Economics to an Imperfect World. *American Economic Review*, *69*(2), 1-13.

Kahneman, D., & Tversky, A. (2000). *Choices, Values, and Frames*. Cambridge: University Press.

Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment under Uncertainty: Heuristics and Biases*. Cambridge: Cambridge University Press.

Kahnemann, D. (2011). *Thinking, Fast and Slow*. Farrar, Straus and Giroux.

Ksenzhek, O. (2007). *Money: Virtual Energy: Economy Through the Prism of Thermodynamics*. Universal Publishers.

Lucas, R. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics*, *22*(1), 3-42. http://dx.doi.org/10.1016/0304-3932(88)90168-7

Martin, R. (2011). The St. Petersburg Paradox. In Edward N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2011 ed.). Retrieved from http://plato.stanford.edu/archives/win2011/entries/paradox-stpetersburg/

Marx, K. (1992). *Capital: A Critique of Political Economy* (Vols 1-3). Penguin. (Original work published 1867).

McKenzie, R. B., & Tullock, G. (1981). *The New World of Economics: Explorations into the Human Experience* (Chaps. 2, 20). New York: Irwin.

Menger, C. (2007). *Principles of Economics*. CreateSpace. (Original work published 1871).

Murphy, R. P. (2011). *The Chicago School versus the Austrian School*. Ludvig von Mises Institute. Retrieved from http://mises.org/daily/5390/The-Chicago-School-versus-the-Austrian-School

Pareto, V. (1906). *Manuale di Economia Politics, con una Introduzione ulla Scienza Sociale*. Societa Editrice Libraria.

Peterson, C. H., & Lewis, W. C. (1998). *Managerial Economics* (4th ed.). Prentice Hall.

Pollis, A., & Koslin, B. L. (1962). On the Scientific Foundations of Marginalism. *American Journal of Economics & Sociology*, *21*(2), 113-130. http://dx.doi.org/10.1111/j.1536-7150.1962.tb00829.x

Rhoads, S. E. (2007). *Concise Encyclopedia of Economics* (*Marginalism*). D. R. Henderson (Ed.). Liberty Fund, Inc.

Ricardo, D. (2004). *The Principles of Political Economy and Taxation*. Dover Publications (Original work published 1817).

Rosen, S. (1974). Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy*, *82*(1), 34-55. http://dx.doi.org/10.1086/260169

Rosen, S. (1986). The theory of equalizing differences. *Handbook of Labor Economics* (Chapter 12), *1*, 641-692. http://dx.doi.org/10.1016/S1573-4463(86)01015-5

Samuelson, P. (1938). A Note on the Pure Theory of Consumers' Behaviour. *Economica*, *5*, 61-71. http://dx.doi.org/10.2307/2548836

Schulak, E. M., & Unterköfler, H. (2011). *Austrian School of Economics*. Ludwig von Mises Institute.

Simon, H. A. (1955). A Behavioral Model of Rational Choice. *Quarterly Journal of Economics*, *69*, 99-118. http://dx.doi.org/10.2307/1884852

Skousen, M. (2005). *Vienna & Chicago, Friends or Foes?: A Tale of Two Schools of Free-Market Economics*. Capital Press.

Smith, A. (2012). *The Wealth of Nations*. Simon & Brown (Original work published 1776).

Stigler, G. J. (1950a). The Development of Utility Theory, I. *Journal of Political Economy*, *58*(4), 307-327. http://dx.doi.org/10.1086/256962

Stigler, G. J. (1950b). The Development of Utility Theory, II. *Journal of Political Economy*, *58*(5), 373-396. http://dx.doi.org/10.1086/256980

Strotz, R. (1953). Cardinal Utility. *American Economic Review*, *43*(2), 384-397.

Von Mises, L. (2012). *The Theory of Money and Credit*. Snowball Publishing. (Original work published 1912).

Von Neumann, J., & Morgenstern, O. (1944). *Theory of Games and Economic Behavior*. Princeton, NJ: Princeton University Press.

Von Wieser, F. (1889). *Der natürliche Wert*. Wien: Hoelder.

Von Wieser, F. (2012). *Natural Value*. (W Smart, Ed., & C. A. Malloch, Trans.). (Original work published 1889).

Warlas, L. (2010). *Elements of Pure Economics*. Routledge. (Original work published 1874, 1877).

Wicksteed, P. H. (2012). *The Common Sense of Political Economy*. Forgotten Books. (Original work published 1910).

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

An Examination of Price Discovery and Volatility Spillovers of Crude Oil in Globally Linked Commodity Markets

Sanjay Sehgal[1], Neha Berlia[2] & Wasim Ahmad[1]

[1] Department of Financial Studies, University of Delhi, South Campus, New Delhi, India

[2] Swiss Institute of Banking and Finance, University of St. Gallen, Switzerland

Correspondence: Neha Berlia, Swiss Institute of Banking and Finance, University of St. Gallen, 9000, Switzerland. Tel: 41-71-222-0116. E-mail: neha.berlia@student.unisg.ch

Received: February 3, 2013 Accepted: March 15, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p15 URL: http://dx.doi.org/10.5539/ijef.v5n5p15

Abstract

This paper examines the price discovery and volatility spillovers between spot and futures as well as futures prices of three strategically linked oil markets viz., ICE, MCX and NYMEX from 05 February, 2006 to 15 October, 2012. The results confirm the long-run relationship between futures and spot prices in each market, futures prices lead spot prices in the price discovery process. Analysing the futures prices, we find that ICE is the most dominant futures trading platform followed by NYMEX and MCX in price discovery process. Thus, MCX an emerging market platform seems to act like a satellite market vis-à-vis international platforms. The volatility spillover results suggest that there is a long-term spillover from ICE to MCX and from MCX to NYMEX. The volatility information seems to flow from NYMEX to ICE. The GARCH-CCC & DCC model results confirm both cross market and with in market co-movements which become weak during the crisis period and tend to become stronger during the stable period. The study provides relevant implications for policy makers and market traders. The outcome of this study contributes to commodity market literature especially relating to information transmission between strategically linked markets.

Keywords: price discovery, volatility spillovers, energy markets, crude oil market, MGARCH

1. Introduction

Since, the early 1970s, the frequent upheavals in energy market especially the price of crude oil have always been an issue of great concern for academician, regulators and policy makers owing to its adverse impact on the macroeconomic fundamentals of the global economy. In this regard, an important issue that has garnered a great deal of attention of researchers and policy makers is of testing the efficient market behaviour of energy markets particularly the crude oil with respect to their price discovery and volatility spillover potentials (Lean, McAleer and Wong, 2010). In recent years, especially after the global economic crisis of 2008, there have been significant changes in the energy markets worldwide particularly the crude oil. In the literature, studies have considered several factors such as globalization, changing economic dynamics, international relations and global politics, war, technological innovations and developments in energy market and the recent financial crisis that has shifted the economic and political focus from west to east, as responsible for volatile energy market environment that has also increased the need of market players to hedge the investment risk using derivatives such as futures and options of energy products (Nomikos and Andriosopoulos, 2012). In international commodity market, crude oil market is characterized as an umbrella market because of large variety of products such as West Texas Intermediate (WTI); Brent Blend (BB); Maya, Bonny Light (BL) and Dubai-Fateh (DF). Among these crude oils, WTI and BB are considered as light and sweet crude oil because of higher API gravity index (Note 1) compared to others (Kaufmann and Ullman, 2009). Hence, WTI and BB are widely used for domestic and industrial purposes. In both mature and emerging markets, WTI and BB are also highly traded crude oil on their trading platforms. In terms of recent trends, WTI is being taken as a benchmark for price determination for crude oil industry. Keeping these issues in mind, this paper attempts to examine the price discovery and volatility spillovers between futures and spot prices and between futures prices of WTI traded on three commodity trading platforms viz., New York Mercantile Exchange (NYMEX), Inter-Continental Exchange (ICE) and Multi Commodity Exchange (MCX). It may be noted that NYMEX and ICE are two principle platforms for oil trading at global level, and hence compete with each other for price leadership role in crude oil market (Goyal and

Tripathi, 2012). MCX is the major commodity exchange in India. India is a fast emerging trillion dollar economy for which crude oil is an important item in the import bill (Chakrabarty and Chakravarty, 2012). Hence, MCX in our case represents an emerging market platform which shall help us in understanding the information transmission process between mature and emerging economies relating to an international commodity like crude oil. In futures markets, a market is characterized as dominant market when it assimilates all the new information more quickly in its price and has stronger volatility spillovers to other markets (Hong, 2001). Under efficient market hypothesis (EMH), it is assumed that all the publicly available information must be incorporated into the price of traded assets and no one should have lead in making speculation and arbitrage, but in a technology driven complex financial system, it is often observed that the process of information transmission is not as symmetrical as it is understood (Tangerås, 2012). Therefore, this motivates the researchers and policy makers to investigate the energy market platforms with respect to their price discovery and volatility spillover potential. In literature, price discovery implies the lead-lag relationship between futures and spot prices in a market and between futures prices in two different markets (Tse,1999). Under cointegration framework, it implies the establishment of long-run equilibrium relationship. In the event of any departures from equilibrium due to exogenous shocks, price discovery also takes into account the speed of adjustment of a market towards equilibrium price. Econometrically, such process is called as error correction mechanism (see, Zhong, Darrat, and Otero, 2004; Rittler, 2012). Besides, price discovery, volatility spillover also plays important role in information transmission as it highlights the process through which volatility in one market affects that of another market (Chan, Chan and Karolyi, 1991). The present study is particularly important in light of the increasing integration of global commodity markets that has generated interests for understanding the volatility spillovers from one market to another. These spillovers are usually attributed to the cross-market hedging and changes in commonly available information, which may simultaneously impact the expectations of various participants across markets (Engle, Ito and Lin, 1990). More specifically, volatility spillover examines information assimilation in two different ways: firstly, in terms of own-volatility spillovers under lagged innovations (information) and lagged volatility spillover effects, as it highlights whether lagged information and lagged volatility of an asset traded on an exchange impacts current volatility or not, if this is the case, it is called clustering effects under ARCH framework and volatility persistence under GARCH framework, it has strong implications for market participants as it highlights the assimilation of information other than the information contained in the price (Hong, 2001; Gagnon and Karolyi, 2006; Nekhili and Naeem, 2009). Secondly, cross-volatility spillovers measure spillover of past information and lagged volatility of an asset/market on other asset/market (Gagnon and Karolyi, 2006). It has also practical implications more importantly than the first one as it helps in characterizing the commodity market as dominant or satellite trading platform (see, Karmakar, 2009; Mahalik, Acharya and Babu, 2010; Du, Yu and Hayes, 2011; Liu and An, 2011; Arouria, Jouini, and Khuong, 2012, among others).

This paper also sets to examine the process of how volatility in the oil futures prices changes across markets. Since, oil prices in examined countries play important role in driving economic growth and among sample commodity exchanges, it is important for market participants to understand the volatility spillovers process across these exchanges and their dominance in oil trading. In particular, the study empirically examines the first and second moments properties of oil futures traded on three sample exchanges. Much of the research to date has focused on the interaction between the cash and the futures tiers of the crude oil market. The present study tries to answer the following research questions: Firstly, which is the dominant trading platform for crude oil trading (WTI) globally by comparing the information linkages between NYMEX and ICE, the two leading international trading platforms for oil futures contracts? Secondly, what is the information transmission process between these mature trading platforms and an emerging market trading platform such as MCX? In order to address these questions, the study sets to examine the following objectives:

(i) to examine the lead-lag relationship between spot and futures prices and between futures prices of sample markets;

(ii) to investigate the volatility spillovers among sample markets in order to ascertain the dominant and satellite platforms.

2. Literature Review

In this section, we mainly focus on the subject of information linkages among strategically located crude oil markets where research has been restricted to the financial markets , prior research has focused mainly on financial market and comparatively less attention has paid to the commodity and foreign exchange markets (see Koutmos and Booth, 1995; Hamao, Masulis, and Ng, 1990; Hong, 2001). Notable studies relating to energy products (see Antoniou and Foster, 1992; Ng and Pirrong, 1996; Tse and Booth, 1997; Lin and Tamvakis, 2001;

Ewing, Malik and Ozfidan 2002; Hammoudeh, Li and Jeon, 2003; Lanza, Manera and McAleer, 2006; Malik and Hammoudeh, 2007; Mu, 2007; Hammoudeh and Yuan, 2008; Kaufmann and Ullman, 2009; Bekiros and Diks, 2008; Nomikos and Andriosopoulos, 2012; Arouri, Jouini, and Khuong, 2012; Ji and Fan, 2012). So far, none of the study has examined the price discovery and volatility spillovers by taking into account the recent changes in international economic dynamics and strong upheavals in energy products particularly the crude oil.

The study of Tse and Booth (1997) examines the information transmission between New York heating oil futures and London gas oil futures and reports that the former is more dominant market than later. The findings of their study imply that the information share can also determine the nature of the market. Lin and Tamvakis (2001) examine the spillover effects between NYMEX and London's International Petroleum Exchange (IPE) crude oil futures markets for the period 4 January, 1994 to 30 June, 1997. Broadly, the study reports that there is stronger volatility spillover from NYMEX to IPE when traded in different hours. Using Dynamic Conditional Correlations (DCC – GARCH), Lanza, Manera, and McAleer (2006) examine the daily returns on West Texas Intermediate (WTI) oil forward and futures prices for the period 3 January, 1985 to 16 January, 2004. The study finds the evidence of dramatic aberrations in time-varying conditional correlations with the magnitude being negative to zero. They further report strong variaitions in correlation patterns which is in contrast with the common view that usually suggests high correlation between futures prices of different maturit Spargoli and Zagaglia (2007) examine the comovement between futures markets for crude oil traded on NYMEX and ICE for the period 26 April, 1993 to 26 April, 2007. Using structural BEKK-GARCH model, the study reports that during the turmoil period, NYMEX reacts on the arrival of new information more quicker than ICE. This further implies that NYMEX assimilates new price related information quicker than ICE. Bekiros and Diks (2008) examine relationship between futures and spot prices of WTI under different time intervals by aplying the linear and nonlinear causal relationships for the period October, 1991 to October 2007. The study analyses two sample periods namely PI which spans (1991 to 1999) and PII (1999 to 2007). More importantly, the study highlights the weaknesses related with the first moment relationship (lead-lag relationship) with the use of nonlinear causality test. Based on the linear cauality results, the study finds bi-directional Granger causality between spot and futures prices in both periods, whereas the nonlinear causality results suggest the uni-directional causal relationship from spot to futures prices only in PII. Kaufmann and Ullman (2009) examine the unified nature of global oil market by way of investigating the causal relationships among prices for crude oils from Africa, Europe, Middle East and North America on both spot and futures markets. The study also includes different variants of crude oil such as WTI, BB, Maya, Bonny Light, Dubai–Fateh. The study reports the weak relationship between futures and spot prices. The study also finds that spot prices of Dubai-Fateh lead the other spot and futures prices, while among other crude oil futures and spot prices, WTI leads other exchanges and contracts. However, studies have also examined the information transmission of oil under different dimensions by linking the oil with metals and stock markets. In this regard, Lean, McAleer, and Wong (2010) examine the market efficiency of oil futures and spot prices prices of WTI by applying both mean-variance (MV) and stochastic dominance (SD) approaches. The study reports no evidence of any MV and SD relationships between examined series. The study also concludes that spot and futures donot dominate one another. Hence, there is no arbitrage opportunity between futures and spot markets.

More recently, Arouria, Jouini and Khuong (2012) examine the impact of oil price fluctuations on European equity markets by analysing the volatility spillover and hedging effectiveness. Based on the results of Vector Autoregression (VAR-GARCH) model, they find strong evidence of significant volatility spillovers between oil price and sector stock returns. Their findings imply that the volatility in the oil futures impacts the sector stock returns considerably. This further means that there is stronger flow of information from oil futures to sector stock returns. In Indian context, Goyal and Tripathi (2012) exmine the lead-lag relationship between spot and futures of crude oil by applying mutual and across exchange causality tests. Using the daily data of US WTI crude oil spot prices, UK Brent spot, MCX WTI spot, the study finds the evidence of price discovery in mature exchnages, where spot prices lead futures prices under VECM framework. The study further reports the reverse causality from emerging to mature exchnages. Ewing and Malik (2013) examine the volatility tranmission between gold and oil futures by taking into account the strcutural breaks. Using univarate and bi-variate GARCH models, the study finds the strong evidence of significant volatility transmission between gold and oil returns after taking into account the structural breaks in variance. By and large the findings of recent studies as mentioned above are not in line with the present work. To summarize, we can say that while there is a broad consensus on the role of information linkages across markets, the issue is still unsettled especially in the light of the recent turbulent periods which have jolted the commodity markets across globe especially the crude oil prices taking northward trend. Moreover, the futures markets in emerging countries are characterized by low liquidity and less efficient trading systems (Tomek, 1980; Carter, 1989), making them different from the counterpart markets in mature

countries. Under emerging market framework, this is the first attempt to examine the price discovery and volatility spillovers by taking into account more recent period, which has still been unexplored in cross-market framework, is of great importance as it is the time when these trading platforms have achieved a higher level of trading liquidity and there may be strengthening of international linkages in terms of energy products.

3. Methodology

3.1 Process of Price Discovery and Cointegration

At first stage, stationarity condition using conventional methods of unit root tests viz., Augmented Dickey Fuller (ADF), Phillips and Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests have been used to check for stationarity for all sample series. Following Zhong, Darrat and Otero (2004) and Hou and Li (2012), we apply Johansen and Juselius (1992) test to exhibit the long-run relationship followed by vector error correction model (VECM) as mentioned in equations (1) and (2). The bivariate co-integrated series $P_t = (F_t, S_t)'$, :

$$\Delta F_t = \alpha_1 + \beta_1 EC_{t-1} + \sum_{i=1}^{k} d_{1i}\Delta F_{t-i} + \sum_{i=1}^{k} g_{1i}\Delta S_{t-i} + \varepsilon_{1t} \quad (1)$$

$$\Delta S_t = \alpha_2 + \beta_2 EC_{t-1} + \sum_{i=1}^{k} d_{2i}\Delta F_{t-i} + \sum_{i=1}^{k} g_{2i}\Delta S_{t-i} + \varepsilon_{2t} \quad (2)$$

Note that $EC_{t-1} = F_{t-1} - a - bS_{t-1}$ is the lagged error correction (EC) term.

The error correction model of the bivariate co-integrated series $P_t = (F_{1,t}, F_{2,t})'$, is represented by a vector error correction model (VECM):

$$\Delta F_{1,t} = b_1 + \beta_1 EC_{t-1} + \sum_{i=1}^{k} d_{1i}\Delta F_{1,t-i} + \sum_{i=1}^{k} g_{1i}\Delta F_{2,t-i} + \varepsilon_{1t} \quad (3)$$

$$\Delta F_{2,t} = b_2 + \beta_2 EC_{t-1} + \sum_{i=1}^{k} d_{2i}\Delta F_{1,t-i} + \sum_{i=1}^{k} g_{2i}\Delta F_{2,t-i} + \varepsilon_{2t} \quad (4)$$

Where, $EC_{t-1} = F_{1,t-1} - a - bF_{2,t-1}$ is the lagged EC term.

Given the large number of parameters that would have to be estimated in the spillover model (discussed in subsection in 3.2), a two-step procedure similar to that implemented by Bekaert and Harvey (1997), Tse (1999), Ng (2000) and Rittler (2012) has been considered in this study. In the first step, a VECM is estimated to obtain the residuals. In the second step, first stage residuals are used to estimate the volatility spillovers between spot and futures prices and between the futures prices of both markets.

3.2 Process of Volatility Spillovers

Numerous studies have investigated the process of volatility spillover to exhibit the spread of news from one market that affects the volatility spillover process of another market. Considering the volatility spillovers across markets, the important studies in the existing literature are of Hamao, Masulis and Ng (1990), Koutmos and Booth (1995) and Lin, Engle and Ito (1994) for US, UK and Japanese Stock markets and Booth, Martikainen and Tse (1997) and Christofi and Pericli (1999) in other international stock markets. Most studies in the literature have used different variants of GARCH models to study the volatility spillovers between markets. Engle, Ito and Lin (1990) introduced the GARCH models to examine the volatility spillovers. According to Chan, Chan and Karolyi (1991), it is the volatility which determines the flow of information from one market to another and not just the simple price change. (Note 2)

Keeping in view the above mentioned literature, we now set up a model on the basis of the standardized residuals obtained from the VECM. The GARCH-BEKK (Baba, Engle, Kraft and Kroner, 1990) model is used to model the volatility spillover dynamics between futures and spot prices and between futures prices of ICE, MCX and NYMEX. Apart from BEKK model, constant conditional correlation (CCC) and dynamic conditional correlation (DCC) models are employed to infer upon the constant and time-varying correlation patterns of sample oil price series under consideration. A brief description of each model is mentioned below.

3.2.1 GARCH (BEKK) Model

The BEKK model is the most natural way to deal with the multivariate matrix operations. In this study, the model is implemented on the residuals of the series under following specification.

Mean equation:

$$\upsilon_{it} = \mu_{i0} + \sum_{j=1}^{2} \mu_{ij} \upsilon_{j,t-1} + \varepsilon_{it} \tag{5}$$

where $\varepsilon_{it} \mid I_{it-1} \sim N(0, h_{it}), i = 1,2$

In equation 5, υ_{it} is the estimated residual of the sample series. ε_{it} is a random error term with conditional variance h_{it}. I_{it-1} denotes the market information at time *t*-1. Equation (5) specifies the variance equation. *i*=1, 2 denotes the bivariate model. The BEKK parameterization of multivariate GARCH model is written in the following manner:

$$H_{t+1} = C'C + A'\varepsilon_t \varepsilon_t' A + B' H_t B \tag{6}$$

Where the individual elements of C, A and B matrices for equation (6) are mentioned below:

$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$, $B = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$ and $C = \begin{bmatrix} c_{11} & 0 \\ c_{21} & c_{22} \end{bmatrix}$

The off-diagonal elements of matrix A (a_{12} and a_{21}) represent the short-term volatility spillover (ARCH effect) from market 1 to another market 2. The off-diagonal elements of matrix B (b_{12} and b_{21}) represent the long-term volatility spillover (GARCH effect) in the same manner as mentioned above.

3.2.2 CCC and DCC-GARCH Models

Engle (2002) dynamic conditional correlation (DCC) model is estimated in two steps. In the first step, GARCH parameters are estimated followed by correlations in the second step.

$$H_t = D_t R_t D_t \tag{7}$$

In equation (7), H_t is the 2×2 conditional covariance matrix as in our case, R_t is the conditional correlation matrix and D_t is a diagonal matrix with time-varying standard deviations on the diagonal.

$$D_t = diag(h_{11t}^{1/2}, h_{22t}^{1/2})$$

$$R_t = diag(q_{11t}^{-1/2}, q_{22t}^{-1/2}) Q_t diag(q_{11t}^{-1/2}, q_{22t}^{-1/2})$$

Where Q_t is a symmetric positive definite matrix:

$$Q_t = (1 - \theta_1 - \theta_2)\overline{Q} + \theta_1 \varepsilon_{t-1} \varepsilon'_{t-1} + \theta_2 Q_{t-1} \tag{8}$$

$\overline{Q}$ is the 2×2 unconditional correlation matrix of the standardized residuals ε_{it}. The parameters θ_1 and θ_2 are non-negative with a sum of less than unity. Under the condition of $R_t = R$ and $R_{ij} = \rho_{ij}$ equation (9) becomes constant conditional correlation (CCC) model.

$$\rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t} q_{jj,t}}} \tag{9}$$

The MGARCH models are estimated by Quasi-Maximum Likelihood Estimation (QMLE) using the Broyden-Fletcher-Goldfarb-Shanno (BFGS) algorithm. T statistics are calculated using a robust estimate of the covariance matrix (see Sadorsky, 2012).

4. Data

The sample data for the daily spot and futures prices of NYMEX, ICE and MCX for WTI have been retrieved from the Bloomberg database. All closing prices of futures series are taken for the nearest contract to maturity (see Zhong, Darrat and Otero, 2004). The sample period of the study is 05 February, 2006 to 15 October, 2012 (1727 observations). In order to maintain parity across the sample markets, the price series are taken in USD terms (Note 3). For estimation purpose, all price series have further been converted into natural logarithms. The sample series under investigation are denoted as follows: ICE, NYMEX and MCX denote the futures prices of WTI crude oil traded on ICE, NYMEX and MCX platforms, MCXSPOT denotes the spot price of MCX and SPOT denotes the spot prices of ICE and NYMEX.

5. Empirical Results

The time-series graphs of actual WTI crude oil prices clearly exhibit the evidence of similar movement in prices, implying that there is not much scope of arbitration in oil market and the relevant market information is intercepted by each sample market immediately (see Figure 1).

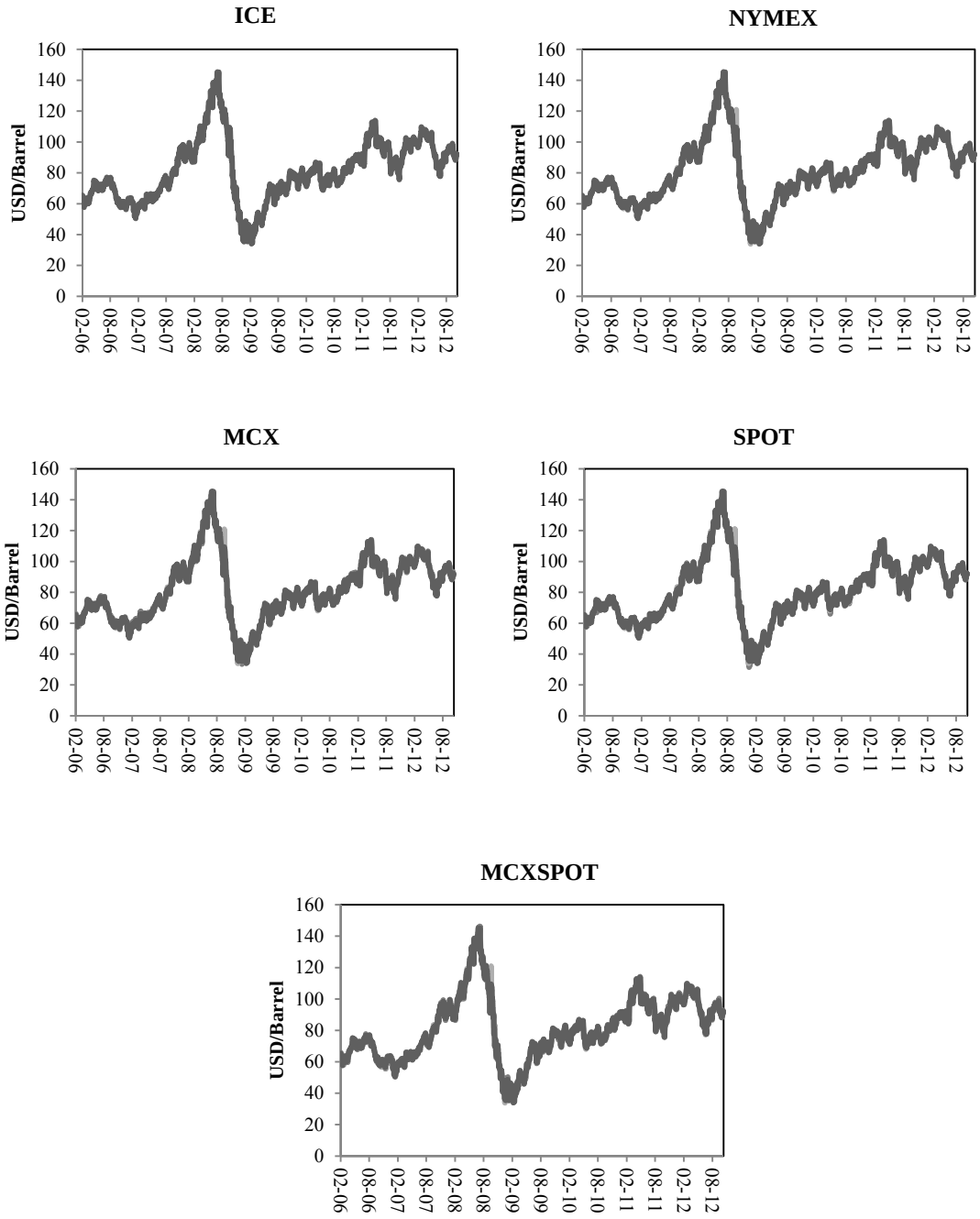

Figure 1. Time-series plots of ICE, NYMEX, MCX, SPOT and MCXSPOT

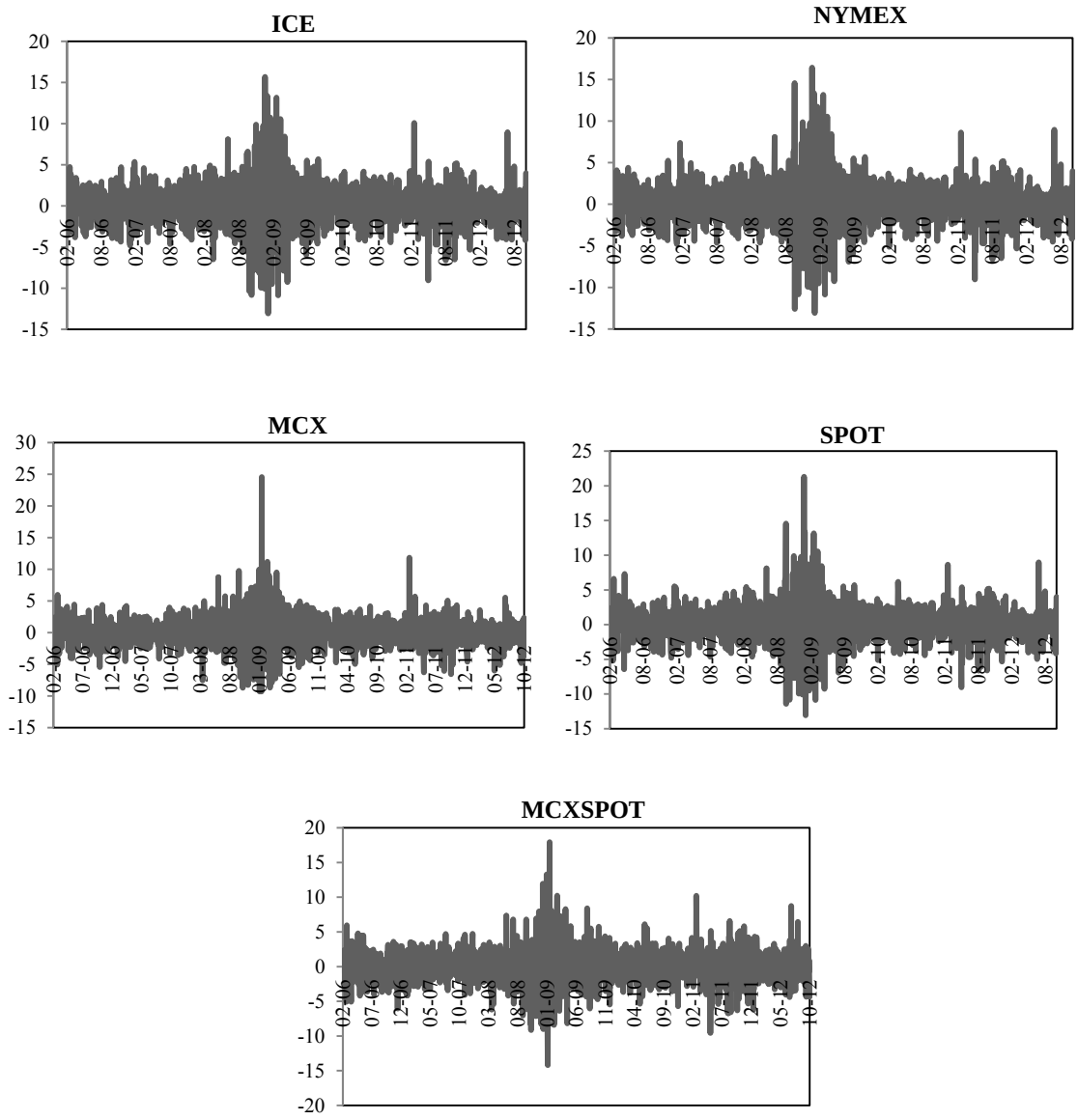

Figure 2. Time-series plot of daily returns of ICE, NYMEX, SPOT, MCX and MCXSPOT

Besides this, we have also plotted the continuously compounded daily returns graphs of all sample markets. It appears that there is strong case of clustering in each market during June, 2008 to August 2009 and during April, 2011 to June, 2011 (see Figure 2). While the first clustering period can be identified with the global economic crisis and its aftermath, second clustering period is linked with the phase when the Eurozone crisis intensified. The return behaviour of each market appears to be similar as it has been observed in case of actual prices. But it would be interesting to see how the behaviour of these markets changes in terms of their price discovery under first moment condition and volatility spillover in second moments. The descriptive statistics of sample oil futures and spot series as shown in Table 1 (Note 4). The mean returns of WTI crude oil appear to be almost same across markets. The highest mean daily returns are observed in case of NYMEX and SPOT which is 0.021 percent and lowest in case of ICE, MCX and MCXSPOT which is 0.020 percent. The standard deviation as a measure of volatility is highest for SPOT (2.559) and NYMEX (2.538) followed by ICE (2.477) and MCXSPOT (2.437). Strikingly, the lowest volatile market appears to be MCX which has volatility of 2.252. However, this low volatility may be the outcome of lower information flows owing to less trading volume coupled with relatively greater price regulations in an emerging market like India. In general, the risk-returns relationship is positive for all sample series under consideration. The volatility measures are more than hundred times larger than the mean values. All returns series exhibit positive skewness and are also leptokurtic. This automatically leads to the violation of normality assumption as exhibited by Jarque-Bera (JB) statistics. The results imply that all the

sample markets are not informationally efficient. There is also strong evidence of volatility clustering in sample series, indicating the need for greater analysis of second moment. Ljung-Box (LB) test confirms no autocorrelation in level of sample series up to 10 lags with the exception of NYMEX, MCX-SX and SPOT, while, all variables indicate significant autocorrelation in squared terms.

Table 1. Descriptive statistics of sample commodities

	Futures Returns			**Spot Returns**	
	ICE	MCX	NYMEX	MCXSPOT	SPOT
Mean	0.020	0.020	0.021	0.020	0.021
Max.	15.659	24.532	16.410	17.915	21.277
Min.	-13.065	-9.301	-13.065	-14.196	-13.065
Std.Dev.	2.477	2.252	2.538	2.437	2.559
Skewness	0.063	0.725	0.134	0.172	0.307
Kurtosis	7.453	13.421	7.972	7.346	9.308
JB	1427.781	7965.404	1783.879	1367.761	2890.642
Prob.	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Arch	48.814	14.955	45.048	33.858 [0.000]**	57.608
	[0.000]**	[0.000]**	[0.000]**		[0.000]**
LB	17.459 [0.064]	11.928 [0.289]	24.554	29.0469	30.376
			[0.006]**	[0.001]**	[0.000]**
LB^2	1106.96	239.081	1038.05	587.742	798.412
	[0.000]**	[0.000]**	[0.000]**	[0.000]**	[0.000]**
Obs.	1727	1727	1727	1727	1727

Notes: ** denotes level of significance at 1% and better. Values in parentheses [ ] indicate the p-values. JB=Jarque Bera and LB= Ljung Box. LB statistics is reported up to 10 lags.

5.1 Tests of Stationarity and Price Discovery Process

Stationarity conditions of the oil futures-spot price series expressed in logarithmic form are tested by conventional ADF, PP and KPSS tests (see Table 2). All unit root tests clearly confirm the existence of unit root at level and exhibit stationarity at first difference for all oil price series. The results of Johansen and Juselius (1992) test of cointegration indicate that all sample oil price series exhibit the long-run relationship, confirming the strong informational linkages between spot and futures as well as between futures prices of the examined sample trading platforms (Table, 3). (Note 5)

Table 2. Unit root results

	ADF		**PP**		**KPSS**	
Variables	**Level**	**First Difference**	**Level**	**First Difference**	**Level**	**First Difference**
Futures prices						
ICE	-2.213	-43.971**	-2.061	-44.082**	0.202	0.060**
MCX	-2.045	-41.899**	-2.029	-41.900**	0.204	0.061**
NYMEX	-2.259	-43.947**	-2.088	-44.110**	0.201	0.060**
Spot prices						
MCXSPOT	-2.181	-44.173**	-2.047	-44.252**	0.202	0.061
SPOT	-2.258	-43.496**	-2.213	-43.503**	0.201	0.055
Critical Values						
1%	-3.963				0.216	
5%	-3.412				0.146	
10%	-3.128				0.119	

Note: * indicates the level of significance at 1% and better.

Table 4 exhibits the VECM results. The EC which is also called as speed of adjustment co-efficient βi is shown in the table. The results indicate that in case of between spot and futures prices of all sample markets, the speed of adjustment co-efficient (β_2) appears to be greater in spot than the futures market, indicating that when the co-integrated series is in disequilibrium in the short-run, it is the spot price (cash market) that makes greater adjustment than the futures price (futures market) in order to restore the equilibrium. In other words, futures

price leads the spot price in price discovery process. From investment strategy perspective, the significantly negative EC term for spot series implies that spot prices are over-valued in all sample markets. In contrast, significantly positive is reported only for NYMEX futures implying that the futures prices in these markets are relatively undervalued. The information provides market traders an incentive to sell/short-sell oil in spot and buys oil futures and exercise lending options to make arbitrage profits. Such an arbitrage process is probably ensuring a long-run equilibrium relationship between spot and futures prices in these markets as confirmed by cointegration results. The causality test reconfirms our findings that there is an observable bilateral causality between all sample futures and spot prices which is stronger from former to latter. In sum, oil futures prices help in discovery of oil spot prices.

Table 3. Johansen cointegration results

Trace test				Maximum Eigen value test			
Null	Alternative	Statistics	95% critical value	Null	Alternative	Statistics	95% critical value
Cointegration between ICE and SPOT							
r=0	r>=1	317.806**	25.872	r=0	r=1	313.19**	19.387
r<=1	r>=2	4.614	12.518	r<=1	r=2	4.614	12.518
r<=2	r>=3			r<=2	r=3		
Cointegration between MCX and MCXSPOT							
r=0	r>=1	258.953**	25.872	r=0	r=1	254.78**	19.387
r<=1	r>=2	4.167	12.518	r<=1	r=2	4.167	12.518
r<=2	r>=3			r<=2	r=3		
Cointegration between NYMEX and SPOT							
r=0	r>=1	278.88**	25.872	r=0	r=1	274.09**	19.387
r<=1	r>=2	4.782	12.517	r<=1	r=2	4.782	12.517
r<=2	r>=3			r<=2	r=3		
Cointegration between ICE and NYMEX							
r=0	r>=1	252.167**	15.494	r=0	r=1	248.64**	14.264
r<=1	r>=2	3.517	3.841	r<=1	r=2	3.517	3.841
r<=2	r>=3			r<=2	r=3		
Cointegration between ICE and MCX							
r=0	r>=1	150.53**	25.872	r=0	r=1	146.94**	19.387
r<=1	r>=2	3.596	12.517	r<=1	r=2	3.596	12.517
r<=2	r>=3			r<=2	r=3		
Cointegration between NYMEX and MCX							
r=0	r>=1	167.92**	25.872	r=0	r=1	164.36**	19.387
r<=1	r>=2	3.558	12.517	r<=1	r=2	3.558	12.517
r<=2	r>=3			r<=2	r=3		

Notes: a) * indicates level of significance at 1%, based of which order of integration is decided. b). The lag structure is decided based on the minimum values of the Akaike information Criterion.

Table 4. Estimated co-efficient of VEC model

Commodity	Co-efficient	Commodity	Co-efficient
$\beta_{1(ice/spot)}$	-0.048	$\beta_{2(spot/ice)}$	-0.35
	[-0.893]		[-6.367]**
$\beta_{1(mcx/mcxspot)}$	-0.102	$\beta_{2(mcxspot/mcx)}$	-0.499
	[-1.869]		[-11.242]**
$\beta_{1(nymex/spot)}$	0.285	$\beta_{2(spot/nymex)}$	-0.767
	[2.918]**		[-7.959]**
$\beta_{1(ice/nymex)}$	-0.133	$\beta_{2(nymex/ice)}$	-0.834
	[-1.091]		[-6.959]**
$\beta_{1(ice/mcx)}$	-0.146	$\beta_{2(mcx/ice)}$	-0.333
	[-2.068]**		[-5.436]**
$\beta_{1(nymex/mcx)}$	-0.257	$\beta_{2(mcx/nymex)}$	-0.244
	[-4.072]**		[-4.472]**

Notes: values in parentheses [ ] show t-values. ** denotes the level of significance at 1% and better.

In cross market analysis, a long-run equilibrium relationship is again confirmed between futures prices of all sample markets, there are significant EC terms for all futures series with the exception of ICE/NYMEX, thereby implying that any departures from equilibrium are significant. Based on the magnitude of EC co-efficient and its statistical significance, it can be inferred that among all three futures markets, it is the ICE which leads NYMEX and MCX futures markets in price discovery process. In other words, ICE futures prices assimilate new information quicker than NYMEX and MCX. Strikingly, in case of NYMEX and MCX futures prices, speed of adjustment is by and large same, indicating that MCX is fastly getting integrated with global trading platforms in case of oil. From global investor's perspective, the ICE futures seem to be relatively over-valued owing to as depicted by significantly negative coefficient. The arbitrage process may involve selling ICE futures and buying NYMEX futures to reap short-term profits. The causality tests provide a reconfirmation that ICE seems to be the dominant platform in the crude oil price discovery process followed by NYMEX and then MCX. However, the price discovery results of VECM are further substantiated by the Granger causality results (see Table 5). The results indicate bidirectional causal relationship between spot and futures prices of sample oil markets with stronger causality moving from futures to spot. Indicating that futures price leads the spot price in price discovery process. However, among three oil trading platforms prices analysed pairwise, it appears that ICE strongly Granger causes NYMEX and MCX as the magnitude of F-statistics of ICE is found to be higher than MCX and NYMEX. In case of between NYMEX and MCX, NYMEX stronger Granger causes MCX, implying that in international oil market, ICE futures prices assimilate new market information quicker than NYMEX and MCX for price discovery.

Table 5. Granger causality results

Null Hypothesis:			F-Statistic	Prob.
ICE	$\not\rightarrow$	SPOT	22.131**	[0.000]
SPOT	$\not\rightarrow$	ICE	6.195**	[0.000]
MCXSPOT	$\not\rightarrow$	MCX	4.071**	[0.003]
MCX	$\not\rightarrow$	MCXSPOT	323.977**	[0.000]
SPOT	$\not\rightarrow$	NYMEX	6.777**	[0.000]
NYMEX	$\not\rightarrow$	SPOT	21.704**	[0.000]
MCX	$\not\rightarrow$	ICE	2.077**	[0.043]
ICE	$\not\rightarrow$	MCX	37.700**	[0.000]
NYMEX	$\not\rightarrow$	ICE	6.464**	[0.000]
ICE	$\not\rightarrow$	NYMEX	27.671**	[0.000]
MCX	$\not\rightarrow$	NYMEX	4.258**	[0.000]
NYMEX	$\not\rightarrow$	MCX	28.902**	[0.000]

Notes: shows null hypothesis does not Granger Cause. Values in parentheses are p-values. ** denotes the level of significance at 5% and better.

5.2 Volatility Spillovers Process

The estimated results of GARCH-BEKK model to examine the volatility spillovers among sample countries are shown in Table 6 (Panel A to F). The volatility spillover results between ICE futures and its SPOT shown in Panel (A) confirm that there is ARCH effect only in case of SPOT. This implies that past innovations of SPOT prices have significant and positive impact on the current SPOT volatility. Turning to cross volatility spillover effects in the short-run, the results indicate that there are bilateral volatility spillovers between ICE and SPOT prices with stronger volatility spillover moving from ICE futures to SPOT. It may be noted that in case of ICE, the past innovations in spot prices impact the current futures price volatility positively while exactly opposite is the case from futures to spot. With respect to long-term effects of ICE futures and spot, the results indicate that there is strong evidence of volatility persistence, implying that there is strong GARCH effect in case of futures and spot. This further means that the past volatility of current futures/spot prices impacts the current volatility futures/spot significantly. Surprisingly, the volatility persistence appears to be stronger in futures compared to spot. Turning to cross market long-term volatility spillovers, the results indicate that there are bilateral volatility spillovers between spot and futures with stronger volatility spillover moving from futures to spot. It may here be noted that unlike short-term, the past volatility of SPOT impacts the current volatility of futures (ICE) negatively while futures price volatility spot price volatility positively.

Similarly, in case of MCX in the short-run, the spillover results indicate that there is no ARCH effect in futures and spot prices. While, there is unilateral volatility spillover moving from futures to spot. The spillover appears

to be negative implying that the past innovations in futures market impact the current spot market inversely in the short-term. With respect to long-term spillovers, the results indicate strong evidence of volatility persistence in case of futures and spot prices. The results imply that the past volatility of futures and spot impact their current futures and spot considerably. Strikingly, there appears to be no long-term cross-market volatility spillovers between spot and futures prices in case of MCX. With respect to NYMEX (see Panel C), the results indicate that there is a positive short-term clustering in case of SPOT prices. Surprisingly, there is no cross-market spillover implying that in the short-term, it is only the SPOT market which bears the impact of past innovations in the market. Turning to long-term volatility spillovers, the results indicate no evidence of volatility persistence. However, there is a negative volatility spillover moving from futures to spot, while, inverse is not found.

Table 6. MGARCH results

Panel A. ICE-SPOT

Variables	BEKK		CCC		DCC	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
μ_1	0.032	[0.951]	0.062	[2.248] *	0.053	[2.097] *
μ_2	0.032	[1.093]	0.061	[2.409] *	0.051	[2.218] *
$c_{(1,1)}$	0.037	[1.259]	0.039	[2.505] *	0.037	[2.175] *
$c_{(2,1)}$	-0.133	[-1.884]				
$c_{(2,2)}$	0.001	[0.002]	0.047	[2.285] *	0.042	[2.021] *
$\alpha_{(1,1)}$	-0.105	[-1.339]	0.079	[3.248] *	0.086	[2.013] *
$\alpha_{(1,2)}$	-0.656	[-6.492]*				
$\alpha_{(2,1)}$	0.215	[2.705] *				
$\alpha_{(2,2)}$	0.584	[5.191] *	0.107	[2.682] *	0.108	[2.213] *
$\beta_{(1,1)}$	1.186	[53.072] *	0.869	[22.399] *	0.855	[13.571] *
$\beta_{(1,2)}$	0.647	[5.021] *				
$\beta_{(2,1)}$	-0.212	[-9.201] *				
$\beta_{(2,2)}$	0.325	[2.394] *	0.832	[14.318] *	0.822	[11.065] *
$\rho_{(2,1)}$			0.934	[78.323] *		
$\theta_{(1)}$					0.019	[0.884]
$\theta_{(2)}$					0.565	[8.372] *
Log likelihood	-2459.49		-2618.61		-2596.76	

Panel B. MCX-SPOT

Variables	BEKK		CCC		DCC	
	Coeff	t-Stat	Coeff	t-Stat	Coeff	t-Stat
μ_1	0.030	[1.379]	0.039	[1.693]	0.037	[1.521]
μ_2	0.027	[1.283]	0.036	[1.651]	0.041	[1.777]
$c_{(1,1)}$	0.123	[1.827]	0.021	[3.32] *	0.021	[3.523] *
$c_{(2,1)}$	-0.135	[-1.613]				
$c_{(2,2)}$	0.013	[0.143]	0.034	[1.759]	0.033	[2.265] *
$\alpha_{(1,1)}$	0.185	[1.510]	0.056	[4.22] *	0.059	[4.587] *
$\alpha_{(1,2)}$	-0.219	[-2.034]*				
$\alpha_{(2,1)}$	0.031	[0.353]				
$\alpha_{(2,2)}$	0.224	[1.885]	0.102	[2.44] *	0.108	[3.443] *
$\beta_{(1,1)}$	0.971	[23.27] *	0.919	[59.14] *	0.918	[56.56] *
$\beta_{(1,2)}$	0.104	[1.679]				
$\beta_{(2,1)}$	-0.002	[-0.064]				
$\beta_{(2,2)}$	0.909	[14.27] *	0.862	[15.48] *	0.861	[21.31] *
$\rho_{(2,1)}$			0.544	[27.56] *		
$\theta_{(1)}$					0.056	[4.10] *
$\theta_{(2)}$					0.399	[1.877]
Log likelihood	-4198.67		-4200.06		-4192.02	

Panel C. NYMEX-SPOT

Variables	BEKK		CCC		DCC	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
μ_1	0.021	[0.539]	0.021	[0.529]	0.026	[0.977]
μ_2	0.025	[0.724]	0.023	[0.537]	0.029	[1.024]
$c_{(1,1)}$	0.932	[20.510]*	0.074	[2.638]*	0.040	[3.047]*
$c_{(2,1)}$	0.927	[23.319]*				
$c_{(2,2)}$	0.000	[-0.006]	0.077	[2.511]*	0.042	[2.858]*
$\alpha_{(1,1)}$	0.318	[1.281]	0.285	[3.372]*	0.189	[6.397]*
$\alpha_{(1,2)}$	-0.408	[-1.291]				
$\alpha_{(2,1)}$	0.029	[0.132]				
$\alpha_{(2,2)}$	0.641	[2.389]*	0.301	[3.633]*	0.190	[5.036]*
$\beta_{(1,1)}$	-0.493	[-1.541]	0.666	[11.52]*	0.728	[35.35]*
$\beta_{(1,2)}$	-1.139	[-3.069]*				
$\beta_{(2,1)}$	0.489	[0.912]				
$\beta_{(2,2)}$	1.087	[1.783]	0.651	[10.315]*	0.721	[23.17]*
$\rho_{(2,1)}$			0.974	[252.50]*		
$\theta_{(1)}$					0.083	[1.250]
$\theta_{(2)}$					0.640	[0.000]
Log likelihood	-1527.9		-1896.8		-1929.4	

Panel D. ICE-NYMEX

Variables	BEKK		CCC		DCC	
	Coeff	t-stats	Coeff	t-stats	Coeff	t-stats
μ_1	0.000	[0.010]	0.086	[2.671] *	0.004	[2.525] *
μ_2	0.003	[0.092]	0.084	[2.595] *	0.006	[1.995]*
$c_{(1,1)}$	0.119	[1.006]	0.028	[1.749]	0.026	[92.4] *
$c_{(2,1)}$	-0.069	[-0.919]				
$c_{(2,2)}$	0.000	[0.000]	0.029	[1.631]	0.027	[207.8] *
$\alpha_{(1,1)}$	0.061	[0.537]	0.072	[1.646]	0.063	[215.2] *
$\alpha_{(1,2)}$	-0.072	[-0.652]				
$\alpha_{(2,1)}$	-0.046	[-0.448]				
$\alpha_{(2,2)}$	-0.111	[-0.970]	0.084	[1.616]	0.076	[985.2] *
$\beta_{(1,1)}$	-0.650	[-2.662]*	0.891	[19.15] *	0.891	[816.8] *
$\beta_{(1,2)}$	-0.367	[-0.829]				
$\beta_{(2,1)}$	1.586	[7.305] *				
$\beta_{(2,2)}$	1.324	[3.144] *	0.878	[15.50] *	0.875	[142.1] *
$\rho_{(2,1)}$			0.954	[77.86] *		
$\theta_{(1)}$					0.041	[-0.048]
$\theta_{(2)}$					0.959	[2.210] *
Log likelihood	-2270.08		-2341.50		-2234.50	

Panel E. ICE-MCX

Variables	BEKK		CCC		DCC	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
μ_1	0.038	[2.032]*	0.045	[1.970]	0.046	[1.896]
μ_2	0.023	[1.234]	0.045	[1.799]	0.037	[1.424]
$c_{(1,1)}$	0.198	[5.142]*	0.012	[1.807]	0.019	[2.46] *
$c_{(2,1)}$	0.062	[1.287]				
$c_{(2,2)}$	0.000	[0.000]	0.014	[2.593] *	0.016	[2.788] *
$\alpha_{(1,1)}$	0.470	[5.091] *	0.058	[2.839] *	0.087	[4.401] *
$\alpha_{(1,2)}$	0.051	[0.476]				
$\alpha_{(2,1)}$	0.215	[2.896] *				
$\alpha_{(2,2)}$	0.190	[2.355] *	0.058	[2.890] *	0.079	[4.77] *
$\beta_{(1,1)}$	0.901	[19.20] *	0.926	[32.76] *	0.890	[35.9] *
$\beta_{(1,2)}$	0.104	[2.152] *				
$\beta_{(2,1)}$	0.032	[0.535]				
$\beta_{(2,2)}$	0.897	[21.40] *	0.925	[41.37] *	0.903	[52.51] *
$\rho_{(2,1)}$			0.839	[66.80] *		
$\theta_{(1)}$					0.058	[3.23] *
$\theta_{(2)}$					0.927	[40.12] *
Log likelihood	-3285.44		-3359.80		-3307.27	

Panel F. NYMEX-MCX

Variables	BEKK		CCC		DCC	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
μ_1	0.027	[1.429]	0.058	[2.104] *	0.034	[1.388]
μ_2	0.035	[2.051]*	0.055	[2.548] *	0.032	[1.380]
$c_{(1,1)}$	0.084	[2.106] *	0.016	[2.129] *	0.017	[2.208] *
$c_{(2,1)}$	0.231	[8.418] *				
$c_{(2,2)}$	0.000	[-0.001]	0.015	[2.058] *	0.022	[2.076] *
$\alpha_{(1,1)}$	0.155	[1.655]	0.050	[3.158] *	0.079	[3.881] *
$\alpha_{(1,2)}$	-0.272	[-4.25] *				
$\alpha_{(2,1)}$	-0.002	[-0.013]				
$\alpha_{(2,2)}$	0.589	[7.342] *	0.060	[2.787] *	0.099	[3.262] *
$\beta_{(1,1)}$	0.909	[26.29] *	0.929	[50.24] *	0.905	[46.91] *
$\beta_{(1,2)}$	0.062	[1.097]				
$\beta_{(2,1)}$	0.089	[2.034] *				
$\beta_{(2,2)}$	0.839	[16.58] *	0.919	[34.21] *	0.878	[26.47] *
$\rho_{(2,1)}$			0.807	[55.29] *		
$\theta_{(1)}$					0.097	[2.481] *
$\theta_{(2)}$					0.877	[18.45] *
Log likelihood	-3392.56		-3496.68		-3433.39	

Notes: Models estimated using QMLE with robust (heteroskedasticity/misspecification) standard errors. μ_i denotes the mean equation coefficients. In the variance equations, c denotes the constant terms, α denotes the ARCH terms and β denotes the GARCH terms. The coefficient α_{12} for example can be interpreted as the short-term volatility spillover moving from ICE futures to its SPOT in Panel, rest of the panels are also interpreted in the same manner, respectively. While, β_{12} represents the long-term volatility spillover from ICE to SPOT for is interpreted in the same manner as above. * denotes the level of significance at 5% and better for panels A toF, respectively.

In sum, we confirm bilateral volatility spillover between ICE futures and spot in both futures as well as spot in the long-run which is stronger from former to latter. Further, a unilateral volatility spillover from futures to spot is confirmed for MCX in the short-term and for NYMEX only in the long-term. Thus, the oil futures seem to have a destabilizing effect on spot prices which should be of concern to policy makers and regulators. With respect to futures markets volatility spillovers involving futures prices, we start with ICE and NYMEX results which indicate that there are no significant own as well as cross-market spillovers in the short-term (see Panel D). The long-term volatility spillover results exhibit high volatility persistence in case of both ICE as well as NYMEX. This implies that the past volatility of ICE and NYMEX impact their current volatility considerably. With respect to cross-market spillover, the results indicate only one way volatility spillover moving from

NYMEX to ICE. This is in contrast with price discovery results especially the Granger causality which indicates ICE as the lead market. The results of volatility spillover have strong implications as it indicates that the past volatility of NYMEX impacts current volatility of ICE futures prices. However, the results of ICE and MCX (see Panel E) indicate that in the short-term, there is strong evidence of volatility clustering in both ICE and MCX futures prices. The results of short-term cross-market volatility spillovers indicate that there is one-way spillover moving from MCX to ICE. In the long-term, the results indicate that there is strong evidence of high volatility persistence in case of ICE and MCX, implying that there are significant impacts of past volatility on current volatility of ICE and MCX futures prices. Turning to cross-market volatility spillover, the results indicate that there is unilateral volatility spillover moving from ICE to MCX. The long-term results are in line with price discovery results indicating the dominance of ICE over MCX. Lastly, we analyse the spillover results of MCX and NYMEX. The results further indicate that in the short-run, own volatility spillovers are high for MCX while in case of NYMEX this is not the case. With respect to short-term cross market volatility spillover, the results indicate that negative and unilateral volatility spillovers moving from NYMEX to MCX. The negative volatility spillover co-efficient indicate that the past innovations of NYMEX indicate the current volatility of MCX significantly. Turning to long-term results, it appears that there is strong evidence of volatility persistence in both markets, implying that there is impact of past volatility of futures prices on current volatility of futures prices. With respect to cross-market volatility, the results indicate that there is unilateral volatility spillover moving from MCX to NYMEX. The results imply that in contrast to the short-term, in the long-term, past volatility of MCX appears to have stronger impact on current volatility of NYMEX.

To summarize, we can say that the volatility spillover results are more or less in line with price discovery results. Turning to cross-market volatility spillover, there is a case of unilateral volatility spillover in each market, implying that the information flow across markets is not symmetric. However, there is also strong finding that comes out from this study is the evidence of strong volatility persistence in most of the sample markets. This implies that own volatility spillover is stronger than the cross-market spillovers. The possible explanation could be due to the domestic reasons such as longer trading hours, presence of more noise trader than value traders and regulatory regime which could have strong bearing on the market. However, the spot and futures market results indicate that it is the futures price which assimilates new information quicker than spot in each sample market with the exception of MCX. Turning to cross-market volatility spillovers, the results indicate that between ICE and NYMEX, the volatility spillover of NYMEX appears to have stronger effect on ICE. Similarly in case of ICE and MCX, the spillover impact of MCX is stronger in the short-term while in the long-term ICE dominates over MCX. While, MCX futures price volatility impacts NYMEX futures price volatility. NYMEX seems to be the dominant market vis-a-vis ICE while the later more dominant platform in price discovery process.

Turning to constant and time-varying dynamic conditional correlations, the results of CCC model suggest that there is strong correlation between each pair of market. But based on the magnitude of correlations, it appears that the correlation is high between NYMEX and its SPOT (0.97) and is significant followed by ICE and its SPOT (0.93) and MCX and its MCXSPOT (0.54). With respect to cross market correlations, the results indicate the high correlation between ICE and NYMEX (0.95) followed by ICE and MCX (0.83) and MCX and NYMEX (0.80). The CCC model provides interesting results. MCX futures exhibit greater association with international counterpart exchanges then its local spot market. This implies that emerging market platforms like MCX exhibit greater integration with international markets than at domestic level. This may be due to nature of oil as an international commodity and the possible market microstructure differences between futures and spot markets, making the former more informationally linked to each other than to their cash counterpart. Turning to DCC results, the estimated coefficients of $\theta_{(1)}$ and $\theta_{(2)}$ are high in each case except ICE with its SPOT and MCX with its MCXSPOT.

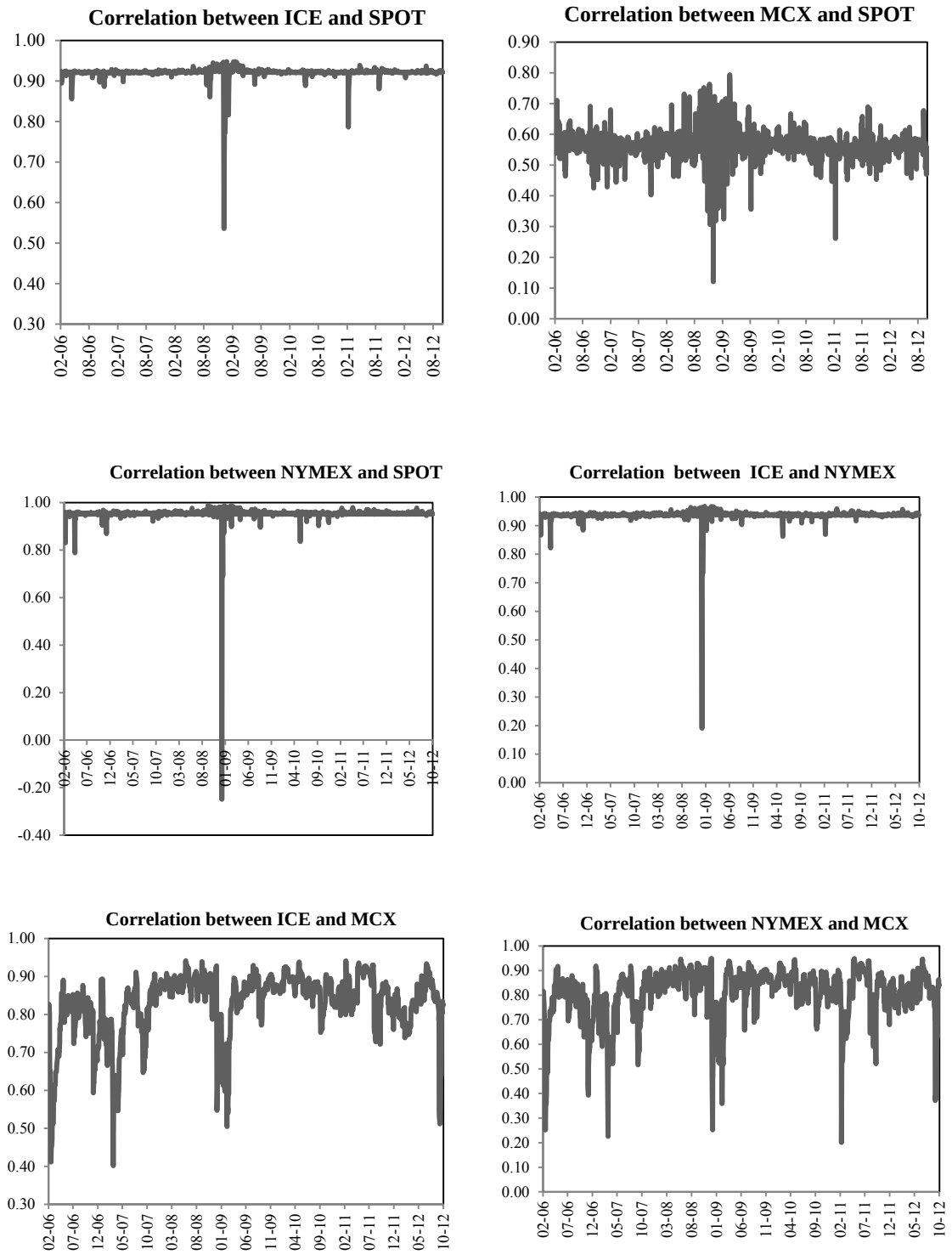

Figure 3. Time –varying conditional correlations from the DCC model

5.3 Dynamic Conditional Correlations

Figure 3 shows the time-varying DCC correlations. The results between futures and spot prices of sample markets indicate the evidence of volatility clustering in each case. But there appears to be stronger volatility clustering in case of MCX. The DCC patterns in case of ICE and SPOT, the magnitude of correlation coefficients are high (0.90) indicating the strong evidence of co-movement. The similar DCC patterns are also seen in case of NYMEX and SPOT. In case of MCX, the dynamic conditional correlations are high and ranges from 0.10 to

0.80. The dynamic conditional correlation of within markets indicates the up until 2008 there is not much variation in correlations. There appears to be strong variation in correlations around October, 2008 then shoot up around June, 2009. Seemingly, there is again fall in correlation around October, 2010 then again went up afterwards, indicating the strong impact of global financial crisis and Eurozone turmoil. Turning to cross market volatility spillovers, there is not much variation in DCC in case of ICE and NYMEX but there are apparent ups and downs in dynamic conditional correlations of ICE and MCX and NYMEX and MCX. The magnitudes of dynamic conditional correlations among the three pairs are ranging from 0.20 to 0.90. The correlation patterns of ICE and NYMEX are in tandem with within market correlations. The correlation patterns of ICE and MCX and MCX and NYMEX reached low values around March, 2007, October, 2008 and October, 2010. After that there is sudden jump in the magnitude of correlations co-efficient and reaches up to 0.90. This implies that during crisis period, the dynamic conditional correlations are generally lower and increases significantly afterwards. The possible reasons could be because of the sudden fall in demand during crisis period and once economies are bottomed out and demand resurges, closer comovement is observed between the alternative oil markets (see Sadorsky, 2012). However, it appears that there is again fall in dynamic conditional correlations during June, 2012 to October, 2012, as can be observed from the graph. To conclude, we can say that there is a clear trend in the dynamic conditional correlations patterns of examined markets during crisis event and normally the correlations appear to be higher afterwards. Finally, we go for diagnostic checking of the model, the diagnostic tests for the standardized residuals and its squared values exhibit no evidence of serial correlation at the 1% level across all the models applied (see Table 7).

Table 7. Diagnostic tests for standardized residuals

	BEKK		CCC		DCC	
	$Q_{(20)}$	$Q_{sqr(20)}$	$Q_{(20)}$	$Q_{sqr(20)}$	$Q_{(20)}$	$Q_{sqr(20)}$
ICE/SPOT	24.818	24.365	27.179	24.995	27.449	25.141
	[0.209]	[0.227]	[0.130]	[0.202]	[0.123]	[0.196]
ICE/NYMEX	23.836	28.986	25.222	28.706	25.502	28.781
	[0.250]	[0.088]	[0.193]	[0.094]	[0.183]	[0.092]
ICE/MCX	31.081	23.874	28.183	21.664	28.347	21.365
	[0.054]	[0.248]	[0.105]	[0.359]	[0.101]	[0.376]
MCX/SPOT	18.018	21.008	17.685	19.667	17.651	19.569
	[0.586]	[0.480]	[0.608]	[0.620]	[0.610]	[0.620]
NYMEX/MCX	23.470	26.219	19.869	32.436	19.446	32.973
	[0.266]	[0.131]	[0.466]	[0.039]	[0.493]	[0.034]
NYMEX/SPOT	26.614	30.618	19.431	15.623	19.313	15.413
	[0.113]	[0.080]	[0.494]	[0.740]	[0.502]	[0.752]

Note: values in parentheses are p-values.

6. Conclusion

This paper examines the price discovery and volatility spillovers between spot and futures and between futures prices of three markets viz., ICE, MCX and NYMEX. The results confirm the price discovery between spot and futures and among sample futures markets. Between spot and futures, the futures price leads the spot price in price discovery process, implying that futures prices assimilate new market information quicker than spot in all sample markets which is in contrast with Goyal and Tripathi (2012). The results of futures prices of three markets analysed pairwise indicate that ICE is the more dominant market followed by NYMEX and MCX in terms of price discovery. Causality test results further confirm a two way information transmission between spot and futures markets which is stronger from former to the later. Two-ways information linkages between pair of futures markets which are stronger from ICE to NYMEX, ICE to MCX and NYMEX to MCX. The volatility spillover results indicate that it is the futures price which assimilates new information quicker than spot in each sample market with the exception of MCX. Turning to cross-market volatility spillovers, the results show that between ICE and NYMEX, the volatility spillover of NYMEX appears to have stronger effect on ICE. Similarly in case of ICE and NYMEX, the spillover impact of MCX is stronger in the short-term while in the long-term ICE dominates over MCX. Seemingly, between NYMEX and MCX, it is the NYMEX in the short-term which has stronger spillover than MCX. While opposite is the case found in the long-run. Based on the results, we conclude that in terms of volatility spillovers, it is the NYMEX which appears to be dominant market while ICE and MCX appear to be equally competing markets which is in line with Spargoli and Zagaglia (2007). The CCC

model results show strong co-movement between ICE futures, NYMEX futures and their spot platforms. For MCX, the cross market association (between futures prices) seems to be much stronger than with in market association (between spot and futures), thus implying that emerging market platform for oil is more integrated with its international exchanges than with the domestic spot markets. The DCC results confirm stronger cross market and with in market association confirm weaker during the economic crisis period which seem to become stronger for stable period.

The research has strong implications for policy makers as well as market traders. The mature market trading platforms like ICE and NYMEX seem to be dominant with regard to information dissemination on oil trading vis-à-vis emerging market platforms like MCX which clearly appears to be a satellite market. ICE seems to play leadership role in the international oil price discovery process. Hence, price quote of ICE for WTI crude should be used as a pricing benchmark by world economies including India. Futures markets for oil seem to be more informationally efficient than spot market, as expected. From risk management perspective NYMEX seems to take lead in the information transmission relating to return volatility. International futures prices seem to be more correlated with each other than with the corresponding spot prices, confirming the international nature of oil as a commodity. Finally, oil market integration seems to be stronger during stable phase than during crisis period which may have policy implications for global oil trade.

Further, the futures market volatility does have some destabilizing implications for spot prices, thus indicating that crude prices may be affected by speculative activity besides the demand-supply fundamentals and tax regimes. The market trades may exploit any departures from equilibrium in the short-run by developing appropriate arbitrage strategies. The present study contributes to commodity market literature especially that which deals with information linkages between mature and emerging market platforms and focuses on little explored area of information linkages between mature and emerging market platforms. The study is particularly relevant given the strategic importance of oil in global economy.

Acknowledgements

The authors are grateful to the editor of this journal and to an anonymous reviewer for valuable comments and suggestions. All errors and omissions are solely ours.

References

Antoniou, A., & Foster, A. (1992). The effect of futures trading on spot price volatility: Evidence for Brent Crude oil using GARCH. *Journal of Business Finance & Accounting, 19*(4), 473-484. http://dx.doi.org/10.1111/j.1468-5957.1992.tb00639.x

Arouria, H. E., Jouini, J., & Khuong, N. D. (2012). On the impacts of oil pricefluctuations on European equity markets: Volatility spillover and hedging effectiveness. *Energy Economics, 34*(2), 611-617. http://dx.doi.org/10.1016/j.eneco.2011.08.009

Baba, Y., Engle, R. F., Kraft, D., & Kroner, K. (1990). Multivariate simultaneous generalized ARCH. *Unpublished Manuscript*.

Bekaert, G., & Harvey, C. R. (1997). Emerging equity market volatility. *Journal of Financial Economics, 43*(1), 29-77. http://dx.doi.org/10.1016/S0304-405X(96)00889-6

Bekiros, D. S., & Diks, G. H. (2008). The relationship between crude oil spot and futures prices: Cointegration, linear and nonlinear causality. *Energy Economics, 30*(5), 2673-2685. http://dx.doi.org/10.1016/j.eneco.2008.03.006

Booth, G. G., Martikainen, T., & Tse, Y. (1997). Price and volatility spillovers in Scandinavian stock markets. *Journal of Banking and Finance, 21*(6), 811-823. http://dx.doi.org/10.1016/S0378-4266(97)00006-X

Carter, C. A. (1989). Arbitrage opportunities between thin and liquid futures markets. *Journal of Futures Markets, 9*(4), 347-353. http://dx.doi.org/10.1002/fut.3990090408

Chakrabarty, R., & Chakravarty, L. S. (2012). An Econometric Study of Indian Export and Import of Black Gold (oil). *Procedia - Social and Behavioral Sciences, 37*, 182-196. http://dx.doi.org/10.1016/j.sbspro.2012.03.285

Chan, K., Chan, K. C., & Karolyi, G. A. (1991). Intraday volatility in the stock index and stock index futures markets. *Review of Financial Studies, 4*(4), 657-684. http://dx.doi.org/10.1093/rfs/4.4.657

Chiang, T. C., Jeon, B. N., & Li, H. (2007). Dynamic correlation analysis of financial contagion: Evidence from Asian markets. *Journal of International Money and Finance, 26*(7), 1206-1228.

http://dx.doi.org/10.1016/j.jimonfin.2007.06.005

Christofi, A., & Pericli, A. (1999). Correlation in Price Changes and Volatility of Major Latin American Stock Markets. *Journal of Multinational Financial Management, 9*(1), 79-93. http://dx.doi.org/10.1016/S1042-444X(98)00047-4

Du, X., Yu, L. C., & Hayes, D. J. (2011). Speculation and volatility spillover in the crude oil and agricultural commodity markets: A Bayesian analysis. *Energy Economics, 33*(3), 497-503. http://dx.doi.org/10.1016/j.eneco.2010.12.015

Engle, R. F. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. *Journal of Business & Economic Statistics, 20*(3), 339-350. http://dx.doi.org/10.1198/073500102288618487

Engle, R. F., Ito, T., & Lin, W. (1990). Meteor showers or heat waves? Heteroscedastic intraday volatility in the foreign exchange market. *Econometrica, 58*(3), 525-542. http://dx.doi.org/10.2307/2938189

Ewing, B. T., & Malik, F. (2013). Volatility transmission between gold and oil futures under structural breaks. *International Review of Economics and Finance, 25*, 113-121. http://dx.doi.org/10.1016/j.iref.2012.06.008

Ewing, T. B., Malik, F., & Ozfidan, O. (2002). Volatility transmission in the oil and natural gas markets. *Energy Economics, 24*(6), 525-538. http://dx.doi.org/10.1016/S0140-9883(02)00060-9

Gagnon, l., & Karolyi, A. G. (2006). Price and volatility transmisison across borders. *Financial Markets, Institutions and Instruments, 17*(3), 107-158. http://dx.doi.org/10.1111/j.1468-0416.2006.00115.x

Goyal, A., & Tripathi, S. (2012). Regulations and price discovery: oil spot and futures markets. *Working Paper*, Indira Gandhi Institute of Development Research, Mumbai , WP-2012-016, 1-29.

Gregory, A. W., & Hansen, B. E. (1996). Residual-based tests for cointegration in models with regime shifts. *Journal of Econometrics, 70*(1), 99-126. http://dx.doi.org/10.1016/0304-4076(69)41685-7

Hamao, Y. R., Masulis, R. W., & Ng, V. K. (1990). Correlation in price changes and volatility across international stock markets. *Review of Financial Studies, 3*(2), 281-307. http://dx.doi.org/10.1093/rfs/3.2.281

Hammoudeh, S., & Yuan, Y. (2008). Metal volatility in presence of oil and interest rate shocks. *Energy Economics, 30*(2), 606-620. http://dx.doi.org/10.1016/j.eneco.2007.09.004

Hammoudeh, S., Li, H., & Jeon, B. (2003). Causality and volatility spillovers among petroleum prices of WTI, gasoline and heating oil in different locations. *The North American Journal of Economics and Finance, 14*(1), 89-114. http://dx.doi.org/10.1016/S1062-9408(02)00112-2

Hong, Y. (2001). A test for volatility spillover with application to exchange rates. *Journal of Econometrics, 103*(1-2), 183-224. http://dx.doi.org/10.1016/S0304-4076(01)00043-4

Hou, Y., & Li, S. (2012). Price discovery in Chinese stock index futures market: New evidence based on intraday data. *Asia Pacific Financial Markets*.

Ji, Q., & Fan, Y. (2012). How does oil price volatility affect non-energy commodity markets? *Applied Energy, 89*(1), 273-280. http://dx.doi.org/10.1016/j.apenergy.2011.07.038

Johansen, S., & Juselius, K. (1992). Testing Structural Hypothesis in a Multivariate Cointegration Analysis of the PPP and UIP for UK. *Journal of Econometrics, 53*(1-3), 211-244. http://dx.doi.org/10.1016/0304-4076(92)90086-7

Karmakar, M. (2009). Price discoveries and volatility spillovers in S&P CNX nifty future and its underlying index CNX nifty. *Vikalpa, 34*(2), 41-56.

Kaufmann, K. R., & Ullman, B. (2009). Oil prices, speculation, and fundamentals: Interpreting causal relations among spot and futures prices. *Energy Economics, 31*(4), 550-558. http://dx.doi.org/10.1016/j.eneco.2009.01.013

Koutmos, G., & Booth, G. G. (1995). Asymmetric volatility transmission in international stock markets. *Journal of International Money and Finance, 14*(6), 747-762. http://dx.doi.org/10.1016/0261-5606(95)00031-3

Lanza, A., Manera, M., & McAleer, M. (2006). Modeling dynamic conditional correlations in WTI oil forward and futures returns. *Finance Research Letters, 3*(2), 114-132. http://dx.doi.org/10.1016/j.frl.2006.01.005

Lean, H. H., McAleer, M., & Wong, W. K. (2010). Market efficiency of oil spot and futures: A mean-variance

and stochastic dominance approach. *Energy Economics, 32*(5), 979-986. http://dx.doi.org/10.1016/j.eneco.2010.05.001

Lin, W. L., Engle, R. F., & Ito, T. (1994). Do bulls and bears move across borders? International transmission of stock returns and volatility. *Review of Financial Studies, 7*(3), 507-537. http://dx.doi.org/10.1093/rfs/7.3.507

Lin, X. S., & Tamvakis, N. M. (2001). Spillover effects in energy futures markets. *Energy Economics, 23*(1), 23. http://dx.doi.org/10.1016/S0140-9883(00)00051-7

Ling, S., & McAleer, M. (2003). Asymptotic theory for a vector ARMA-GARCH model. *Econometric Theory, 19*(2), 280-310. http://dx.doi.org/10.1017/S0266466603192092

Liu, Q., & An, Y. (2011). Information transmission in informationally linked markets: Evidence from US and Chinese commodity futures markets. *Journal of International Money and Finance, 30*(5), 778-795. http://dx.doi.org/10.1016/j.jimonfin.2011.05.006

Mahalik, K. M., Acharya, D., & Babu, S. M. (2010). Price discovery and volatility spillovers in futures and spot commodity markets: Some empirical evidence from India. *IGIDR Proceedings/Project Reports Series*, 062–10.

Malik, F., & Hammoudeh, S. (2007). Shock and volatility transmission in the oil, US and Gulf equity markets. *International Review of Economics and Finance, 16*(3), 357-368. http://dx.doi.org/10.1016/j.iref.2005.05.005

Mu, X. (2007). Weather, storage, and natural gas price dynamics: Fundamentals and volatility. *Energy Economics, 29*(1), 46-63. http://dx.doi.org/10.1016/j.eneco.2006.04.003

Nekhili, R., & Naeem, M. (2009). Volatility spillovers among the Gulf Arab emerging. *The 3rd International Conference on Computational and Financial Econometrics* (pp. 1-14). Limassol, Cyprus.

Ng, A. (2000). Volatility spillover effects from Japan and the US to the Pacific-Basin. *Journal of International Money and Finance, 19*(2), 207-233. http://dx.doi.org/10.1016/S0261-5606(00)00006-1

Ng, K. V., & Pirrong, C. S. (1996). Price dynamics in refined petroleum spot and futures markets. *Journal of Empirical Finance, 2*(4), 359-388. http://dx.doi.org/10.1016/0927-5398(95)00014-3

Nomikos, N., & Andriosopoulos, K. (2012). Modelling energy spot prices: Empirical evidence from NYMEX. *Energy Economics, 34*(4), 11531169. http://dx.doi.org/10.1016/j.eneco.2011.10.001

Rittler, D. (2012). Price discovery and volatility spillovers in the European Union emissions trading scheme: A high-frequency analysis. *Journal of Banking & Finance, 36*(3), 774-785. http://dx.doi.org/10.1016/j.jbankfin.2011.09.009

Sadorsky, P. (2012). Correlations and volatility spillovers between oil prices and the stock prices of clean energy and technology companies. *Energy Economics, 34*(1), 248-255. http://dx.doi.org/10.1016/j.eneco.2011.03.006

Spargoli, F., & Zagaglia, P. (2007). The comovements between futures markets for crude oil: Evidence from a structural GARCH model. *Stockholm University Working Paper 2007-15*, 1-19.

Tangerås, P. T. (2012). Optimal transmission regulation of an integrated energy market. *Energy Economics, 34*(5), 1644-1655. http://dx.doi.org/10.1016/j.eneco.2012.01.007

Tomek, W. G. (1980). Price behavior on a declining terminal market. *American Journal of Agricultural Economics, 62*(3), 434-445. http://dx.doi.org/10.2307/1240198

Tse, Y. (1999). Price discovery and volatility spillovers in the DJIA index and futures market. *Journal of Futures Markets, 19*(8), 911-930. http://dx.doi.org/10.1002/(SICI)1096-9934(199912)19:8<911::AID-FUT4>3.0.CO;2-Q

Tse, Y., & Booth, G. G. (1997). Information shares in international oil futures. *International Review of Economics and Finance, 6*(1), 49-56. http://dx.doi.org/10.1016/S1059-0560(97)90013-7

Zhong, M., Darrat, F. A., & Otero, R. (2004). Price discovery and volatility spillovers in index futures markets: Some evidence from Mexico. *Journal of Banking and Finance, 28*(12), 3037-3054. http://dx.doi.org/10.1016/j.jbankfin.2004.05.001

Zivot, E., & Andrews, D. W. (1992). Further evidence on the great crash, the oil price shock, and the unit-root hypothesis. *Journal of Business Economics and Statistics, 10*(3), 251-270.

Notes

Note 1. American Petroleum Institute (API) gravity index is a measure of how light or heavy a petroleum product relative to water. See Kaufmann and Ullman (2009) for more details.

Note 2. For further details, Chan et al, (1991) could be a good reference on the need to study the volatility spillovers.

Note 3. Previous day observation is used in case of missing observations assuming that the data were unavailable because of national holidays or any other reasons. Two days rolling average to account for time synchronization of different markets lying in different time zones has not been considered in this study due to severe autocorrelation problem as highlighted by (Chiang et al, 2007).

Note 4. Sample oil prices series have been calculated using the first difference of the log price series multiplied by 100.

Note 5. We have also checked the presence of any structural break in the sample series of oil prices by applying Zivot and Andrews (1992) test of unit root with structural break. We find that all the structural breaks occur in the month of September, 2008, indicating the turmoil in oil prices due to global fiancial crisis. We have also reconfirmed the results of price disovery under regime shifts by emplying Gregory and Hansen (1996) model of cointergation with regime shifts. The results confirm the price discovery results of Johansen and Juselius (1992) for all sample commodities. In order to conserve, we have not mentioned the results. However, results are available with the authors upon request.

Appendix

Appendix 1. Zivot-Andrew structural breaks unit root results

Variables	At level	Break period
ICE	-4.347	23-09-2008
NYMEX	-4.818	23-09-2008
MCX	-4.256	01-09-2008
MCXSPOT	-4.377	01-09-2008
SPOT	-4.878	23-09-2008
Critical Values		
1%	-5.57	
5%	-5.08	

Note: All series exhibit non-stationarity, confirming the use of cointegration with regime shifts.

Appendix 2. Gregory and Hansen cointegration test with regime shifts

Variables	t-stat	Break-Period
ICE on SPOT	-15.830**	02-02-2009
SPOT on ICE	-15.918**	02-02-2009
NYMEX on SPOT	-16.805**	16-01-2009
SPOT on NYMEX	-16.857**	16-01-2009
MCX on MCXSPOT	-20.664**	04-02-2008
SPOTMCX on MCX	-20.497**	04-02-2008
ICE on NYMEX	-39.416**	21-01-2009
NYMEX on ICE	-39.432**	21-01-2009
ICE on MCX	-12.933**	27-02-2009
MCX on ICE	-12.895**	27-02-2009
MCX on NYMEX	-20.029**	20-02-2009
NYMEX on MCX	-20.024**	20-02-2009
Significance level critical values		
1%	-5.47	
5%	-4.95	

Note: ** indicates the level of significance at 1%. EG based GH test considers dependent and independent variable like linear regression.

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Marginal Abatement Cost Curves (MACCs): Important Approaches to Obtain (Firm and Sector) Greenhouse Gases (GHGs) Reduction

Ali Ahmed Ali Almihoub[1], Joseph M. Mula[1] & Mohammad Mafizur Rahman[1]

[1] School of Accounting, Economics and Finance, Faculty of Business and Law, University of Southern Queensland, Australia

Correspondence: Ali Ahmed Ali Almihoub, School of Accounting, Economics and Finance, Faculty of Business and Law, University of Southern Queensland, Australia. Tel: 61-43-419-5770. E-mail: ali.almihoub@usq.edu.au

Received: December 31, 2012 Accepted: March 21, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p35 URL: http://dx.doi.org/10.5539/ijef.v5n5p35

Abstract

The study aims to identify appropriate methods that can help organisations to reduce energy use and emissions by using an effective concept of sustainability. In different countries, estimates of marginal abatement costs for reducing GHG emissions have been widely used. Around the world, many researchers have focused on MACCs and reported different results. This may due to different assumptions used which in turn lead to uncertainty and inaccuracy. Under these circumstances, much attention has been paid to the need for the role of MACC in providing reliable information to decision makers and various stakeholders. By reviewing the literature, this paper has analysed MACCs in terms of the role of different approaches to MACCs, representations of MACCs, MACC applications, pricing carbon, verification, and sectors analysis for energy and emissions projections. This paper concludes that MACCs should depend on actual data to provide more reliable information that may assist (firms and sectors) stockholders to determine what appropriate method for reducing emission.

Keywords: marginal abatement cost curves (MACCs), different approaches to MACCs, representations of MACCs, MACC applications, pricing carbon, verification, and sectors analysis

1. Introducing Marginal Abatement Cost Curves

Marginal cost (MC) is the change in total costs that arises when the quantity produced changes by one unit. In other words, the MC of an additional unit of output is the cost of the additional input needed to produce that output. More precisely, marginal cost is the derivative of total production costs with respect to the level of output (Sullivan & Sheffrin, 2003). The MC approach is defined as the first derivative of the cost as a function of energy conservation or for practical causes; additional costs are compared to the benefits to define efficiency levels (Jakob, 2006). It is also called incremental cost.

Narrowing the definition to abatement costs, enterprise cost explains the cost of an individual abatement alternative, which is assumed to have no large indirect economic impacts on markets and prices (Ekins, Kesicki, & Smith, 2011). It takes into account such things as the change of techniques in production factories, enhancement of efficiency, fuel switching, or the achievement of infrastructure changes. Cost measurement contains investment, operation, upkeep, and fuel costs as well as disposal (Hutton, Haller, & Bartram, 2007). In the technology cost accounts, a technology that has many implementations in diverse enterprises takes learning curves into account as well as associated efficiencies and economies of scale (Ekins et al., 2011).

Typically abatement cost data is collected at a micro-economic level and illustrates the costs of technical options for reducing a certain kind of pollution (Schwarzenegger, 2005). They are presented as cost functions (abatement cost curves). Such cost functions plot, for each kind of measure, the cost per unit of avoided pollutant against the volume of avoided pollutants. In applying such curves they mostly confirm the standard economic hypothesis of increasing marginal costs (Faber et al., 2011). However, exceptions mostly exist. In studies of CO_2 abatement costs it is often found that significant primary reductions can be obtained as negative costs (net savings), for example by applying energy reduction measures that will enhance profitability (UN, 2003).

Emission scenarios give an indication of possible effects of mitigation policies (Van Vuuren et al., 2008). Emissions scenarios for climate change investigations are not anticipatory or predictive but reflect expert judgments regarding plausible future emissions depending on research into socioeconomic, environmental, and

technological trends represented in integrated assessment models (Moss et al., 2010). Industrial activities into pollution abatement capital expenditures and operating costs may include more than one of these categories of activities-treatment, recycling, disposal, and pollution prevention; and by three types-air emissions, water discharges, and solid wastes (Gallaher, Morgan, & Shadbegian, 2008). Thus, abatement cost, accurate data collection, emissions scenarios and their applications are of critical importance in emission reduction strategies development. Consequently, a contemporary marginal cost approach can be applied in the form of a marginal abatement cost curve.

Marginal Abatement Cost Curve (MACC) is a function that shows the cost in terms of dollars per unit tonne of GHGs, which is associated with the final unit of reduced emission (Kuik, Brander, & Tol, 2009). This last unit of emission abatement is measured in amounts of CO_2 equivalents reduced. Just as the name suggests, a MACC enables one to analyse the cost of the final abated amount of carbon dioxide as well as reveal the total costs associated with CO_2 abatement by integrating the whole cost curve (van Odijk, Mol, Harmsen, Struker, & Jacobs, 2012). According to the Environmental Protection Agency (2008, p. 10):

The marginal abatement cost curve is an evidence-based tool available to policy makers to assess the potential for greenhouse gas abatement in a region and/ or sector of the economy according to the cost of abatement. It is derived by generating expectations about the potential for abatement relative to a reference case. Construction of the marginal abatement cost curve involves assessing individual initiatives for their abatement potential and cost, and arranging these initiatives in graphical format from least cost to highest cost order. Importantly, the profile of initiatives considered is crucial: invoking some abatement options will impact the abatement potential and costs of others (for example, improvements in electricity efficiency in consumption will reduce the abatement potential of electricity supply initiatives).

A MACC meta analysis was undertaken of up-to-date studies into costs of GHGs alleviation policies. It found that marginal abatement costs of tough long-term targets that were considered by the European Commission are frozen and very uncertain but may surpass costs that have been suggested by present policy assessments (Kuik et al., 2009). McKinsey (2007a) has developed MACCs for the international economy and for several countries including Australia, the USA, the UK, and Germany (Hardisty, 2009). In addition, the concept of a MACC is an approach available to an economy to achieve increasing levels of emission reductions. These are valuable tools in understanding emissions trading, driving forecasts of carbon allowance prices, prioritizing investment opportunities, and shaping policy discussions. However, there are a number of approaches to creating MACCs.

2. Different Approaches to MACCs

MACCs can be determined in many ways. First of all, expert-based approaches are developed from experts' assumptions, which are derived from the respective costs of abatement measures, the creation of CO_2 emissions and the potential of abatement measures in reducing CO_2 emissions. For instance, the cost of abatement measures like incorporation of new technologies, improvements in efficiencies as well as fuel switch can be considered using this approach (Kesicki, 2010c). Based on the various assumptions made, abatement measures are openly arranged from the cheapest to the most expensive. With this arrangement, there is an explicit representation of the associated costs of reducing additional emissions (Hogg, , Ballinger, & Elliot, 2008).

In 1970, the concept of an expert-based approach was initially employed in reducing industrial consumption of electricity and crude oil (Kesicki, 2010a). In recent years, this MACC approach has attracted a great deal of attention due to national studies published by McKinsey & Company (Kesicki, 2010b). McKinsey & Company managed to develop two expert-based curves-countries based and global. Through the process of differentiation, expert-based curves can estimate abatement curves. However, this highly relies on discount rates, subsidies as well as taxes. To reflect the societal perspectives in abatement measures over a specific period of time, reduced discount rates (i.e. 3.5%) are normally used (Pye et al., 2008). However, these abatement cost curves normally consider higher rates of interest, taxes, and subsidies in order to come up with the right measure of costs associated with investment decisions. Similarly, there is integration of specific discount rates associated with higher technologies (Kesicki & Strachan, 2011). A MACC could reveal financial constraints that face households as well as the uncertainties that can be linked to investment decisions geared towards reducing the cost of GHG emissions (Kockelman, Bomberg, Thompson, Whitehead, & Traveled, 2009).

One major advantage of this MACC approach is that it offers a great deal of ease in understanding it (van Odijk et al., 2012). Generally, its marginal costs as well as abatement potential of various measures can be linked to a single mitigation option without any ambiguity. In addition, technological details that are considered in this approach can be extensive (Wang, Wang, & Chen, 2009). However, this will depend on improvements from studies (De Vries, van Vuuren, & Hoogwijk, 2007). Basically, a MACC developed using an expert-based

approach reveals the technological capacity of measures used in abating GHG emissions (Watkiss & Hunt, 2011). Since MACCs developed using this approach highly depend on technical judgments, their assessments require integration of technology-specific subsidy distortions as well as existing taxes (Kesicki, 2010b). Nonetheless, a MACC developed using this approach does not take into account behavioural aspects as well as barriers associated with an institution and its implementation. As a result, this seems to leave this approach with higher abatement potentials compared to other approaches. By improving energy efficiency, it is argued that behavioural aspects are sometimes catered for by "adjusting the reference demand" (Kesicki, 2010a, p. 5).

Based on the concept of 'probability of realization,' a technology-based approach can exclude promising technologies from the future since it primarily focuses on commonly existing technologies. Similarly, this MACC approach makes it impossible to have an accumulated abatement cost from various sectors like transport, residential, and industrial that contribute to GHG emissions (Legge & Scott, 2009). This difficulty is quite common due to the fact that mitigation costs are usually implemented by different experts (decision-makers) with different perspectives. In addition, baseline assumptions in this approach have possibilities of high inconsistencies as different experts may have different references to support their perspectives. It implies that for proper calculation of marginal costs associated with abatement potential, a reference aspect of the development must be considered (Murphy & Jaccard, 2011). However, only those that could offer cheaper abatement potentials should be adopted. Most significant in this MACC approach is non-consideration of various interaction types. It should be noted that MACCs developed by this approach cannot capture interactions that occur between behavioural aspects, economy, and abatement measures. On the other hand, there is a possibility of reducing the abatement cost due to the effects of technology learning that occurs before and after a given period of time considered in a MACC (Kesicki, 2010b). Moreover, this approach presents many difficulties in assessing single-based measures.

A Model-Derived MACC approach is another widely used method (Watkiss & Hunt, 2011). This approach uses various energy models and techniques. In this respect, two major MACC models derived are top-down models and bottom-up models, the former being economy-oriented while the latter is engineering-oriented (Kesicki, 2010c). Historically, policy-makers have encountered many difficulties when they were choosing between models for evaluation of policies to influence the technology choices of energy-related intervention (Jaccard, Nyboer, Bataille, & Sadownik, 2003).

An abatement curve is developed in both bottom-up and top-down models by summarising the price of GHG emissions (CO_2). This carbon price can result from either of the two sources: "runs with different strict emission limits" or from the GHG emissions coming from various carbon dioxide prices (Kesicki, 2010a, p. 6). Unlike the expert-based MACC approach, the model-based abatement curve does not consider or show any technical information. The bottom-up approach is highly dependent on technological information. Bottom-up models present how changes in energy efficiency, fuel, and emissions control tools may impact infrastructure and energy use, consequently environmental impacts (S. Morris, Goldstein, & Fthenakis, 2002).

It is generally assumed that technologies that provide energy services themselves are perfect substitutes except for the differences in the expected financial costs, energy use, and emissions. When financial costs are converted in different time periods to present value using a social discount rate, many of the techniques available appear to be profitable or relatively, just a little more expensive than the existing stocks of equipment and buildings. Bottom-up models appear in many cases as a useful method, which can be profitable or improve the environment at a low cost if these low-emission technologies were to achieve market dominance (Bailie, Bernow, Dougherty, & Goldberg, 2009). Traditional bottom-up models are partial equilibrium models with a focus on optimization of costs in the energy sector or sub-sector specifically, but dispense with links between these sectors and the wider economy (Kanudia & Loulou, 1999).

A bottom-up model sometimes exhibits lower MACC values compared to a top-down approach due to the fact that the approach does not incorporate feedback impacts from both macro- and micro-economic elements (Pye et al., 2008). Other than the model's structure, this approach is associated with assumptions on key economic drivers like technology transfer, disaggregation (sectoral and regional), emission levels and trade across borders (Böhringer & Rutherford, 2008). Apart from the aforementioned weaknesses, it should be remembered that a MACC derived from a bottom-up approach has direct abatement costs, highly risks facing penny-switching, where minor changes in costs lead to large shifts in the energy system, and does not consider rebound impacts of abatement measures (Kesicki, 2010b). This highly contrasts with top-down models that try to consider internal economic reactions in the entire economy (Böhringer & Rutherford, 2008). Logically, this would give limited information on how the economy could be in the future. Based on this fact, a MACC based on a bottom-up approach would be quite inefficient in revealing the actual marginal abatement cost, thus bringing an accusation

of overestimating the core elements of a MACC. One example of a MACC developed from the concept of a bottom-up model is Targets Image Energy Regional (TIMER). Its features support of bottom-up models to yield a MACC with a balanced level of aggregation and concentrates on dynamic energy issues like fossil-fuel depletion, inertia, trade and learning by doing (Kesicki, 2010b). Not only do bottom-up models have a place in energy and emissions reductions but also top-down models are considered important.

Alternatively, a top-down analysis estimates total relationships between relative costs and market shares of energy and other inputs for the economy linked to economic sectoral and macro output in a wider context for balance. From the top-down model, the estimated parameters characterise the response of the model to the policy, including the elasticity of substitution and improved efficiency of energy use in autonomous areas. Also it can estimate historical data, if the previous data is available. If the historical data is not available, estimations can be obtained from other sources (Bataille, Jaccard, Nyboer, & Rivers, 2006). The top-down model estimates parameters of real market data, with higher energy prices and consumption change from a historical perspective; they are supposed to reveal the actual preferences of consumers and businesses. Because they require technological details, they have restricted the top-down models of simulation in fiscal policies, which increase the relative cost of inputs to a particular share. The necessary signal to achieve the fiscal target for reducing emissions is due to the cost implied. This includes intangible costs related to risks of new technologies and risks of long-recovery technology. Preferences for the attributes of one technology over its rival are also very important for any emissions reduction. Thus, estimates of cost to achieve environmental goals using the top-down models are usually higher and almost never less than a bottom-up estimate (Rivers & Jaccard, 2006).

The top-down approach is also subject to criticism because it might not be useful for policy makers (Chattopadhyay, 2010). If the top-down approach produces parameters for the imaging of technological change, the elasticity of substitution and autonomous energy efficiency improvement is the amount of data compiled historically. There is no guarantee that these parameter values will still be valid in the future under different policies to improve the environment (Grubb, Köhler, & Anderson, 2002). Growing concern with this issue has led to some top-down models exploring methods of treatment of technological change using the bottom-up approach. But, as of yet there has been little success in linking real-world evidence to estimations of parameters of technological change in these models (Löschel, 2002). Other difficulties are restrictions imposed on the development of policy-makers understanding of technology as well as policies in the form of specifically building tax exemptions, subsidies, regulations, and media programs (Kesicki, 2010a). Because traditional top-down models represent technological change as a phenomenon, the overall abstract, this approach only helps policy makers to assess the level of fiscal policies on the economy such as taxes and tradable permits.

Top-down models capture government details, supply levels of inputs, end users, product flows, producing sectors, money as well as services that exist in the entire economy (Böhringer & Rutherford, 2008). It can thus be seen as a model with an equilibrium approach to MACC development since it integrates economic data in establishing numeric values of final prices that would influence both demand and supply. Unlike bottom-up approaches, top-down models are commonly used for computations of MACCs (Böhringer & Rutherford, 2008). The use of these two approaches ensures that interactions that occur between abatement measures are significantly considered. It is also possible for one approach to compliment the inconsistencies exhibited in the other since they adopt a system's approach in generating a MACC (Böhringer & Rutherford, 2008). As a result, this makes bottom-up and top-down approaches powerful MACC approaches that reveal uncertainty associated with various abatement measures (Jackson, 1991).

While it is impossible for any model of policy to be completely accurate in its representation of the current circumstances or description of the dynamics of the future, the above discussion refers to standards that can judge the ability of the model to be more useful for policy makers seeking to induce technological change (Rivers & Jaccard, 2006). Policy-makers require models that can be a realistic assessment of combined effects of policies ranging from the economy to broad technology-specific measures (Metcalfe, 1995). Thus instruments will include the potential for command and control systems, as well as financial charges and subsidies (Stavins, 2007). To do so, models should include a clear representation of technologies that compete to provide services in all economic sectors. Also, they should mimic the way in which consumers, companies, and producers choose between these techniques to reflect the close balance and feedback in the real world. These could achieve balance between energy and technology overall structure and performance of the economy (Tester, 2005).

Since none of the traditional models (bottom-up or top-down) are good performers in relation to these standards, efforts have been made to develop a hybrid that combines the essential elements of both models (Murphy, Rivers, & Jaccard, 2007; Schaefer & Jacoby, 2005). Thus, some models integrate supply and demand for energy, and even include some of the interactions between the energy system and economy as a whole. Developments

with the optimal model MARKAL is worth considering. MARKAL is applied on a large scale from bottom-up, dynamic, and originally mostly linear programming model developed by the Energy Technology Systems Analysis for International Energy Agency (Schaefer & Jacoby, 2005). As a result, it has contributed to this framework of models for energy planning, national and local, and developed strategies for carbon mitigation (Nystrom & Wene, 1999; Seebregts, Goldstein, & Smekens, 2001; Worrell, Ramesohl, & Boyd, 2004). There is a new type of this form called SAGE (new MARKAL) for a degree of behavioural realism in the process of technology acquisition (Murphy et al., 2007) by consumers, producers and modelling, also myopia, and including the representation of non-monetary costs that affect behaviour. On the other hand, some models include technical details, mostly in the energy supply sector (Bohringer & Loschel, 2006), although others have made greater progress in their representation, including more details of other sectors (Schafer & Jacoby, 2006). Unlike in the expert-based approach, model-based approaches present little complications in combining various abatement curves from different sectors (Böhringer & Rutherford, 2008), due to their reliance on societal perspectives. It is therefore concluded that a majority of expert-based weaknesses are addressed by model-driven approaches, and could be a useful methodology to develop a MACC, but the question of how to represent complex models and their output to decision makers is still a challenge.

3. Representations of MACCs

MACCs are becoming a standard tool for analysing price and number effects in carbon markets and are broadly used, for example, for analysing the integration of national trading systems (Anger, 2008; Criqui, Mima, & Viguier, 1999; Ellerman & Decaux, 1998 ; Stankeviciute, Kitous, & Criqui, 2008). MACCs can be derived in numerous ways which are reflected in the differences across models (Flachsland, Brunner, Edenhofer, & Creutzig, 2011). According to McKinsey & Company (2010a), the representation of a MAC-curve can be in the form of a bar chart or curve. Graphs can be positive or can exhibit negative and positive values. However, whichever representation method is used, there is little difficulty in reading them. For instance, in a bar chart every bar represents one option towards low carbon emissions with its width representing the abatement capacity relative to business as usual (BAU). The height of every bar also reveals the cost of abatement options, relative to BAU. In either line graph or bar chart, this cost is expressed in dollars/Euros/Cedis per unit tonne of GHG emission controlled or avoided. However, the sum of all bar-widths reveals the total abatement potential while their total area reveals the marginal costs for the chosen direction such as in Figures 1, 2 and 3. Bar charts are now more commonly used even though the method is still referred to as a MAC curve.

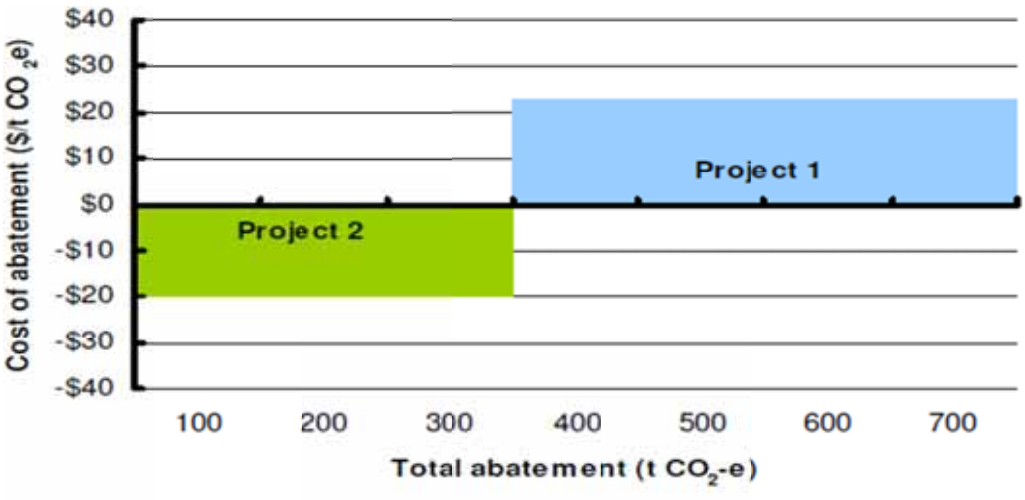

Figure 1. MACC for two projects

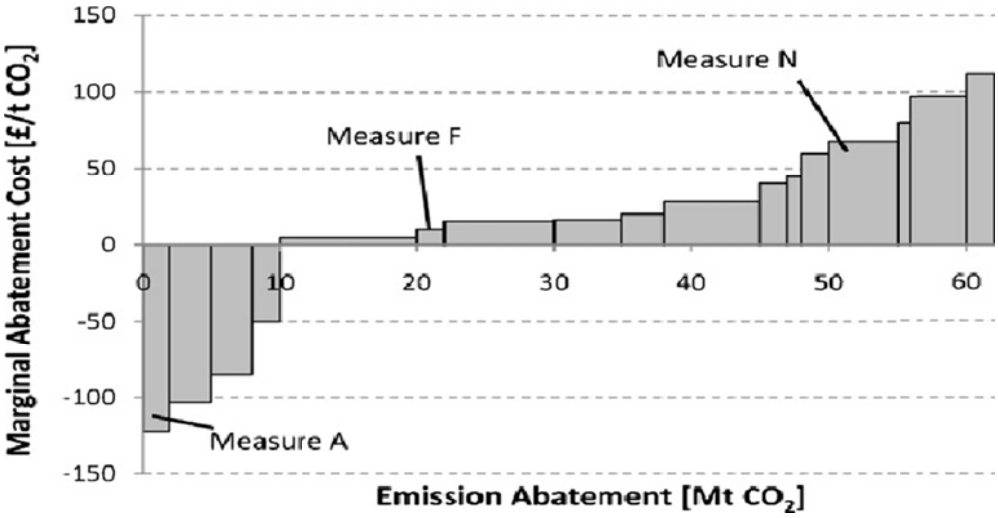

Figure 2. Sample marginal abatement cost curve (Kesicki & Strachan, 2011)

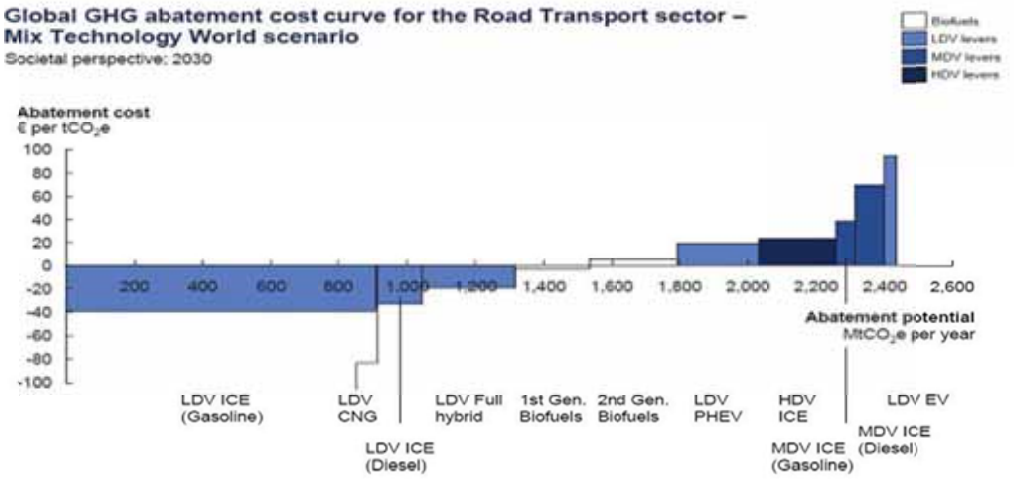

Figure 3. Global GHG MACC for transportation (Powell, 2011)

4. MACC Applications

MACCs have been applied by a number of researchers. Many economists, research institutes, and consultancies have produced MACCs. Bloomberg New Energy Finance (Turner, G, Sjardin, M, & Capua, M. D, 2010) and McKinsey & Company (2007a) have produced broad economy analyses of GHGs reductions for the United States. ICF International (Schwarzenegger, 2005) produced a California specific curve following AB-32 legislation (Sweeney & Weyant, 2008). The US Environmental Protection Agency has done work on a MACC for non-carbon dioxide emissions. Enter data and LEPII-CNRS (France) produced MACCs with the POLES model for the 6 Kyoto Protocol gases. These curves have been used by various public and private actors to assess carbon policies (Turner. G et al., 2010).

Normally, MACCs cover emissions reduction opportunities across some sectors in an economy including power, industry, waste, buildings, agriculture, transport, and forestry. In the UK, MACCs have been widely used in both domestic and international environments in shaping climate change policies (DECC, 2009). This implies that these curves have played a significant role in helping policy makers. In connection to this, the Committee on Climate Change, which was initiated to guide the UK on abating greenhouse effects, came up with MACCs that found various applications in different areas. In this regard, the UK government used the concept of a MACC to introduce a carbon tax that aimed at abating the use of fossil fuels in agricultural, commercial, and industrial

sectors (DECC, 2009). Since their establishment, the use of MACCs has spread to quite a number of countries, which use them to evaluate their climatic policies. For instance, this has been realized in France where model-based MACCs significantly contributed to the preliminary steps in evaluating abatement measures. Based on these curves, quota systems, renewable obligation and feed-in policies have been introduced to control the deployment process of technologies associated with the generation of electricity. However, it is reported that the majority of MACCs being used in the UK are technology-based (bottom-up).

Economically, MACCs have been used by the UK government to guide the potential of technical mitigations for energy (Markets, 2010). It also uses these curves to forecast the future of energy sectors in terms of its cost elements. Another economic application of MACCs is by carbon traders who use it to derive the supply function, which helps in modelling the fundamentals of carbon prices. Based on the decision making properties of MACCs, power companies have applied these concepts in guiding their long-term investment decisions based on the different efficiencies offered by generation choices of abatement measures (Smith et al., 2007). In recent work by McKinsey & Company (2007), it was realized that MACCs have been widely applied to evaluate how greenhouse gas emissions can be reduced.

Nowadays, MACCs have improved as a standard instrument to analyse the impacts of the Kyoto Protocol and emissions trading (Ellerman & Decaux, 1998 ; Wassmann & Pathak, 2007). The idea of a MACC has come from a company or factory level model of reducing emissions, but it is regularly used for assessing reduction costs for individual sectors of the economy as well as certain regions (Klepper & Peterson, 2004). Given (a) emissions of unwanted materials and (b) the availability of pollution control technology, use of marginal costs (shadow prices) to achieve a specific goal given a certain emission level of production is increasing (McKitrick, 1999). Apart from technological adaptation there may also be structural changes that can overcome obstacles to emissions reduction. Many firms have used MACCs instead of net present value (NPV), which determines the present value of net costs by summing the discounted cash flows over the life of the option or project. MACCs present a complete picture of environmental costs and benefits, each option over the lifetime of capital employed (Jorge, Fabio P, Genice A, & O., 2005). To exploit more and get further benefits of using MACC, the following section examines explicit carbon pricing policy regimes that are currently in place.

5. Pricing Carbon

Mitigation risk could be driven by growing pressure from all society segments. Domestic and international efforts may attempt to prevent the worst damage caused by climate change such as significant reductions in emissions of GHGs (Sandor, Bettelheim, & Swingland, 2002). Reductions in emissions are a massive challenge. According to IPCC (2007c), Stern (2007), Garnaut (2008), and Hardisty (2009) there is a globally need to decarbonise by up 60 to 80 per cent by the year 2050, to give business a reasonable opportunity to avoid the worst effects of climate change. The size of this change means that it will put appropriate price signals in the right place to gradually increase the cost of carbon. Management provided by carbon tax on a large scale in one form or another is the main challenge for policymakers at all levels, in all sorts of businesses. Carbon-intensive processes will need to make deep changes to avoid large increases in costs, after-effects on competitiveness, profitability and organizational sustainability (Sandor et al., 2002). Providing a ‘cap and trade’ scheme also means that overall emissions are limited in preventing the expansion and growth in emissions (Parker, 2009). Thus organizations of all kinds have to develop strategies for growth and expansion of their operation within this new frontier.

Including management of carbon in the process of effective decision-making requires that there is a given carbon price (CP). CP can be embedded in the price during financial and economic analyses of projects; these are used to understand current and future effects of different investment decisions on capital (Hardisty, 2009). However, there are many different methods to consider when evaluating carbon. One such method is market-based prices, which set plans for various trading, social value of the real damage of each additional tonne of GHG emissions emitted, by costing of the shade, and marginal costing of controlling pollution (Shobe & Burtraw, 2012). Because of their importance each method will be considered in turn.

There are many kinds of emission reduction prices related to each domestic area that depend on different types of mitigation practices (Lee, Zhou, Jung, Wisniewski, & Sathaye, 1996). Carbon pricing, in one form or another soon became common. In Europe, the prosperity of the carbon market was worth over US$ 24 billion in 2007, handling more than one billion tonnes equivalent of CO_2 (tCO_2e). The trading system in the European Union (emissions trading system) long-term stage was 2 average price and predicted to be about US$ 20-25/tCO_2e (Hardisty, 2009). Clean Development Mechanism (CDM) which was established under the Kyoto Protocol, traded more CO_2 equivalents in 2006, and valued at more than US$15 billion (Hamilton, Bayon, Turner, &

Higgins, 2007). Other trading schemes, voluntary and orderly, began to appear all over the world (Hardisty, 2009). In Alberta, Canada's oil and gas-producing province, home of the huge Athabasca tar sands reserves, the Canadian government announced there will be a new tax just on GHG exceeding mandatory reduction targets that is $15/tonne (Aldy & Stavins, 2012 ; Hardisty, 2009). Voluntary Chicago Climate Exchange has increased year after year since its inception. The Montreal Stock Exchange announced a similar voluntary market in Canada (Hardisty, 2009). Carbon prices paid are also reducing carbon with mandatory renewable energy targets (MRETs) being developed by various governments around the world, national states, and at local levels (Kuwahata & Monroy, 2011).While many USA states have their own major goals for renewable energy in place, full participation by the United States at the federal level could have a resounding impact on the way the rest of the planet approaches organizing carbon reduction in the next decades (Hardisty, 2009; Speth, 2009). Australian has set maximum GHGs thanks to the State and Commonwealth Governments MRETs, which started in 2010 (Jotzo & Betz, 2009). All of these measures impose increasing penalties in terms of direct financial cost to firms that emit large amounts of GHGs.

Although most of the global communities agree to reduce carbon emissions (Nordhaus & Yang, 1996), there is a significant difference in carbon price between the current market-based systems (in the case of cap-and-trade) and carbon tax rates on the basis of real value of the damage caused by carbon emissions in the atmosphere (Metcalf, 2009). The social cost of carbon reflects the value of the damage caused by each additional tonne of GHG emissions that is put in the atmosphere. These impacts are in terms of the likely effects expected on the global economy caused by global warming, sea level rise, and weather-related events decline in agricultural production, loss of biodiversity, and others (Hardisty, 2009; N. Stern, 2008). Carbon markets or taxes reflect only the cost of government policies that are imposed on emitters. This cost is likely to represent only a fraction of the true value of the damage (Metcalf, 2009). Because emissions are linked to rising temperatures from atmospheric concentrations of GHGs, these gases are long-term. Thus, the total amount of GHGs in the atmosphere are directly related to the social cost of carbon, even to the extent that the higher the concentrations, the higher the social cost of carbon (N. Stern, 2008).

It is important to see the effects of climate change on communities and present strategies to deal with these effects (Wilkinson et al., 2009). N. H. Stern (2007) examines the economic effects on a community using expected impacts of climate change at the macroeconomic level. He has estimated what it would cost to take action to stabilize levels of GHGs in CO_2e less than 550 ppm (Hepburn & Stern, 2008). To give the world a chance to avoid high temperatures above about 2°C, on average, it would cost about 1 per cent of global GDP each year (N. Stern, 2008; Wilkinson et al., 2009). However, not acting to control the emissions, in other words to continue business as usual emissions path, will cost the global economy between 5 and 20 per cent of global output now and forever. Therefore, the fight against climate change is a strategy of pro-growth (Hardisty, 2009).

Although emission reduction can boost profits, an increase in costing can have a negative effect on business (Smale, Hartley, Hepburn, Ward, & Grubb, 2006). N. H. Stern (2007) does not address exactly how these results affect long-term business, investment decisions and business planning. Climate changes form risks, uncertainties and many opportunities for business, as society increasingly demands to organise work and decrease emissions of GHGs. If this takes the form of mandated goals that reduce carbon and market structures associated with them, some form of carbon tax is needed to be studied carefully and have clear economic value (Hardisty, 2009). Costs and benefits from actions taken by companies to reduce emissions also need to be studied carefully as the cost of the carbon market (now in the order of US$5-25/t$CO_2$e) ascends toward the social cost, that N. H. Stern (2007) estimates at US$85/t$CO_2$e, to get on the path of emissions as 'business as usual'. It is worth mentioning, in addition to that, since the publication of the Stern Review, world GHG emissions have accelerated significantly (International Energy Agency, 2007), proposing that a similar analysis of the social cost of carbon made today will result in higher social cost of carbon.

A shadow price of carbon and social discount rate could be used to evaluate some environmental projects (Hanley, 1992). The United Kingdom's Government identified the Shadow Price of Carbon (SPC) as one of the options to assess projects within the UK (DEFRA 2008). SPC is based on the realisation that one nation cannot be isolated in determining the course of global emissions. Based on the stability of global concentration of CO_2 in the atmosphere at 550 ppm, N. H. Stern (2007) calculated implicit social cost of carbon in the USA of $30/t$CO_2$e. DEFRA (2003) developed a strategy to achieve stability in the United Kingdom at 550 ppm at a carbon price under US$50/t$CO_2$e, an increase of 2 per cent per year starting in 2007. HM Treasury indicated that a standard social discount rate of 3.5 per cent could be applied (Guo, Hepburn, Tol, & Anthoff, 2006; Scarborough, 2011).

There is another method to express the cost of carbon which is by using marginal abatement cost (Hardisty,

2009; J. Morris, Paltsev, & Reilly, 2008). MAC differs from market price for carbon which is determined directly or indirectly through public policy objectives. Based on the MAC, there is a cost of technological measures and processes to eliminate or reduce emissions (Enkvist, Nauclér, & Rosander, 2007). An actual carbon price signal might realise important mitigation potential in all sectors (IPCC, 2007c). Although carbon pricing is difficult to control, it is worth considering how it could affect efforts to reduce emissions of GHGs. By imposing a cost on emissions, the carbon price inflates operational savings available from the emission reduction activities. In particular, carbon price is considered one key way to capture opportunities available for reducing emissions from sectors.

6. Verification

GHG emission trades to date have included Verified Emission Reductions (VERs) (Springer & Varilek, 2004). In essence, this represents quantifiable change in emissions whose outcomes from a particular activity can be verified by a third party. One of the key drivers to trade in the early stages of this is to hedge such risks (Convery & Redmond, 2007). Prices of these transactions hold some information about prices in the future, because the trading of permits is likely to be valid in the first Kyoto commitment (Springer & Varilek, 2004). However, there are serious doubts whether any particular reduction, regardless of how accurately quantified and monitored, will eventually earn a certificate in accordance with the rules of governments, which have not yet been developed (Heal, 2007; Tietenberg & Nations, 1998). Thus, buyers are expected to have the lowest willingness to pay for pre-compatibility permits. In contrast, the restrictions imposed on binding emissions create a natural source of demand from companies who meet the restrictions internally. This would be expensive (Varilek & Marenzi, 2001).

On the other hand, there is reason to wonder whether those price increases will be realised (Schmidheiny, 1992). This drives the private sector to find innovative ways and cost-effectiveness to abate emissions (Hoffman, 2005). Therefore, an effective MACC with actual and relevant data could help these firms and be the innovative driver.

Verifiable stakeholders could be located in seven main groups (Foster, Obbagy, & Change, 2001; Rankin, Windsor, & Wahyuni, 2011), firm employees and management, shareholders and owners, customers, government agencies, Non-Governmental Organisations (NGOs) and the general public, verifiers and GHG emission reduction trading partners and intermediaries.

To verify various anticipations depends on what the company intends to accomplish with information of its own emissions (Bellassen & Leguet, 2007). The company can, however, want to use verification as a means to improve the inventory. If a company makes general obligations to reduce their emissions, then the company's verification has improved. (Assadourian, 2005; Foster et al., 2001). If a company intends to get some form of subsidy to reduce its emissions and is assured that it will not be punished in reducing emissions voluntarily, then verification expectations are greater. What a company want to achieve by keeping track of GHGs emissions, and thus the extent of activities achieved depends on the position of its administration, and can change over time (Kolk, 2009).

Current activities related to GHG emissions' verification fall into two main categories verification of emissions' inventories at firm level and verification of emissions' reduction projects (Foster et al., 2001; Vine & Sathaye, 2000). In addition, methods used in these activities are similar in many ways as they examine both accuracy and completeness of reported emissions (Vine & Sathaye, 2000). Therefore, both usually include baseline emissions and emissions over a period of monitoring.

Company-wide emissions' inventories require verification of a historical baseline if the company is committed to tracking or reducing their emissions relative to their last year, such as in 1990 (Springer & Varilek, 2004). The first year, that the company used to estimate or measure emissions could be used as the base year. Any significant changes to the company's structure and actions would need to be modified, as well as any changes in methods used in calculating emissions. Any other changes affecting the image of GHGs would need to be included yearly (Foster et al., 2001). Changes may include a large company's acquisitions and divestitures, changes in product mix, outsourcing, and transfer of assets (Miozzo & Grimshaw, 2011). If the company does not consider changes in its structure, it will use the base year emissions as the company's criterion for comparing between previous and current outcomes of any reduction in emissions.

Verification refers to collection of data to identify and prove environmental information, according to specific objectives, for example, to verify emissions of GHGs, emissions over the past year (Trexler & Kosloff, 1998). Verification requires development and implementation of a strategy (PCA, 2002):

1- Scope of the data being verified (for example, GHG emissions from a company's operations in all parts of the

world);

2- Types of data collection (for example, measurement of GHG emissions data, the level of activities causing emissions, and emission factors to translate activity data in to emissions of GHGs); and

3- Perform a battery of tests to make sure the information is correct (for example, to recalculate estimates of emissions).

Design and implementation of infrastructure at the level of the firm to gauge and report on GHG emissions is a relatively new and complex mission (Fiksel, McDaniel, & Mendenhall, 1999). This measurement must be integrated and work in a firm's existing environmental management systems, leading to increased demand for human and financial resources (PCA, 2002). Measurement of GHGs also provides a technical challenge (Arroyo & Peña, 2003; DeSimone & Popoff, 2000). Although there are a growing number of consultants, engineers and accountants who can assist firms to develop a strategy for GHGs, there are only a few firms that have significant experience implementing these strategies (PCA, 2002).

It is important for companies to manage environmental strategies before agreeing to emissions trading. The companies involved need to build credibility in their Partnership for Climate Action (PCA) (Pattberg & Stripple, 2008). Third party verification of emissions as a prerequisite to trading formulates a procedural situation that could impede market activity (Lieberman, Jonas, Nahorski, & Nilsson, 2007). In addition, the use of third party auditors adds transaction costs for emissions trading, and there are currently no standards governing the adoption of auditors. The PCA (2002, p. 1) study, conducted in the USA on a group of firms was compiled by Environmental Defense, of which "intent is to increase understanding of GHG issues through an exploration of the basic and interconnected building blocks of a credible GHG management program". This analysis is based on identifying common elements and the core practices of capacity building programs for nine firms in a PCA. Every firm of the PCA independently and voluntarily designs its management of GHGs. A review of the each firm's program reveals its main elements, which can then be related and compared with a global framework designed program. These elements are setting goals, measuring emissions, action to reduce emissions, and accountability (Price, Galitsky, & Kramer, 2008).

The PCA based its framework of evaluation on an organisation of the United States Acid Rain Program for sulphur dioxide emissions trading. The Acid Rain Program's design was used by the PCA to determine how to apply and control GHGs internationally and showed businesses how to start implementing their own programs for reduction in GHG emissions.

Further discussion with business of the Acid Rain Program revealed further information to benefit the emerging GHG programs by the PCA, both regulatory and voluntary. Firms in the PCA program, who wanted to follow regulatory and/or voluntary practice, used this information to design their individual frameworks. These frameworks represented the basic design decisions made by each firm in the design of their own approach to reduce emissions of GHGs. The details of each design highlighted the differences between each firm estimation and calculation of emission reduction.

Verification is significantly important for environmental data and may lead to actual worthwhile information (Ramanathan & Xu, 2010). Quality control of emissions data commences with a solid basic foundation that is further supported by internal auditing, a process that is managed centrally by companies in the PCA. This process can be similar to a financial audit. It is a quality inspection during a second review by a third party verifier, which is increasingly being used by firms. Though all firms of PCA use or intend to use third-party verification, there are no uniform guidelines for conducting such reviews. In addition, the reviews are relatively new and there are few third-party auditors. However, those few, who have conducted public and private reviews, conclude that data management systems could develop greenhouse gas inventories. These inventories could then show more realistic estimates of the reduction in GHG emissions. This would confirm that the stock reflects accurate operations and covers the actual sources of material GHG emissions (Foster et al. 2001). These estimates and reductions would improve the firm's protocol and would have more consistency with the International Performance Measurement and Verification Protocol (IPMVP).

The International Performance Measurement and Verification Protocol (IPMVP) is an important tool to determine energy savings (Dietmair & Verl, 2009). This method aims to increase certainty, reliability, and level of savings (AEPCA, 2004). It offers some options that determine savings (A, B, C, D). First of all, option (A) Retrofit Isolation (Key Parameter Measurement) which says that savings may be determined by field measurement of the key performance parameters. In fact, typical applications can contain a lighting retrofit, where the power drawn may be monitored and hours of operation are possible to be estimated. Option (B) Retrofit Isolation which says that all Parameter Measurement savings can be determined by field measurement of

all key performance parameters that describe the energy use of the ECM-affected systems. Typical applications can contain a lighting retrofit where both power drawn and hours of operation are possible to be recorded. Another one is option C (Whole Facility) which sees that savings may be determined by measuring energy use at the whole facility or sub-facility level. Typical examples can consist of measurement of a facility where several ECMs may be implemented. Lastly, option (D) Calibrated Simulation which says that savings can be determined through simulation of the energy use of the whole facility. Typical applications can include measurement of a facility where several ECMs might be implemented. However historical energy data are not available. In line with the above discussion, it can be concluded that IPMVP is an appropriate tool for calculating and measuring energy saving (AEPCA, 2004; Energy & Savings, 2001). Therefore, this study will calculate actual energy saving and GHG emission reductions by using the IPMVP, which will strengthen mechanisms for measuring, reporting and verification of emissions. IPMVP concentrates on the general aspects of every firm in all sectors. However, companies in specific sectors will need to calculate GHG inventories that are peculiar to their sector (Lazarowicz, 2009).

7. Sectoral Analysis

Studies by McKinsey and Company (2007a) have developed a MACC for the global economy and for different nations including Australia, the USA, UK, and Germany. National MACCs of this sort are necessarily at high levels, and concentrate on sectors of the economy. Overall, these MACCs disclose a common pattern of significantly available negative cost (net saving) of abatement opportunities (Enkvist et al., 2007). While these overall macro trends are generally instructive, national or sectoral MACCs are not particularly useful for decision making within particular industries and firms as well as for particular projects or investment decisions (Enkvist et al., 2007). However, MACCs related to firms in each sector may provide advantages (Vijay, DeCarolis, & Srivastava, 2010). Sectoral analysis may require detailed disaggregation into many sectors. The total amount of global GHGs emissions across all sectors was 40,858 million tonnes of carbon dioxide equivalents (Mt CO_2e). Australia's net emissions across all sectors totalled 576.2 (Mt CO_2e) in 2008 (Library, 2010). In order to provide evidence, it is necessary that some issues related to each sector are reviewed.

Power sector (Stationery energy), in spite of the importance of the power sector and its contribution to the achievement of effective development programs, the sector's negative impacts on the environment include local effects on air, water, soil, as well as the emission of GHGs. This sector accounts for 25% of global GHG emissions that contribute to the phenomenon of climate change (Australia, 2007; Baumert, Herzog, & Pershing, 2005). In addition, the sector has been shown to effect local air quality and public health (Economic & Asia, 2001). The sector could provide the most significant abatement potential. Improving efficiency at generator plants, capturing and storing emissions, cogeneration, and renewable energy generation are some of the largest abatement potentials that are being investigated (EPAQ, 2008). Both households and industrial sectors consume energy, but the latter also emits GHGs from its processes. Thus, in Australia the power generation sector contributes 51.4 % of GHGs emissions in CO_2 equivalents (Library, 2010). Current emissions of CO_2 from Australia grid-connected electricity generation sector are nearly 190 million tons per year with average emissions intensity of about 0.9 tons/MWhour (t/MWh) (Chattopadhyay, 2010). Any abatement interventions here both in generation and consumption of energy could provide significant economic and environment benefits.

Industry sector emits about 21% of global GHG emissions (Australia 5.4%) that includes direct fossil fuel combustion, indirect CO_2 emissions from electricity and heat consumption, and non-CO_2 emissions from industrial processes (Baumert et al., 2005). Many methods have been applied to measure pollution abatement costs, including surveys and econometric estimations (Riedy, 2003). The common study referenced is the USA cost data that comes from the Census Bureau’s Pollution Abatement Costs and Expenditures (PACE) Survey (Shadbegian & Gray, 2005). Another study has been conducted by McKinsey & Company (2007) and underpinned by ten companies. This study attempts to identify abatement opportunities consisting of energy efficiency, shifting fuels, or shifting to low-carbon alternatives when building new infrastructure (Nauclér & Enkvist, 2009).

Building sector can be split into residential and commercial, and accounts for 15.3% of international GHG emissions (Baumert et al., 2005). This is made up to 9.9% from commercial buildings and 5.4% for residential. The building sector represents a very small portion of the energy sector emissions and a slightly larger portion of the waste sector emissions. While there are a significant number of abatement options that are applicable to this sector, it represents a proportionally small amount of abatement gains. There is however a significant opportunity for the building sector to provide opportunities for improvements in construction practices that will result in emissions abatement in other sectors (EPAQ, 2008). For instance, improvements in more energy efficient

buildings will result in a decrease in energy demand and consumption in most countries.

The United States and the European Union were the two largest emitters of carbon dioxide in 2004 (Baumert et al., 2005), with about 2 $GtCO_2$ and about 1.2 $GtCO_2$ emitted from each respectively. Emissions from the building sector varies greatly between countries, with a major association between emissions and the level of socioeconomic improvement in the region (Lazarowicz, 2009).

It is expected that emissions from buildings would be direct and indirect. These emissions are likely to grow from about 9 $GtCO_2$ in 2006 to 12 $GtCO_2$ in 2030, an increase of 40% between 2006 and 2030, which represents about 15% of the total increase in global emissions by 2030 (Lazarowicz, 2009; Perez-Lombard, Ortiz, & Pout, 2008; Shiel, 2009). Non-OECD States are responsible for 88% of the total increase in emissions at world level; a new building in most of these areas in the coming decades will also be constructed. It is expected that non-OECD emissions from buildings will rise by 2.4% per year, while emissions in OECD states will rise by only 0.4% per year between 2006 and 2030 (Lazarowicz, 2009; Perez-Lombard et al., 2008).

Implementation of a carbon emission trading system is also high on the agenda of the Australian Government. The building sector is in favour of emission trading (for example, be able to trade emissions with other industries), and there is a feeling that this would be more effective (a gain in both monetary value and sustainability) for the industry. Energy consumption has increased in residential and commercial sectors and their services in Australia by 2.2% in 2007-08 (Schultz, 2009). In 2005, commercial sector and services contributed to the 10% or 56Mt CO_2e from GHG emissions in Australian. The residential sector also increased emissions, though less rapidly, due to occupants' increasing use of such devices as energy-intensive air conditioning. In 2005, the residential sector contributed 13% or 74Mt CO_2e of GHGs in Australian emissions (McKnoulty, 2009). Figure 4 below illustrates the growth in the building sector's energy use during 1973–74 and 2003–04.

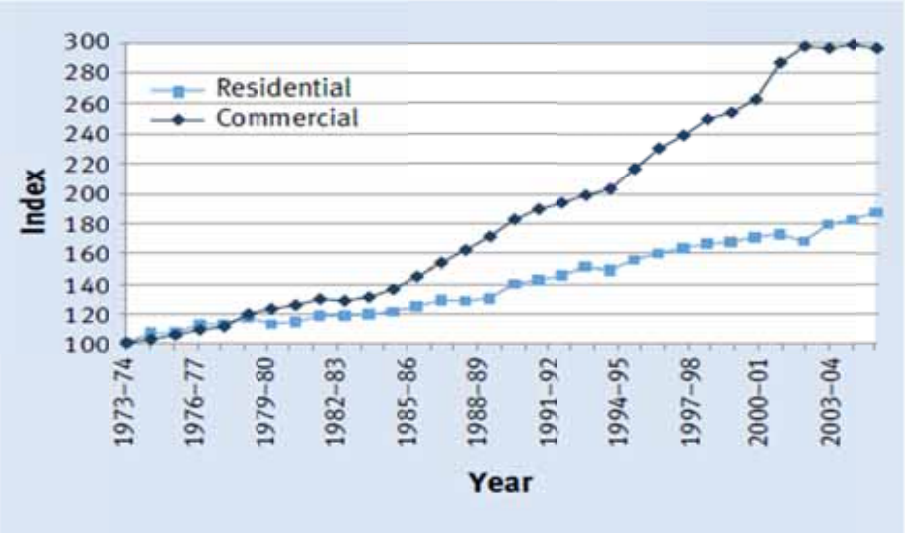

Figure 4. Growth in energy use in building sectors 1973–74 and 2003–04 (McKnoulty, 2009)

There are great opportunities to reduce (cost-effectively) GHG emissions from buildings (Shiel, 2009). It involves better insulated and designed buildings that create lower consumption of energy such as efficiency in lighting, lower heating and cooling energy demand, the replacement of gas with solar power and biomass in space and water heating, application of standards of efficiency in household appliances such as air-conditioners and the replacement of biomass for traditional cooking and heating gas in developing countries (ürge-Vorsatz, Harvey, Mirasgedis, & Levine, 2007; Wagner et al., 2012). In addition, opportunities for mitigation increase, from behaviour changes to lowering energy consumption by users of buildings, particularly in developed countries and several sector of societies in advanced developing countries (Lazarowicz, 2009; Mark Levine & Ürge-Vorsatz, 2008). Abatement cost curves of carbon reduction for the domestic sector show that some measures will be very effective in reducing emissions of CO2 and have demonstrated to be cost-effectiveness for different stakeholders (Kellett, 2007; Weiner, 2009). Therefore, the building sector could play a significant role in reducing GHG emissions with no cost/least cost abatement.

Agricultural sector activities account for approximately 15% of global GHG emissions (Australia 15.2%) (Baumert et al., 2005). This sector presents an important and unique opportunity to provide net negative

emissions. Thus, the agricultural sector can offset emissions from other sectors. Within the literature there are many attempts to develop international MACCs for this sector (McKinsey, 2008, 2009; Moran et al., 2010). Specific MACCs have been developed for agriculture, employing qualitative judgment (Weiske, 2005, 2006), and other practical methods (Smith et al., 2008; Weiske et al., 2006). These studies are dominated by macroeconomic general equilibrium models for emissions reduction (top-down analysis). Committee on Climate Change (UK) has recognised the need to fulfill emission reductions in an economic way when it adopted a bottom-up MACC to make this method easier to apply (Moran et al., 2010).

The UK agriculture sector has used four methodological steps for developing a MACC (McVittie, Rees, & Topp, 2010; Moran et al., 2010):

Identify the baseline business as usual (BAU) abatement emission projections for specified budgetary periods of near, medium and long term (e.g. 2012, 2017, 2022).

Identify potential additional abatement interventions for each period, above and beyond the abatement forecast in the BAU, by identifying an abatement measures inventory.

Quantify – calculate MACC

Qualify the maximum technical (abatement) potential MACC in terms of central, low and high estimates (accounting for uncertainties around estimates), based on a review of the likely levels of compliance/uptake associated with existing policies and alternative market conditions.

Transportation sector accounts for approximately 14% of international (Australia 13.9%) GHG emissions (Baumert et al., 2005). Many governments imposed taxes and raised prices of fuel to bring this sector in line with requirements of environmental standards. Existing technologies and changes in operational practices can be introduced to reduce energy consumption and thus emissions. These technical and operational measures have different degrees of CO_2 emissions' reduction potential. Improvements in technologies have been considered the cornerstone for any abatement in the transportation sector, frequently providing end users with an economic benefit (Dinica, 2002; Li, Akintoye, Edwards, & Hardcastle, 2005).

Increasing use of biofuels generates additional abatement costs. In road traffic (private cars), the most important technical lever is improving efficient consumption of both gasoline and diesel engines (McKinsey & Company, 2008). Another important lever for fuel reduction is reducing vehicle weight. The forced introduction of hybrid vehicles in different classes could lead to considerable abatement. Enhancements in driving instruction offers the highest abatement approach across all parts of the mobility chain contributing further to GHG reductions such as traffic flow management and driving behaviour (Abe, 2011).

In aviation and rail traffic the benefits from technical optimization could improve abatement potentials and optimize capacity utilization. In the transportation sector, approximately 40% of abatement interventions pay off for decision makers (Baumert et al., 2005). However, they often require comparatively high initial investments.

Implementation of these levers in addition to the politically favoured use of biofuels (with additional abatement costs) could reduce emissions in the transportation sector by a total of 28 Mt CO_2e by 2020 globally (Baumert et al., 2005). This reduction corresponds to an 11% decrease compared to today's level. McKinley & Company (2007) joint work with automobile makers proposes that these measures might reduce average fuel consumption per kilometre by more than 50% with net economic benefits to consumers. This could result in a net savings of 1.1 Mt CO_2e per annum if a quarter of new cars reached this standard by 2030. Thus, further studies are needed at firm level to test various methods, models, and assumptions of MACCs developed for national and global analyse. Therefore, ways to reduce GHGs while maintaining a sustainable economy need to be found and implemented.

8. Conclusion

Decision-makers and stockholders are looking for how to determining the cost and benefits of reducing GHG emissions and they need to understand estimate environmental costs to reduction emissions. Many research into this topic have been conducted in last few decades and report different results. The reason why is studies that assumptions used for estimating MACCs are different. The results of this study confirm the notion that actual data is important to build MACCs. Overall, while there have been developments made in applying approaches of MACCs, much remains to be done in future.

References

Abe, M. (2011). Achieving a sustainable automotive sector in Asia and the Pacific: Challenges and opportunities for the reduction of vehicle CO_2 emissions. *Asia-Pacific Research and Training Network on Trade Working*

Paper Series, No. 108.

AEPCA. (2004). *A Best Practice Guide to Measurement and Verification of Energy Savings* (T. A. E. P. C. A. f. the, I. A. P. o. A. i. the & A. D. o. I. T. a. Resources, Trans.). Commonwealth of Australia.

Aldy, J. E., & Stavins, R. (2012). The Promise and Problems of Pricing Carbon: Theory and Experience. *Journal of Environment & Development*, *21*(2), 152-180. http://dx.doi.org/10.1177/1070496512442508

Anger, N. (2008). Emissions trading beyond Europe: Linking schemes in a post-Kyoto world. *Energy Economics*, *30*(4), 2028-2049.

Arroyo, V., & Peña, N. (2003). Establishing A Domestic GHG Reduction Target: Key Approaches AND Challenges. *A Climate Policy Framework: Balancing Policy and Politics*, 29.

Assadourian, E. (2005). State of Corporate Responsibility and the Environment. *The Geo. Int'l Envtl. L. Rev.*, *18*, 571.

Australia, B. C. O. F. (2007). Strategic framework to reduce emissions.

Bailie, A., Bernow, S., Dougherty, W., & Goldberg, M. (2009). *The Bottom Line on Kyoto*. World Wildlife Fund (WWF).

Bataille, C., Jaccard, M., Nyboer, J., & Rivers, N. (2006). Towards general equilibrium in a technology-rich model with empirically estimated behavioral parameters. *The Energy Journal*, Special Issue# 2, 93-112.

Baumert, K., Herzog, T., & Pershing, J. (2005). *Navigating the numbers: Greenhouse gas data and international climate policy*. The World Resources Institute, 10 G Street, NE Suite 800 Washington, D. C. 20002 USA.

Bellassen, V., & Leguet, B. (2007). The emergence of voluntary carbon offsetting. *Renewable energy*, *20*, 5.

Bohringer, C., & Loschel, A. (2006). Promoting renewable energy in Europe: a hybrid computable general equilibrium approach. *The Energy Journal*, Special Issue# 2, 135-150.

Böhringer, C., & Rutherford, T. F. (2008). Combining bottom-up and top-down. *Energy Economics*, *30*(2), 574-596.

Chattopadhyay, D. (2010). Modeling greenhouse gas reduction from the Australian electricity sector. *Power Systems, IEEE Transactions on*, *25*(2), 729-740.

Convery, F. J., & Redmond, L. (2007). Market and price developments in the European Union emissions trading scheme. *Review of Environmental Economics and Policy*, *1*(1), 88-111.

Criqui, P., Mima, S., & Viguier, L. (1999). Marginal abatement costs of CO_2 emission reductions, geographical flexibility and concrete ceilings: an assessment using the POLES model. *Energy policy*, *27*(10), 585-601.

De Vries, B. J. M., van Vuuren, D. P., & Hoogwijk, M. M. (2007). Renewable energy sources: Their global potential for the first-half of the 21st century at a global level: An integrated approach. *Energy policy*, *35*(4), 2590-2610. http://dx.doi.org/10.1016/j.enpol.2006.09.002

DECC. (2009). Carbon Valuation in UK Policy Appraisal: A Revised Approach: Climate Change Economics. Department of Energy and Climate Change,UK.

DEFRA. (2003). The Scientific Case for Setting a Long Term Emissions Reduction Target, UK Department for Environment, Food and Regional Affairs, London. Retrieved 30 May 2012 from http://www.defra.gov.uk/environment/climatechange/pubs

DeSimone, L. D., & Popoff, F. (2000). *Eco-efficiency: The business link to sustainable development*. The MIT Press.

Dietmair, A., & Verl, A. (2009). Energy consumption forecasting and optimisation for tool machines. *Energy*, *62/63*.

Dinica, V. (2002). Energy policies for CO_2 emission reduction. *Encyclopedia of life support systems*.

Economic, U. N., & Asia, S. C. f. W. (2001). *Towards Harmonization of Environmental Standards in the Energy Sector of ESCWA Member States*. United Nations.

Ekins, P., Kesicki, F., & Smith, A. Z. P. (2011). Marginal Abatement Cost Curve: A call for caution. UCL Energy Institute & University College Londone, UK.

Ellerman, A., & Decaux, A. (1998). Analysis of post-Kyoto CO_2 emissions trading using marginal abatement curves.

Energy, D., & Savings, W. (2001). International Performance Measurement & Verification Protocol.

Enkvist, P., Nauclér, T., & Rosander, J. (2007). A cost curve for greenhouse gas reduction. *McKinsey Quarterly, 1*, 34.

EPAQ. (2008). *Environmental Protection Agency – Queensland An enhanced Queensland Marginal Abatement Cost Curve*. Retrieved from http://www.google.com.au/

Faber, J., Nelissen, D., St Amand, D., Consulting, N., Balon, T., Baylor, M., . . . Kane, D. (2011). Marginal Abatement Costs and Cost Effectiveness of Energy-Efficiency Measures.

Fiksel, J., McDaniel, J., & Mendenhall, C. (1999). *Measuring progress towards sustainability principles, process and best practices*.

Flachsland, C., Brunner, S., Edenhofer, O., & Creutzig, F. (2011). Climate policies for road transport revisited (II): Closing the policy gap with cap-and-trade. *Energy policy*.

Foster, S. A., Obbagy, J. E., & Change, P. C. O. G. C. (2001). *An Overview of Greenhouse Gas Emissions Verification Issues*. Pew Center on Global Climate Change.

Gallaher, M. P., Morgan, C. L., & Shadbegian, R. J. (2008). Redesign of the 2005 pollution abatement costs and expenditure survey. *Journal of Economic and Social Measurement, 33*(4), 309-360.

Garnaut, R. (2008). The Garnaut climate change review. *change, 13*, 1-5.

Grubb, M., Köhler, J., & Anderson, D. (2002). Induced technical change in energy and environmental modeling: Analytic approaches and policy implications. *Annual Review of Energy and the Environment, 27*(1), 271-308. http://dx.doi.org/10.1146/annurev.energy.27.122001.083408

Guo, J., Hepburn, C. J., Tol, R. S. J., & Anthoff, D. (2006). Discounting and the social cost of carbon: a closer look at uncertainty. *environmental science & policy, 9*(3), 205-216. http://dx.doi.org/10.1016/j.envsci.2005.11.010

Hamilton, K., Bayon, R., Turner, G., & Higgins, D. (2007). State of the voluntary carbon markets 2007. *Picking up steam.* Washington, DC.

Hanley, N. (1992). Are there environmental limits to cost benefit analysis? *Environmental and Resource Economics, 2*(1), 33-59.

Hardisty. (2009). Analysing the role of decision-making economics for industry in the climate change era. *Management of Environmental Quality: An International Journal, 20*(2), 205-218. http://dx.doi.org/10.1108/14777830910939507

Heal, G. (2007). A celebration of environmental and resource economics. *Review of Environmental Economics and Policy, 1*(1), 7-25. http://dx.doi.org/ 10.1093/reep/rem007

Hepburn, C., & Stern, N. (2008). A new global deal on climate change. *Oxford Review of Economic Policy, 24*(2), 259-279. http://dx.doi.org/ 10.1093/oxrep/grn020

Hoffman, A. J. (2005). Climate change strategy: The business logic behind voluntary greenhouse gas reductions. *California Management Review, 47*(3), 21-46.

Hogg, D., Ballinger, A., & Elliot, T. (2008). *Development of Marginal Abatement Cost Curves for the Waste Sector* (e. r. c. Committee on Climate Change. Bristol, Trans.) (pp. 1-199).

Hutton, G., Haller, L., & Bartram, J. (2007). Global cost-benefit analysis of water supply and sanitation interventions. *Journal of water and health, 5*(4), 481-502. http://dx.doi.org/ 10.2166/wh.2007.009

International Energy Agency. (2007). World energy outlook, IEA, Paris.

IPCC. (2007). *Fourth Assessment Report, Impacts, Adaptation and Vulnerability, Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.

Jaccard, M., Nyboer, J., Bataille, C., & Sadownik, B. (2003). Modeling the cost of climate policy: distinguishing between alternative cost definitions and long-run cost dynamics. *Energy Journal, 24*(1), 49-73.

Jackson, T. (1991). Least-cost greenhouse planning supply curves for global warming abatement. *Energy policy, 19*(1), 35-46.

Jakob, M. (2006). Marginal costs and co-benefits of energy efficiency investments: The case of the Swiss residential sector. *Energy policy, 34*(2), 172-187.

Jorge, F. P., Genice, A., & M. O. (2005). SO_2, NOx, and Particle Control Technologies and Abatement Costs for the Mexican Electricity Sector. Centre for Energy Research (CIE), UNAM, México World Resources Institute (WRI). Secretaría de Energía (SENER).

Jotzo, F., & Betz, R. (2009). Australia's emissions trading scheme: opportunities and obstacles for linking. *Climate Policy, 9*(4), 402-414. http://dx.doi.org/10.3763/cpol.2009.0624

Kanudia, A., & Loulou, R. (1999). Advanced bottom-up modelling for national and regional energy planning in response to climate change. *International Journal of Environment and Pollution, 12*(2), 191-216.

Kellett, D. J. (2007). Community-based energy policy: a practical approach to carbon reduction. *Journal of environmental planning and management, 50*(3), 381-396. http://dx.doi.org/10.1080/09640560701261679

Kesicki, F. (2010a). Marginal abatement cost curves for policy making–expert-based vs. model-derived curves. Paper presented at *the IAEE's 2010 International Conference*, Rio de Janeiro.

Kesicki, F. (2010b). *Marginal Abatement Cost Curves for Policy Making–Expert-Based vs. Model-Derived Curves* (pp. 1-19). London WC1H 0HY, United Kingdom, viewed 24 February 2011.

Kesicki, F. (2010c). Marginal Abatement Cost Curves: Combining Energy System Modelling and Decomposition Analysis. *Environmental Modeling and Assessment*, 1-11.

Kesicki, F., & Strachan, N. (2011). Marginal abatement cost (MAC) curves: confronting theory and practice. *Environmental science & policy*. http://dx.doi.org/10.1016/j.envsci.2011.08.004

Klepper, G., & Peterson, S. (2004). Marginal abatement cost curves in general equilibrium: the influence of world energy prices. *Working Papers*.

Kockelman, K., Bomberg, M., Thompson, M., Whitehead, C., & Traveled, V. M. (2009). GHG Emissions Control Options. *The University of Texas at Austin-white paper*.

Kolk, A. (2009). *International business and global climate change*. Routledge.

Kuik, O., Brander, L., & Tol, R. (2009). Marginal abatement costs of greenhouse gas emissions: A meta-analysis. *Energy Policy, 37*(4), 1395-1403.

Kuwahata, R., & Monroy, C. R. (2011). Market stimulation of renewable-based power generation in Australia. *Renewable and Sustainable Energy Reviews, 15*(1), 534-543. http://dx.doi.org/10.1016/j.rser.2010.08.020

Lazarowicz, M. (2009). Global Carbon Trading: a framework for reducing emissions. Stationery Office.

Lee, H., Zhou, D., Jung, Y., Wisniewski, J., & Sathaye, J. (1996). Greenhouse gas emissions inventory and mitigation strategies for asian and pacific countries: Summary of workshop presentations and working group discussions. *Ambio*, 220-228.

Legge, T., & Scott, S. (2009). *Policy Options to Reduce Ireland's Greenhouse Gas Emissions*. Esri.

Li, B., Akintoye, A., Edwards, P. J., & Hardcastle, C. (2005). Perceptions of positive and negative factors influencing the attractiveness of PPP/PFI procurement for construction projects in the UK: Findings from a questionnaire survey. *Engineering, Construction and Architectural Management, 12*(2), 125-148. http://dx.doi.org/10.1108/09699980510584485

Library, P. (2010). How much Australia emits. Retrieved 12 February 2011 from http://www.aph.gov.au/library/pubs/climatechange/

Lieberman, D., Jonas, M., Nahorski, Z., & Nilsson, S. (2007). *Accounting for climate change: uncertainty in greenhouse gas inventories-verification, compliance, and trading*. Springer Verlag.

Löschel, A. (2002). Technological change in economic models of environmental policy: a survey. *Ecological Economics, 43*(2-3), 105-126.

Markets, O. o. G. a. E. (2010). The Renewable Obligation Buy-out Price and Mutualisation Ceiling.

McKinsey, & Company (Cartographer). (2008). Costs and potentials of greenhouse gas abatement in the Czech Republic- Key findings. Retrieved from http://lightbucket.wordpress.com/2008/05/17/the-cost-of-carbon-abatement/

McKinsey. (2008). An Australian cost curve for greenhouse gas reduction (p. 28). Sydney: McKinsey & Company Australi Climate Change Initiative.

McKinsey. (2009). Pathways to a low-carbon economy – global greenhouse gases (GHG) abatement cost curve. In J. Edmonds (Ed.), *Version 2 of the Global Greenhouse Gas Abatement Cost Curve – January 2009*. (p.

192). United States: Climate Change Special Initiative.

McKitrick, R. (1999). A derivation of the marginal abatement cost curve. *Journal of Environmental Economics and Management, 37*(3), 306-314.

McKnoulty, J. (2009). Building ClimateSmart in Queensland Building and Regulatory Reform. Published by the Queensland Government.

McVittie, A. B., Rees, R., & Topp, C. F. E. (2010). Marginal abatement cost curves for UK agricultural greenhouse gas emissions. *Universität Hohenheim, Stuttgart, Germany*, 33.

Metcalf, G. E. (2009). Designing a carbon tax to reduce US greenhouse gas emissions. *Review of Environmental Economics and Policy, 3*(1), 63-83.

Metcalfe, J. S. (1995). Technology systems and technology policy in an evolutionary framework. *Cambridge Journal of Economics, 19*(1), 25-46.

Miozzo, M., & Grimshaw, D. (2011). Capabilities of large services outsourcing firms: the "outsourcing plus staff transfer model" in EDS and IBM. *Industrial and Corporate Change, 20*(3), 909-940.

Moran, D., Macleod, M., Wall, E., Eory, V., McVittie, A., Barnes, A., . . . Moxey, A. (2010). Marginal Abatement Cost Curves for UK Agricultural Greenhouse Gas Emissions. *Journal of Agricultural Economics, 62*(1). Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1477-9552.2010.00268

Morris, J., Paltsev, S., & Reilly, J. (2008). Marginal abatement costs and marginal welfare costs for greenhouse gas emissions reductions: results from the EPPA model. *Environmental Modeling and Assessment*, 1-12.

Morris, S., Goldstein, G., & Fthenakis, V. (2002). NEMS and MARKAL-MACRO models for energy-environmental-economic analysis: A comparison of the electricity and carbon reduction projections. *Environmental Modeling and Assessment, 7*(3), 207-216.

Moss, R., Edmonds, J., Hibbard, K., Manning, M., Rose, S., van Vuuren, D., . . . Kram, T. (2010). The next generation of scenarios for climate change research and assessment. *Nature, 463*(7282), 747-756.

Murphy, R., & Jaccard, M. (2011). Energy efficiency and the cost of GHG abatement: A comparison of bottom-up and hybrid models for the US. *Energy policy*. http://dx.doi.org/10.1016/j.enpol.2011.08.033

Murphy, R., Rivers, N., & Jaccard, M. (2007). Hybrid modeling of industrial energy consumption and greenhouse gas emissions with an application to Canada. *Energy Economics, 29*(4), 826-846. http://dx.doi.org/10.1016/j.eneco.2007.01.006

Nauclér, T., & Enkvist, P. A. (2009). Pathways to a low-carbon economy: Version 2 of the global greenhouse gas abatement cost curve. *McKinsey & Company*, 26-31.

Nordhaus, W. D., & Yang, Z. (1996). A regional dynamic general-equilibrium model of alternative climate-change strategies. *The American Economic Review*, 741-765.

Nystrom, I., & Wene, C. O. (1999). Energy-economy linking in MARKAL-MACRO: interplay of nuclear, conservation and CO 2 policies in Sweden. *International Journal of Environment and Pollution, 12*(2), 323-342.

Parker, L. (2009). Climate change and the EU Emissions trading Scheme (ETS): Kyoto and Beyond. *International Journal of Energy, Environment and Economics, 17*(4), 385.

Pattberg, P., & Stripple, J. (2008). Beyond the public and private divide: remapping transnational climate governance in the 21st century. *International Environmental Agreements: Politics, Law and Economics, 8*(4), 367-388. http://dx.doi.org/ 10.1007/s10784-008-9085-3

PCA. (2002). Common Elements among Advanced Greenhouse Gas Management Programs. The Partnership for Climate Action. Retrieved 7 July 2012 from http://www.greenbiz.com

Perez-Lombard, L., Ortiz, J., & Pout, C. (2008). A review on buildings energy consumption information. *Energy and buildings, 40*(3), 394-398. http://dx.doi.org/10.1016/j.enbuild.2007.03.007

Powell, J. B. (2011). Future energy and chemicals from bio-based feed stocks: catalytic challenges and opportunities. Shell Chief Scientist –Chemical Engineering. University of Delaware Campus, Newark, DE.

Price, L., Galitsky, C., & Kramer, K. J. (2008). International experience with key program elements of industrial energy efficiency or greenhouse gas emissions reduction target-setting programs.

Pye, S., Fletcher, K., Gardiner, A., Angelini, T., Greenleaf, J., Wiley, T., & Haydock, H. (2008). Review and

update of UK abatement costs curves for the industrial, domestic and non-domestic sectors 1-137.

Ramanathan, V., & Xu, Y. (2010). The Copenhagen Accord for limiting global warming: Criteria, constraints, and available avenues. *Proceedings of the National Academy of Sciences, 107*(18), 8055.

Rankin, M., Windsor, C., & Wahyuni, D. (2011). An investigation of voluntary corporate greenhouse gas emissions reporting in a market governance system: Australian evidence. *Accounting, Auditing & Accountability Journal, 24*(8), 1037-1070. http://dx.doi.org/ 10.1108/09513571111184751

Riedy, C. (2003). A Framework for Economic Analysis of Greenhouse Abatement Options. Retrieved 20 September 2010 from http://een.anu.edu.au/wsprgpap/papers/riedy1

Rivers, N., & Jaccard, M. (2006). Useful models for simulating policies to induce technological change. *Energy policy, 34*(15), 2038-2047.

Sandor, R. L., Bettelheim, E. C., & Swingland, I. R. (2002). An overview of a free–market approach to climate change and conservation. *Philosophical Transactions of the Royal Society of London. Series A: Mathematical, Physical and Engineering Sciences, 360*(1797), 1607-1620. http://dx.doi.org/10.1098/rsta.2002.1022

Scarborough, H. (2011). Intergenerational equity and the social discount rate. *Australian Journal of Agricultural and Resource Economics, 55*(2), 145-158. http://dx.doi.org/ 10.1111/j.1467-8489.2011.00532.x

Schaefer, A., & Jacoby, H. D. (2005). Technology detail in a multisector CGE model: transport under climate policy. *Energy Economics, 27*(1), 1-24.

Schafer, A., & Jacoby, H. D. (2006). Experiments with a hybrid CGE-MARKAL model. *The Energy Journal,* Special Issue# 2, 171-177.

Schmidheiny, S. (1992). *Changing course: A global business perspective on development and the environment.* the MIT Press.

Schultz, A. (2009). Energy update 2009, Australian Bureau of Agricultural and Resource Economics, Canberra.

Schwarzenegger, A. (2005). *Emission reduction opportunities for non-CO2 greenhouse gases in California*. California: California Climate Change Center.

Seebregts, A. J., Goldstein, G. A., & Smekens, K. (2001). *Energy/environmental modeling with the MARKAL family of models*.

Shadbegian, R. J., & Gray, W. B. (2005). Pollution abatement expenditures and plant-level productivity: A production function approach. *Ecological Economics, 54*(2-3), 196-208.

Shiel, J. (2009). Practical greenhouse gas reduction strategies for the existing building stock. *Architectural Science Review, 52*(4), 270-278. http://dx.doi.org/10.3763/asre.2009.0070

Shobe, W., & Burtraw, D. (2012). Rethinking environmental federalism in a warming world. *Resources for the Future Discussion Paper* (pp. 12-04).

Smale, R., Hartley, M., Hepburn, C., Ward, J., & Grubb, M. (2006). The impact of CO2 emissions trading on firm profits and market prices. *Climate Policy, 6*(1), 31-48. http://dx.doi.org/10.1080/14693062.2006.9685587

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., . . . Rice, C. (2007). Policy and technological constraints to implementation of greenhouse gas mitigation options in agriculture. *Agriculture, Ecosystems & Environment, 118*(1-4), 6-28.

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., . . . Rice, C. (2008). Greenhouse gas mitigation in agriculture. *Philosophical Transactions of the Royal Society B: Biological Sciences, 363*(1492), 789.

Speth, J. G. (2009). *The bridge at the edge of the world: Capitalism, the environment, and crossing from crisis to sustainability*. Yale University Press.

Springer, U., & Varilek, M. (2004). Estimating the price of tradable permits for greenhouse gas emissions in 2008–12. *Energy policy, 32*(5), 611-621. http://dx.doi.org/10.1016/S0301-4215(02)00313-0

Stankeviciute, L., Kitous, A., & Criqui, P. (2008). The fundamentals of the future international emissions trading system. *Energy policy, 36*(11), 4272-4286.

Stavins, R. N. (2007). Environmental economics: National Bureau of Economic Research.

Stern, N. (2008). The economics of climate change. *The American Economic Review, 98*(2), 1-37.

Stern, N. H. (2007). *The economics of climate change: the Stern review*. Cambridge Univ Pr.

Sullivan, A., & Sheffrin, S. M. (2003). Economics: Principles in action. *Upper Saddle River, New Jersey, 7458*, 90.

Sweeney, J., & Weyant, J. (2008). Analysis of Measures to Meet the Requirements of California's Assembly Bill 32. Discussion draft, September 2008 (p. 108). California, viewed 15 April 2012: Stanford, CA: Stanford University Precourt Institute for Energy Efficiency.

Tester, J. W. (2005). *Sustainable energy: choosing among options*. The MIT Press.

Tietenberg, T., & Nations, U. (1998). *International Rules for Greenhouse Gas Emissions: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting and Accountabiligy. Executive Summary*. United Nations.

Trexler, M. C., & Kosloff, L. H. (1998). The 1997 Kyoto Protocol: what does it mean for project-based climate change mitigation? *Mitigation and Adaptation Strategies for Global Change, 3*(1), 1-58.

Turner, G., Sjardin, M., & Capua, M. D. (2010). US Marginal Abatement Cost Curve, 1-33. Retrieved from http://en.wikipedia.org/wiki/Marginal_Abatement_Cost#cite_ref-1

UN. (2003). *Integrated Environmental and Economic Accounting*. New York: United Nation.

ürge-Vorsatz, D., Harvey, L. D. D., Mirasgedis, S., & Levine, M. D. (2007). Mitigating CO2 emissions from energy use in the world's buildings. *Building research & information, 35*(4), 379-398.

van Odijk, S., Mol, S., Harmsen, R., Struker, A., & Jacobs, E. (2012). *Utilizing marginal abatement cost curves (MAC curves) to strategically plan CO2 reduction possibilities for the water sector: the case of watercycle organisation Waternet*.

Van Vuuren, D., Meinshausen, M., Plattner, G., Joos, F., Strassmann, K., Smith, S., . . . De La Chesnaye, F. (2008). Temperature increase of 21st century mitigation scenarios. *Proceedings of the National Academy of Sciences, 105*(40), 15258.

Varilek, M., & Marenzi, N. (2001). *Greenhouse Gas Price Scenarios for 2000-2012: Impact of Different Policy Regimes*. Washington, DC: Natsource LLC.

Vijay, S., DeCarolis, J. F., & Srivastava, R. K. (2010). A bottom-up method to develop pollution abatement cost curves for coal-fired utility boilers. *Energy policy, 38*(5), 2255-2261. http://dx.doi.org/10.1016/j.enpol.2009.12.013

Vine, E. L., & Sathaye, J. A. (2000). The monitoring, evaluation, reporting, verification, and certification of energy-efficiency projects. *Mitigation and Adaptation Strategies for Global Change, 5*(2), 189-216.

Wagner, F., Amann, M., Borken-Kleefeld, J., Cofala, J., Höglund-Isaksson, L., Purohit, P., . . . Winiwarter, W. (2012). Sectoral marginal abatement cost curves: implications for mitigation pledges and air pollution co-benefits for Annex I countries. *Sustainability Science*, 1-16. http://dx.doi.org/10.1007/s11625-012-0167-3

Wang, K., Wang, C., & Chen, J. (2009). Analysis of the economic impact of different Chinese climate policy options based on a CGE model incorporating endogenous technological change. *Energy policy, 37*(8), 2930-2940. http://dx.doi.org/10.1016/j.enpol.2009.03.023

Wassmann, R., & Pathak, H. (2007). Introducing greenhouse gas mitigation as a development objective in rice-based agriculture: II. Cost-benefit assessment for different technologies, regions and scales. *Agricultural Systems, 94*(3), 826-840.

Watkiss, P., & Hunt, A. (2011). Cover Delivery Report.

Weiner, M. (2009). Energy Use in Buildings and Industry: Technical Appendix. London, Committee on Climate Change.

Weiske, A. (2005). Survey of technical and management-based mitigation measures in agriculture. *MEACAP WP3 D7a*, 146.

Weiske, A. (2006). Selection and specification of technical and management-based greenhouse gas mitigation measures in agricultural production for modelling. *MEACAP WP3 D10a*, 71.

Weiske, A., Vabitsch, A., Olesen, J. E., Schelde, K., Michel, J., Friedrich, R., & Kaltschmitt, M. (2006). Mitigation of greenhouse gas emissions in European conventional and organic dairy farming. *Agriculture,*

Ecosystems & Environment, 112(2-3), 221-232.

Wilkinson, P., Smith, K. R., Davies, M., Adair, H., Armstrong, B. G., Barrett, M., . . . Oreszczyn, T. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: household energy. *The Lancet, 374*(9705), 1917-1929. http://dx.doi.org/10.1016/S0140- 6736(09)61713-X

Worrell, E., Ramesohl, S., & Boyd, G. (2004). Advances in Energy Forecasting Models Based on Engineering Economics. *Annu. Rev. Environ. Resour., 29*, 345-381. http://dx.doi.org/10.1146/annurev.energy.29.062403.102042

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Study on Correlation between Different NDF Data and Fluctuations of RMB Exchange Rate

Wang Nan[1] & Hou Tieshan[1]

[1] Department of Finance and Management, School of Economics, Dalian University of Technology, Dalian, Liaoning, China

Correspondence: Wang Nan, 551 Shao Xing Road No.18, Heping District, Shenyang Liaoning Province, China, 110003, China. Tel: 86-139-9834-0386. E-mail: nancy.22@163.com

Received: March 14, 2013 Accepted: March 28, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p55 URL: http://dx.doi.org/10.5539/ijef.v5n5p55

Abstract

Forecasting of exchange rate is a nonlinear problem. In this paper, we use Nonlinear Auto Regressive model which is named NARX for short with exogenous Inputs to forecast RMB exchange rate. Due to the selecting of external input X can influence the accuracy of forecasting, we choose non-deliverable forward exchange rate, which is known as NDF, to be X and achieved good results. There are many kinds of NDFs in different time spans, this paper contrasts the differences of network performance when using different NDFs as X, and get the result that the correlation of using different NDFs is not that big. We can always get very good result when using any time spans' NDF. And NDF is effective when using it to exchange rate forecasting.

Keywords: RMB exchange rate, forecasting, NDF, NARX

1. Introduction

Exchange rate forecasting is an important and challenging task for both academic researchers and business practitioners.

Theoretical and empirical research on exchange rate behavior is mainly carried out from two aspects: one is from the various factors that affecting exchange rate, looking for a relationship that exists between exchange rate and those factors; on the other hand, is from the exchange rate movement itself, for example, its stochastic nature as a time series.

It's a long history of research on macro structure model of exchange rate, but found the performances of these models are not satisfactory, since the implementation of floating exchange rate system in many advanced industrial countries after the collapse of the Bretton Woods system. Large magnitude and high frequency of exchange rate fluctuations in international foreign exchange market cannot be explained by these models. Therefore, some researchers turn to microstructure models, to analysis the actual behavior of market characteristics and market traders, such as Krugman and Miller (1992), Allen and Taylor (1992), Frankel and Froot (1990) etc.

Previous assessments of forecasting performance of exchange rate models have focused upon a narrow set of models typically of the 1970's vintage. The canonical papers in this literature are by Meese and Rogoff (1983, 1988), who examined monetary and portfolio balance models. Succeeding works by Mark (1995) and Chinn and Meese (1995) focused on similar models.

In recent twenty years, with the rapid development of computer hardware, and continuous improvement of econometrics theories, people can analysis historical data on economic and financial variables using econometric models. Researchers often use autoregressive time series models to simulate their movements. Some researchers also use this method for the study of exchange rate. For example, Michael, Nobay and Peel (1992), Sarantis (1999) and Taylor, Peel and Sarno (2000) use STAR model to do the research, Obstfeld and Taylor (2002), O'Connell, Pippenger and Goering (2000) use TAR model.

Neural networks have successfully been used for exchange rate forecasting. Hu (1998) examines the effects of the number of input and hidden nodes as well as the size of the training sample on the in-sample and out-of-sample performance using neural network. The British pound/US dollar is used for detailed examinations. It is found that neural networks outperform linear models, particularly when the forecast horizon is short. In

addition, the number of input nodes has a greater impact on performance than the number of hidden nodes, while a larger number of observations for reduce forecast errors.

Cheung and Chinn (2003) assessed the predictive capabilities of models developed during the 1990's systematically. And conclude that the answer to the question "Are Empirical Exchange Rate Models of the Nineties Fit to Survive?" is a bold "perhaps." That is, the results do not point to any given model/specification combination as being very successful. On the other hand, some models seem to do well at certain horizons, for certain criteria. And indeed, it may be that one model will do well for one exchange rate, and not for another.

Jamal and Sundar (2011) applied the neural network model to forecast bilateral exchange rates between the US and Germany and US and France. The predictions from the neural network model were compared to those based on a standard econometric model. Their results suggest that the neural network model may have some advantages when frequent short term forecasts are needed.

In China, Wei and Jiang first established the Mark/dollar exchange rate forecasting model using neural network method in 1995, the results shows that its accuracy of forecasting is higher than time series model.

2. Forecasting of NARX Network

Computing ability of recurrent neural network has been widely validated. Usually neural network's working process can be summed up as input data into neural network, compute after neural network being trained, and get calculating result which expressed by neural element through threshold function ultimately.

Nonlinear Auto Regressive models with exogenous inputs, which is known as NARX model for short, is an important kind of offline nonlinear system, it can be expressed as:

$$y(t+1) = f[y(t),y(t-1),\ldots, y(t-n_y+1),u(t),u(t-1),\ldots, u(t-n_u+1,W)]$$
$$=f[y(t),u(t),W] \quad (1)$$

U (t) and y (t) represents input and output of the network at time t. 1, ... t presents the order of input and output sequence wherein $u(t)\in R$, $y(t)\in R$ express model's input and output in time t; $n_u\geq 1$, $n_y\geq 1$ ($n_u\geq n_y$) stand as input memory vector and output memory vector, W is weight matrix, f is a nonlinear function simulation by multilayer perceptions. The following figure shows the structure chart of NARX network.

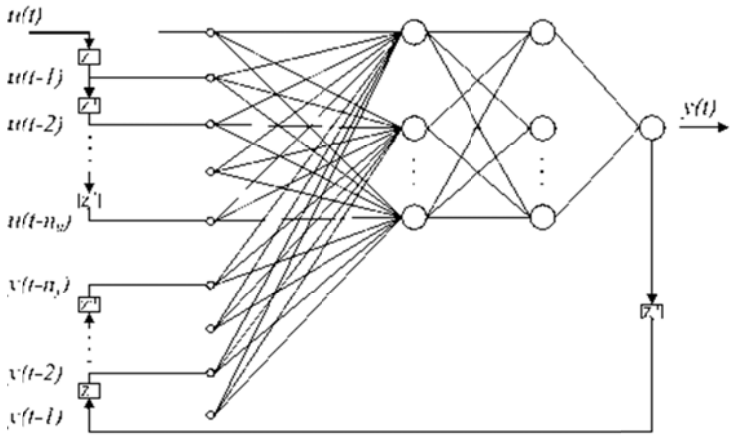

Figure 1. Structure of NARX network

Unlike other recurrent neural network, feedback of NARX network is got from the output layer only, and the network do not accept feedback from hidden layers. Computation ability of NARX neural networks with parameters has been verified in theory. Although NARX network get feedback value only from output layer, the use of NARX network will not decline its computing ability compare with other traditional recurrent neural networks. NARX network has shown its applicability in modeling of many nonlinear systems. Moreover, researchers found that NARX network has advantages of faster convergence and better normalization compared with other neural networks.

As the name suggests, NARX network needs an external input X, and obviously the greater correlation of external input x (T) and time series y (T), the more accurate of the prediction value. When x (T) is a constant value (such as zero), the NARX network can be regarded as nonlinear autoregressive network without exogenous inputs, i.e. NAR network.

When we try to do forecast the trend of RMB exchange rate using NARX network scientifically, we need to select a helpful variable x, in order to join in the NAR network for forecasting. As the financial market is a dramatic market that can be impacted by policy and news fiercely, artificial neural network can not make these data quantified and put them into network, and the question comes out: Is there a variable on behalf of policy that always change?

In recent years, the offshore RMB non-deliverable forward (NDF) market has attracted more and more attention. NDF market provides a lot of references to exchange rate forecasting.

3. Non-Deliverable Forward

A non-deliverable forward referred to as NDF, is a kind of forward exchange transaction, and also is a kind of derivative financial instruments. Mainly refers to that customer and Bank get a agreement with the forward exchange rate and amount of the transaction, and take the delivery of the contract according to the price spread between the exchange rate that previously agreed on contract and the spot exchange rate, without having to pay the principal at a specified maturity date in the future. So it is called "non" delivery. The settlement currency is convertible currencies, usually dollars.

NDF contract can be divided into two kinds, offshore NDF and onshore NDF. The so-called offshore NDF refers to NDF that use freely convertible international currencies to delivery, which is usually US dollar. Onshore NDF market appears only once in the history in Australia in 1973 on a large scale. The only onshore NDF market should be the world's earliest record of NDF market. From a global perspective, NDF transactions are mainly concentrated in offshore market. Onshore NDF market similar to Australia's NDF market is relatively rare. The offshore NDF transactions occur mainly in international financial center that have developed finance and are less regulated cities like Hong Kong, Singapore and London. Delivery of their offshore NDF is usually in US dollar. Won and RMB offshore NDF transactions mainly occur in Hong Kong and Singapore; Poland's Zloty offshore NDF transaction occurs mainly in London. NDF that people usually say is offshore NDF.

4. Hedging Use NDF

The appearance of NDF provides a good way of hedging and arbitrage for investors and users of funds. The principle of hedging that NDF can provide to the enterprise is that it can lock the cost of purchase or sale in advance, as it is a kind of forward exchange transaction.

Before RMB is freely convertible and the RMB forward market is more developed, NDF is very useful to foreign-related enterprises to guard against the risk of RMB exchange rate because of its low cost and high efficiency. Import enterprises can use a NDF contract to lock the risk of RMB exchange rate by purchasing NDF contract of suitable duration and matchable amount. When the export enterprises need to convert dollars into RMB some time in the future, they can make use of a NDF contract to prevent the exchange rate risk of RMB by selling it at suitable time and matchable amount.

For example, on January 1st, 2006, 1-years period NDF of RMB is 8.08 Yuan/dollar on offshore market. A foreign enterprise expected the appreciation of RMB will continue within a year, in order to protect itself from the loss of translation risk, the company hopes to hedge through a 1-year contract of NDF. They can buy a nominal amount of RMB-NDF contract, such as a contract of one million US dollars for a period of one year. The forward rate is 7.91 Yuan/dollar. After one year, three cases may occur, i.e. RMB spot and forward exchange rate are not changed; RMB spot exchange rate appreciate, and devaluation of RMB. If the maturity of 1-year RMB/ US dollar spot exchange rate is 7.91, then the trader's bank will pay him $ 1,000,000 / (7.91/8.08) - 1,000,000 = $ 21,491.78; if RMB / USD spot is 8.11, then the trader's bank will pay 1,000,000 / (8.11/8.08) - $ 1,000,000 = -3,699.14, which means the trader must pay 3,699.14 dollars to the bank. Thereby avoid the risk of RMB appreciation successfully. The specific results are shown below in the following table.

Table 1. Three Situations of NDF contract when maturity

	Depreciation	flat	appreciation
RMB/USD	8.11	8.08	7.91
Dollar equivalent	1,021,491.78	1,000,000.00	996,300.86
Bank liquidation paid	21,491.78	0.00	-3,699.14

In China, including Hong Kong and Macao, the start up of NDF business is from foreign banks that have Branches in Hong Kong or Singapore, and the RMB NDF market is mainly in Singapore and Hong Kong. The main market participants are big banks and investment institutions, their customers are mainly multinational

companies who have large amounts of RMB income in China. These multi-national corporations avoid the exchange rate risk of their RMB revenues and profits by participating in the RMB NDF transactions.

Generation of NDF is derived from controlling of currency speculation, and thus speculative arbitrage is also an important function of NDF in addition to hedge.

5. Forecasting of RMB Exchange Rate with NDF

NDF is formed early from the financial crisis of Mexico in 1995, the earliest contract is Mexico Peso NDF contract in dollar. In Asian markets, the three largest NDF trading markets are Korean Won, Taiwan Dollar and RMB transaction.

The RMB NDF began from June 1996 in Singapore with the longest transaction of 6-months period. Market liquidity is poor at that time, so that the market is not very active initially. NDF transaction has become increasingly active after the Asian financial crisis in 1997. The RMB NDF market has formed for more than ten years till now. In Singapore and Hong Kong, RMB NDF market has become one of Asia's most important offshore RMB forward markets now. Daily trading volume increased to billions of dollars from tens of millions dollars gradually. NDF market prices reflect the expectations for RMB exchange rate of international community. According to the statistics of Emerging Market Traders Association, the Korean won NDF, Brazilian real NDF, new Taiwan dollar NDF and RMB NDF are most traded currencies.

According to the estimates of International Settlements bank, the RMB NDF accounted for 90% of the RMB forward transactions both at home and abroad, which is mainly concentrated in five varieties: three months, six months, nine months, one year and three years.

Pricing of NDF is different from that of forward. Opposed to China's RMB exchange rate formation mechanism, RMB NDF exchange rate is fully market-oriented. It depends on market expectations of exchange rate entirely. RMB NDF market can reflect the expectations of appreciation and devaluation of RMB exchange rate. For example, from the beginning of 2005 to July 21st 2005, before the appreciation of RMB, the premium remained within 3000 to 4000, equivalent to 3 percent to 4 percent, which means that the overseas market expected RMB exchange rate appreciated by 3 to 4 percent against the US dollar in one year. That is, the market expectation of RMB exchange rate is from 8.28 at that time to about 7.88 one year later.

This is because RMB exchange rate is an official exchange rate, and NDF exchange rate is equivalent to a floating exchange rate shows market expectations. Although there is not substantial impact on the value of the RMB, but it can show the pressure of appreciation from international community, as well as the changes of the market on RMB supply and demand.

Although majority trades of NDF market is to speculate, it can not reflect the real price fully. When the domestic market becomes more and more important, the importance of NDF decreased. But NDF has been an important reference for foreign exchange departments of domestic bank and foreign investors. Arbitrage conduct makes the NDF market and the forward market close again once deviated from each other. This makes more accurately when forecasting exchange rate movements by using the two prices.

6. Effectiveness of NDF

Exchange rate changes can be regarded as a dynamic time sequence Y (t), the NARX network mentioned before, in the presence of an associated variable X (t), can be used for the forecasting of Y (t). Clearly, the change of X (t) and Y (t) associate with each other better, and then the more accurate the prediction result of the Y (t) is. We establish a model using NDF as the external input x of the NARX network to forecast the RMB exchange rate movements.

As mentioned before, there are a lot of RMB NDF transaction varieties, including 1-week NDF, 1-month NDF, 3-month NDF, 1-year NDF and so on. Which varieties of the NDF data should we choose as the external input x of NARX network to get the best result of exchange rate forecasting?

In this paper, we selected several varieties of NDF that have larger trading volume as the external input to forecast, respectively, the results are as follows:

We generated a NARX network by selecting the 1-month NDF as X (T), select the exchange rate of the RMB from January 1, 2005 to December 31 2010, against the US dollar as Y (T) for a total of 1469 exchange rate data. Select corresponding NDF as X (T), choose 1323 of them (90%) randomly used for training, 73 (5%) of them to verify normalized degree of the network to prevent over training of the network, the other 73 (5%) are used to sample testing. A total of 98 data used to the Promotion of testing samples from January 2011 to the end of May 2011 to test the generated network. Set 10 as the number of hidden layer neuron network, delay parameter is 2,

and use BP algorithm to train the network.

The performance of NARX network is shown in figure below:

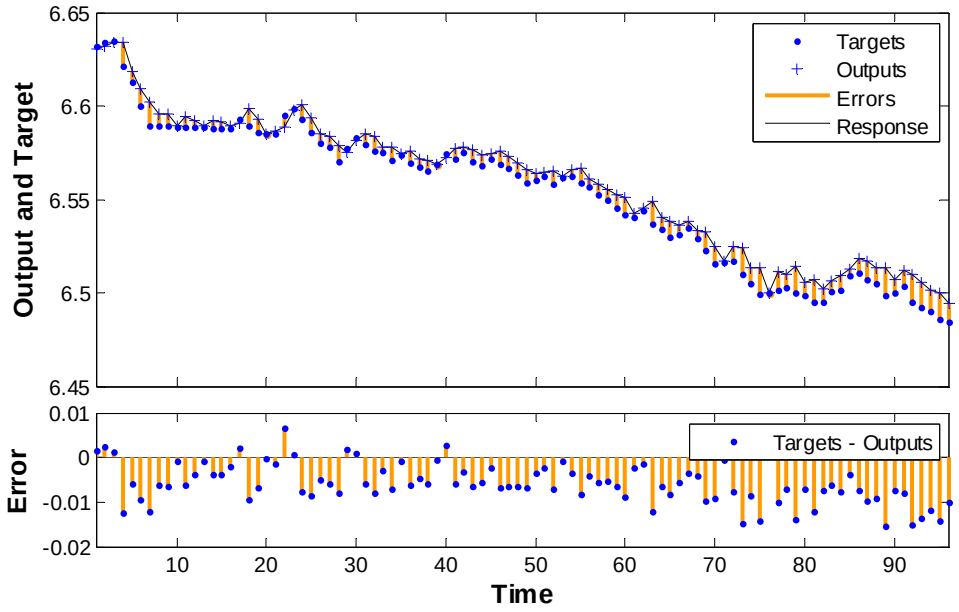

Figure 2. Response of output element when using 1-month NDF

To further validate if there is a different performance when using different kind's NDF during forecasting. We selected 2-month NDF, 6-month NDF, and 1-year NDF values for training, testing, and the following results were obtained respectively.

Promotion performance chart is shown as below when using 2-month NDF to train and promote the NARX network:

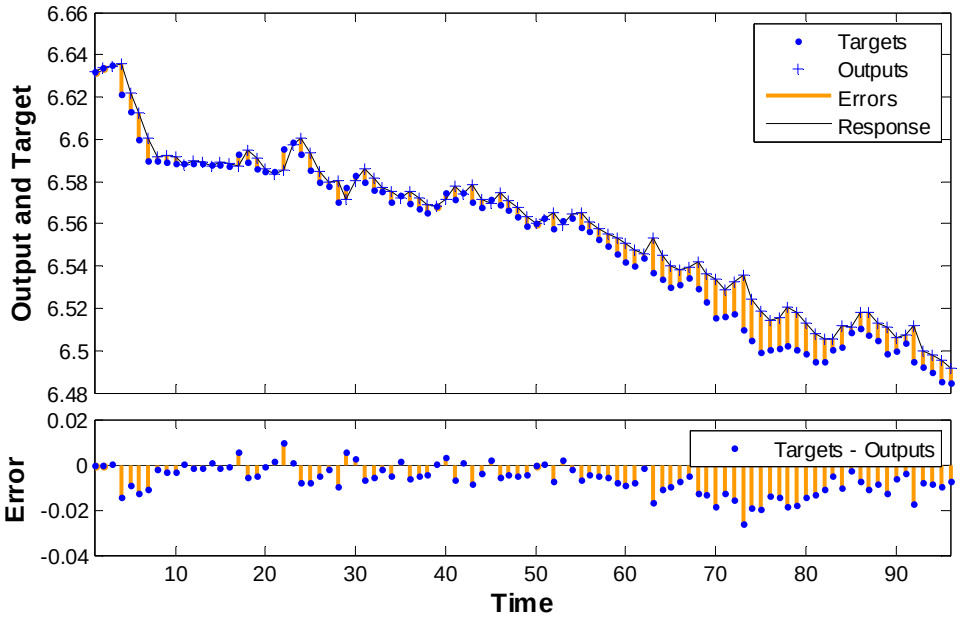

Figure 3. Response of output element when using 2-month NDF

Promotion performance chart is shown as below when using 3-month NDF to train and promote the NARX

network:

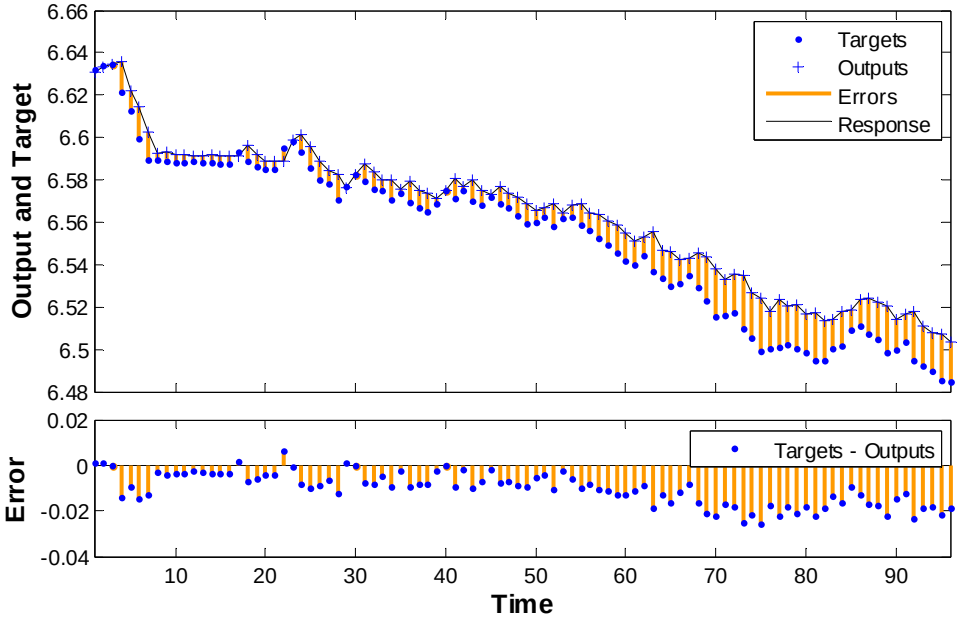

Figure 4. Response of output element when using 3-month NDF

Promotion performance chart is shown as below when using 6-month NDF to train and promote the NARX network:

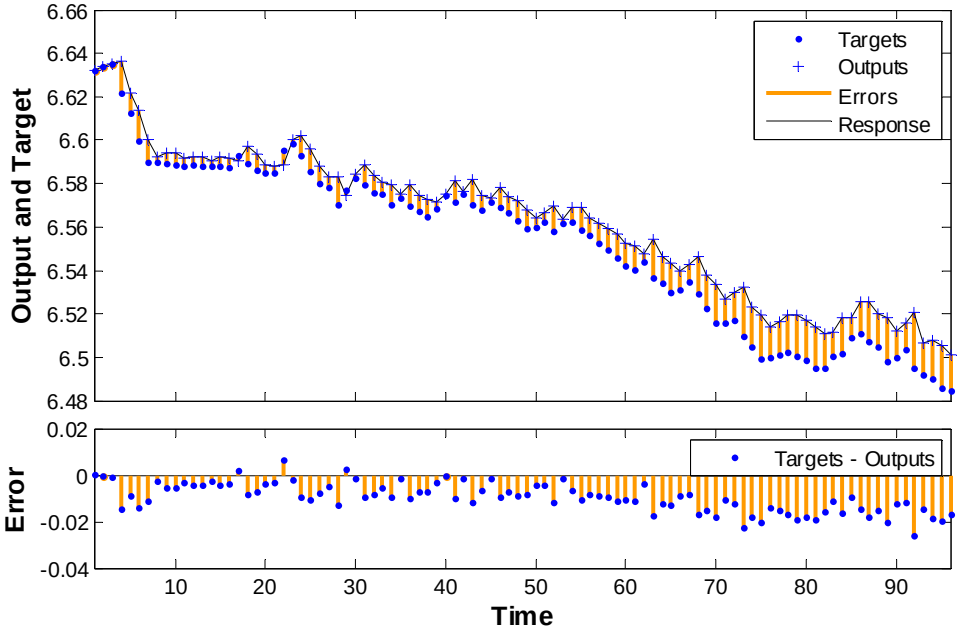

Figure 5. Response of output element when using 6-month NDF

Promotion performance chart is shown as below when using 1-year NDF to train and promote the NARX network:

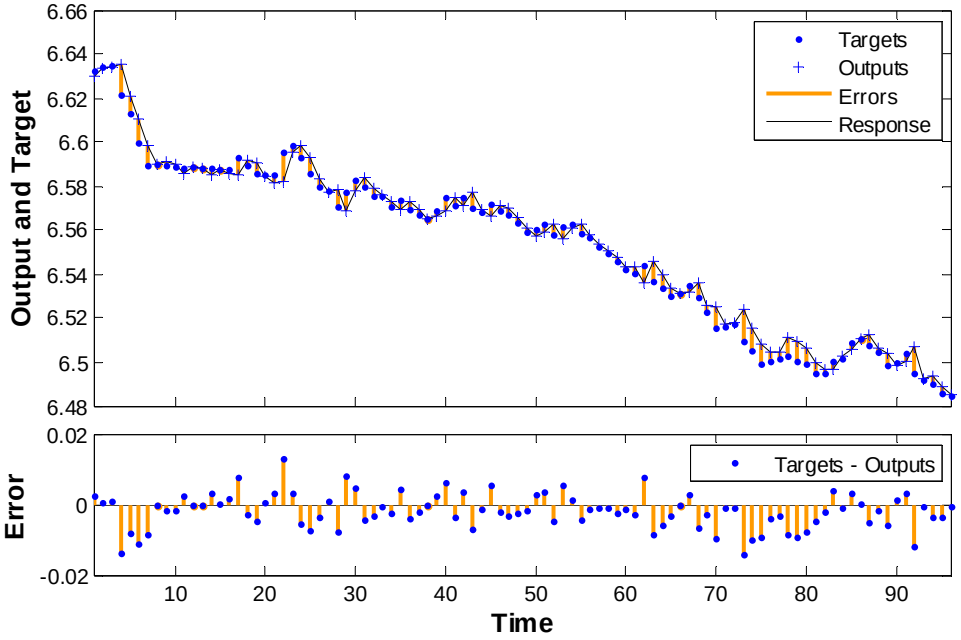

Figure 6. Response of output element when using 1-year NDF

Through observation of the experimental results, it is found that smaller error shown on the graph when using NDF dates of 1-month and 1-year, following by using 2-month NDF and data of 3-month. When using 6-month NDF, it has larger error comparing with the others. Then compare MSE and R of each model.

Table 2. MSE and R of each NARX network

	MSE	R
1-month NDF	2.59019e-5	9.92369e-1
2-month NDF	3.00343e-5	9.92839e-1
3-month NDF	7.79260e-5	9.93217e-1
6-month NDF	7.85540e-5	9.93457e-1
1-year NDF	2.75900e-5	9.91852e-1

We observed MSE and R of each NARX model when using different time period's NDF data as external inputs. MSE is mean square error, also known as standard deviation, which is the square root of the average variance, which shows how the data deviate from the mean distance. Standard deviation can reflect the discrete degree of a data set. MSE is on behalf of data variance of input data and output data. Lower value represents smaller deviate of forecasting. So we use MSE to distinguish forecasting results of each model.

Consistent with the observed results of each chart, 1-month data and 1-years data get lowest MSE, 2-month data is a bit poor, 3-month and 6-month's MSE are slightly inferior. Although MSE has slight difference, this distinction is very little at the levels of E-5.

7. Conclusions

7.1 NARX Network Is Suitable for Exchange Rate Forecasting

Neural network models have a long history of application to financial time series data. Nonlinear Auto Regressive models with exogenous inputs, which is known as NARX model is an important kind of offline nonlinear system. Researchers seldom use NARX network to forecast RMB exchange rate. In this paper, we get expected result by using NARX network for RMB exchange rate forecasting. Although the Chinese government does not allow free movement of the RMB/dollar exchange rate in the past, RMB exchange rate has become more and more freely after RMB exchange rate reformation on July 21st 2005. That can avoid training model using a highly constrained dataset.

7.2 Effectiveness of NDF in Forecasting

Artificial neural network is a new interdisciplinary subject related to biological science, mathematics, computer

science and some other subjects. Its value has been widely recognized, especially when people has difficult in modeling. Financial market is a market can be drastic influenced by policy and news. These data can not be quantified into artificial neural network, so we need a variable that can represent changes in policy. To a certain extent, NDF can represent the reaction of the market when new policies published. Thus NDF can be used as an input of NARX network in order to improve the performance of NARX network of exchange rate forecasting when emergency policy published. From the research in this paper, the slightly errors can also prove that selecting NDF as a combination factor in exchange rate forecasting is a very successful choice, and verify the effectiveness of NDF in forecasting.

7.3 1-Year NDF Is Not the Best One for Research of Forecasting

From the experimental results, the shorter duration is the stronger interaction it has with the spot market, because of its largest trading volume and highest mobility. 1-year NDF, which is often chosen to study the association between spot market and forward market, does not have the strongest relationship with spot market. NDF trading volume and liquidity have a certain impact on the interaction between the NDF market and the spot market, but not decisive.

7.4 All NDF Can Get Good Result When Forecasting

NARX network is a branch of artificial neural network, selection of external variable X has significant influence on the accuracy of forecasting results. When forecasting the trend of RMB exchange rate using NARX network, NDF is effective as an input. Above all, it can all achieve excellent results whichever time span of NDF we choose.

References

Allen, H., & Taylor, M. (1992). The Use of Technical Analysis in the Foreign Exchange Market. *Journal of International Money and Finance, 11*, 304-314. http://dx.doi.org/10.1016/0261-5606(92)90048-3

Chen, R., Zheng, Z., & Gong, J. (2008). China should open the RMB NDF market? A comparative study of Yuan and won. *Xiamen University working paper*, 79-89.

Cheung, Y. W., Chinn, M. D., & Antonio, G. P. (2003). Empirical Exchange Rate Models of the Nineties: Are Any Fit to Survive? *Other Recent Work, Department of Economics UCSC, 6,* 124-128.

Chinn, M., & Meese, D. (1995). Banking on currency forecasts: how predictable is the change in money? *Journal of International Economics, 38,* 161-178. http://dx.doi.org/10.1016/0022-1996(94)01334-O

Frankel, J., & Froot, K. (1986). Understanding the U.S. Dollar in the eighties: the expectations of chartists and fundamentalists. *Economic Record, 62,* 24-38.

Huang, X., & Wu, C. (2006). The offshore renminbi non-deliverable forward and interaction of territory of the spot exchange rate price: before and after the reform. *Financial research*, *11,* 83-89.

Jamal, A. M. M., & Sundar, C. (2011). Modeling Exchange Rates with Neural Networks. *Journal of Applied Business Research, 14*(1), 25-28.

Jiang, C., & Song, F. (2010). Hybrid forecasting model based on NARX neural network and ARMA. *Statistics and Decision, 8,* 33-35.

Krugman, P., & Miller, M. (1992). Why have a Target Zone? *Carnegie-Rochester Conference Series on Public Policy, 38,* 279-314. http://dx.doi.org/10.1016/0167-2231(93)90026-S

Lee, R. G. (2005). Foreign Exchange Intervention and Foreign Exchange Market Development in Korea. *BIS Paper, 24,* 196-209.

Lipscomb, L. (2005). An Overview of Non Deliverable Foreign Exchange Forward Markets. *Federal Reserve Bank of New York, Government Report,* 116-118.

Mark, N. (1995). Exchange rates and fundamentals: evidence on long-horizon predictability. *American Economic Review, 85*(3), 201-218.

Meese, R., & Rogoff, K. (1983). Empirical exchange-rate models of the seventies: do they fit out of sample? *Journal of International Economics, 14,* 3-24. http://dx.doi.org/10.1016/0022-1996(83)90017-X

Michael, P., Nobay, A., & Peel, D. (1997). Transaction cosets and non-linear adjustments in real exchange rates: an empirical investigation. *Journal of Political Economy, 105,* 862-879. http://dx.doi.org/10.1086/262096

O'Connell, P., & Goering. (2000). Market frictions and real exchange rates. *Journal of International Money and Finance, 17,* 71-95. http://dx.doi.org/10.1016/S0261-5606(97)00052-1

Obstfeld, & Taylor. (2002). Globalization and Capital Markets. In Bordo, M. D., Taylor, A. M., & Williamson, J. G. (Eds.), *Globalization in Historical Perspective*, *18*, 112-118.

Park, J. (2001). Information Flows between Non-deliverable Forward (NDF) and Spot Markets: Evidence from Korean Currency. *Pacific -Basin Finance Journal, 9,* 363-377. http://dx.doi.org/10.1016/S0927-538X(01)00012-9

Qian, X. (2005). NDF offshore market of RMB exchange rate expectations. *Journal of Shanxi University of Finance and Economics*, *6*, 116-120.

Ren, Z., & Ning, Z. (2005). The expected RMB exchange rate and RMB exchange rate: An Empirical Study of NDF. *Academic research*, *12,* 34-39.

Sarantis, N. (1999). Modeling non-linearities in real effective exchange rates. *Journal of International Money and Finance, 18,* 27-45. http://dx.doi.org/10.1016/S0261-5606(98)00045-X

Taylor, M. P., Peel, D. A., & Sarno, L. (2001). Nonlinear mean-reversion in real exchange rates: toward a solution to the purchasing power parity puzzles. *International economic reviews, 42,* 1015-1042. http://dx.doi.org/10.1111/1468-2354.00144

Wang, F. (2011). Research on the relation between RMB spot exchange rate and RMB NDF. Oriental enterprise culture. *The company and the industry, 9,* 76-77. http://dx.doi.org/10.1016/j.cie.2011.02.013

Zhang, G., & Michael, Y. H. (1998). Neural Network Forecasting of the British Pound/US Dollar Exchange Rate. *Journal of International Mangement Science, 26*(4), 495-506.

Zheng, O., & Lin, P. (2011). Information transmission and interaction of RMB NDF and spot market. *Study on the relationship between financial taxation, 4,* 81-84.

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

The Effect of the Domestic Debt on the Financial Development: A Case Study for Turkey

Y. B. Altaylıgil[1] & R. C. Akkay[1]

[1] Department of Economics, Istanbul University, Istanbul, Turkey

Correspondence: Y. B. Altaylıgil, Department of Economics, Istanbul University, P. K. 34452, Turkey. Tel: 90-212-440-0000 ext. 11720. E-mail: ybaris@istanbul.edu.tr

Received: March 8, 2013 Accepted: March 26, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p64 URL: http://dx.doi.org/10.5539/ijef.v5n5p64

Abstract

The aim of the study is to investigate the relationship between domestic public debt and financial development for the Turkish economy between 2002Q1-2012Q2. The previous panel data studies for developing countries suggest two main approaches. One view asserts a positive relationship between them while the other view asserts a negative relationship. Our results which are based on time-series analysis support the second view which advocates the negative relationship between domestic indebtedness and financial development. On the other hand we criticize the generalization of the results provided by other studies. According to our view each country may have different responses against the changes in domestic public debt due to its own specific economic and financial condition.

Keywords: public debt, financial development, lazy bank view, safe asset view, time series models

1. Introduction

There is huge literature about the effect of the public indebtedness on the economic growth both in the short- and in the long-run. The conventional view asserts that public debt can have a positive effect on growth via triggering aggregate demand and output in the short-run; but in the long-run the positive effect turns into a negative effect because of the crowding-out of capital and output (Elmendorf and Mankiw, 1998). There are also other channels through which economic growth is negatively affected as a result of high public indebtedness. These channels can be summarized as higher long-term interest rates, higher future distortionary taxation, inflation and greater uncertainty about prospects and policies (Kumar and Woo, 2010).

On the other hand another huge literature focuses on the relation between financial development and economic growth. On the theoretical side endogenous financial growth models indicate mathematically how financial development may have a positive effect on the economic growth (Greenwood and Jovanovic, 1990; Bencivenga and Smith, 1991; Saint-Paul Gilles, 1992; King and Levine, 1993b). On the empirical side many cross-country studies provide empirical results which support also the positive relationship between finance and growth (Levine and Zervos, 1998; Levine, 1998; Benhabib and Spiegel, 2000; Beck and Levine, 2004; Caporale, Howells and Soliman, 2005). On the contrary some researchers like Minsky, Kindleberger advocates the negative effect of finance on the economic growth based on the occurrence of financial crisis (Stiglitz, 2000). Furthermore, Lucas advocates that the impact of finance on growth is overstressed (Lucas, 1988). According to Mankiw the negative impact of finance exists especially in countries in which the financial system regulation is weak (Mankiw, 1998). There are also some cross-country studies which indicate empirically the negative effect of finance on growth (De Gregorio and Guidotti, 1995; Harris, 1997; Aizenmann, 2004).

However, while the effect of the public debt and financial development on economic growth has been widely investigated; the relation between public debt and financial development is unexplored. In this paper our aim is to investigate empirically this relation for Turkey between the years 2002-2012 based on the quarterly data. We start to our analysis by asking a simple question: Why do governments issue debt?

Governments issue debt mainly because of two reasons. The first reason is about conducting monetary policy and the second is about the compensation of the government deficits. The public debt issuance is a powerful instrument to balance monetary expansion. In this manner the negative impact of the inflows of foreign currencies could be impeded through the placement of public debt (Foncerrada, 2005, pp. 251-252). In other

words the excess money is taken out of the circulation which could cause otherwise demand pressure and price increases in the domestic markets. The other reason of the debt issuance is based on the imbalance of the government expenses and income. Especially developing countries face with this imbalance due to the serious problems about raising revenue. Low income level and large informal sector make it difficult to collect direct and indirect taxes which represent a large portion of the public income. Additionally governments loose a reliable resource through trade liberalization which leads huge losses of tax revenues from tariffs. Inflation tax which could be thought as one of the traditional source of government revenue has lost its popularity due to the diligence about the price stability since 1990's. Given these difficulties in tax collection and inefficiency in the tax base leads developing countries to finance their government expenditures through domestic and international borrowing. This solution raises some questions about the optimal public debt structure. In one sense international borrowing provides countries to access financial resources. On the other hand the volatility in the capital flows into and out of these countries combined with the short-term characteristics of the external debt cause financial crises because of the lack of the financial depth in most of these countries. Additionally for most of these countries the access to international credit market is limited. This vicious cycle usually ends with financial crisis and starts again with renewed borrowing at unfavorable terms. These risks lead many developing governments to reduce the share of the external debt in their total debt structure. The uncertainties and additional costs of external debt force these countries to rely on internal borrowing. While domestic financing reduces macroeconomic risks, the absorption of the domestic financial resources by the governments brings some questions like inefficient credits to private sector and poor financial development to the agenda.

The common feature of the financial system in developing countries can be described as underdeveloped bond and equity markets. This fact causes the domination of the banks as the major lenders to the government in developing countries. The dual-role of banks as major lender to government and to the private sector offers an insight into a new literature which investigates the impact of the public debt on the financial development especially in developing countries.

Kumhof and Tanner (2005), one of the pioneers of this literature, asserts that liquid collateral function of safe government debt facilitates financial intermediation. They put emphasis on the function of public debt in financial development as safest asset in the financial system. According to their "safe asset" view government debt provides a benchmark that facilitates the development of the private sector bond market which is very important for overall financial development. They also assert that stable government debt management may facilitate bank-based financial intermediation if legal system and institutional infrastructure is weak. They describe stable government debt markets as the backbone for further development of financial markets.

David Hauner (2006) in contrast focuses on the increasing share of the bank credit absorbed by the public sector which causes the risk of slowing financial development. He finds empirical evidence about the negative effect of the domestic debt on the financial deepening. He also finds that the increasing share of public sector credit is not related to the income level of the country. According to his findings it is associated mainly with slower growth, increasing government intervention, more government bank ownership and weaker creditor rights. In another work Hauner (2009) adds a new concept to his previous work and set a new approach called "lazy bank" view. According to this view the increase in the profitability of banks through holding huge amount of public debt will cause on the other hand a decrease in their efficiency as the main credit source. This will lead diminishing financial deepening over time. The "lazy bank" view is also supported by the empirical results of the analysis. According to the empirical results there is also positive evidence for "safe asset" view up to a threshold in both bank-level and country-level. Beyond this threshold the increasing level of public debt becomes harmful. Hauner (2009) summarizes the additional costs of large fiscal deficits in developing countries under four titles as important policy implications. First, financial depth and credit to private sector has strong impact on economic growth; second the decrease in private sector credits has negative effect on the small firms and income distribution; third underdeveloped financial sector raises the sensitivity of financial system to capital account crises; fourth, poor financial development supports financial crowding-out.

Emran and Farazi (2008) investigate the impact of the government borrowing on the credits provided by the domestic banking sector for 25 developing countries. The results indicate a significant crowding-out effect on the private credits provided by banks. They find that an increase of the government borrowing by one dollar reduces credit to the private sector up to 80 cents in the long-run. One year later Emran and Farazi (2009) replicate their previous work and investigate crowding out effect for 60 developing countries. Their findings indicate more drastic results. They show empirically that $1.00 more government borrowing reduces private credit by about $1.40. According to their view the crowding-out effect on bank credits may have significant adverse effects on private investment and throughout on economic growth in developing countries where capital markets are not

well developed. Their analysis support “lazy bank” view too.

Riccardo de Bonis (2010) studies the determinants of the quantity of the bank loans and investigates the role of the government debt on the size of loans. The results of his analysis show that there are mainly two channels which the credit size is affected by the government debt. First, government debt reduces the size of the credits to private sector because banks find investing in government bonds more attractive. Second, the low private credit ratio to GDP may correspond to a large weight of the government and connected state-owned enterprises in the economy.

Natia Kutivadze (2011) investigates also the relation between public debt and financial development and finds positive correlation between the development of the domestic debt market and financial development. The results of the analysis provide strong evidence which supports the key role of the financial development on the development of the domestic debt market.

Our main aim is to suggest a new way to investigate the relation between public debt and financial development. This suggestion is based mainly on our criticism about the method of the previous works. The empirical parts of the previous works based on the panel data provides general results which is binding for all countries in the analysis. This common result represents the average response of the financial development against the changes in the public debt ratio of many countries but it hinders different responses of different countries about the same changes. We think in such an analysis overall results will be only sound under the assumption of ruling out the differences between countries about their financial and economic structures which may be an unreliable assumption. Therefore we suggest time series analysis to observe each country’s response against the public debt changes in the context of financial development.

The remainder of this paper is organized as follows: Section 2 represents an overview about the internal and external debt position of the Turkish economy historically. In Section 3 we present our variables. Section 4 provides regression results and Section 5 provides conclusion.

2. External and Internal Debt of the Turkish Economy (2002Q1-2012Q2)

According to our view country specific differences play an important role to provide sound results about the analysis. Therefore we find it crucial to observe the Turkish public debt structure over time.

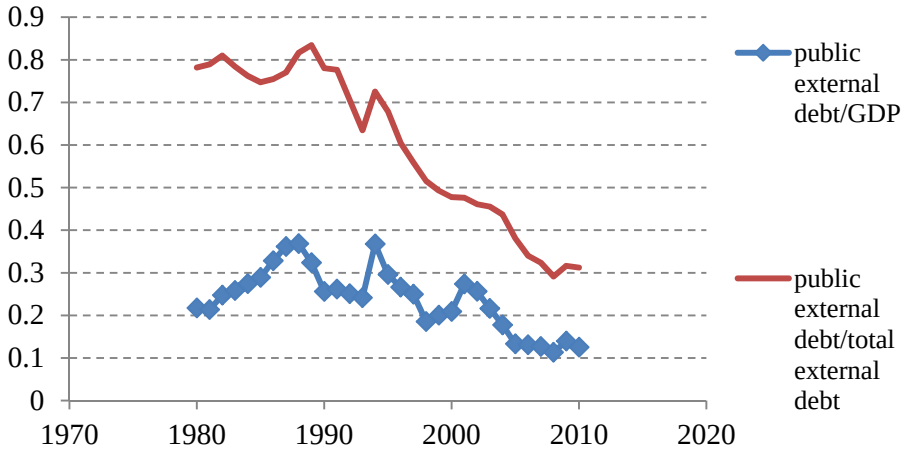

Figure 1. Public external debt

Source: World Bank.

The first figure represents the decrease in the external public debt/GDP and external public debt/total external debt ratio over time. The decrease in the share of the public debt in external borrowing means an increase in the share of the external private borrowing at the same time. In the second figure it can be seen that there is a trend shift in the domestic debt/GDP ratio from % 17 to % 43 during the period 2000Q3-2001Q2. The descending trend of the public external borrowing starting from that period till now supports the claim about the reliance of developing countries on internal borrowing as a result of the increasing financial risk. The uncertainties and additional costs of external debt are mentioned as the main reasons. On the other hand despite the reliance on the internal borrowing, the domestic debt/GDP ratio indicates a descending trend after 2002 up to % 27 percent in 2012.

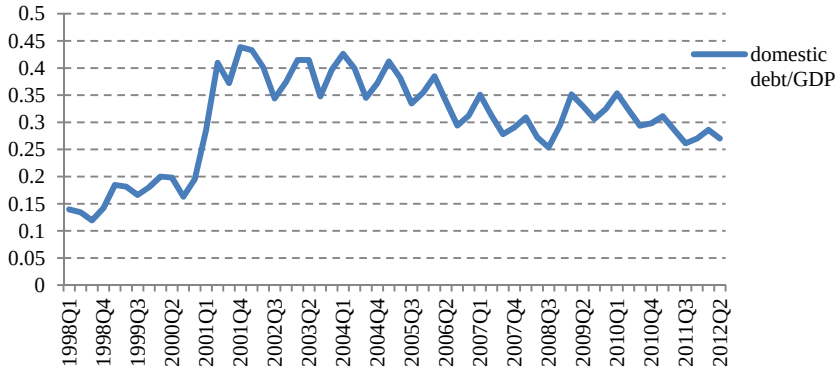

Figure 2. Domestic debt over GDP

Source: Central Bank of Republic Turkey.

The policy choice about relying on domestic sources instead of external borrowing may have some effect on the financial system. In the Turkish case banks play the dominant role in channeling funds from savers to investors like in many other developing and emerging market countries. Therefore the response of the banks due to the changes in the domestic borrowing is an important outcome to evaluate financial development in these countries. In figures 3 and 4 this response of the Turkish banking sector can be seen very clearly. In figure 3 the bank credits to private sector/GDP ratio indicates a tremendous increase after 2002. On the other hand in the same period the bank credits to public sector/GDP shows a decreasing trend. The percentage of the government securities held by banks in total government securities and the weight of these securities in total bank assets is a good indicator to evaluate the "laziness" of the banking sector. In figure 4 both government securities held by banks/domestic debt and government securities held by banks/banks total asset ratios indicate a decreasing trend after 2002. This trend has been corrupted during the financial crisis in 2008 but it has converged very rapidly to its previous trend before 2008.

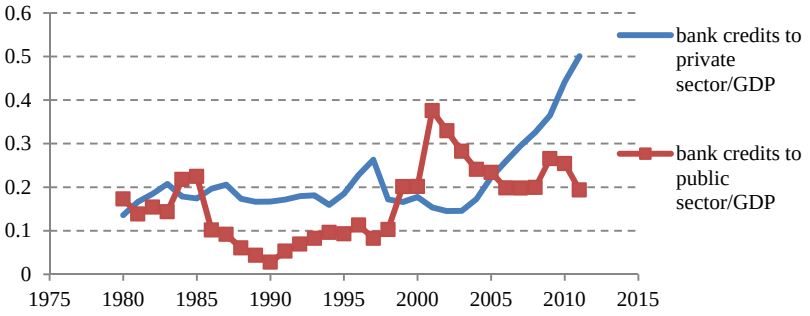

Figure 3. Bank credits to public and private sector

Source: World Bank.

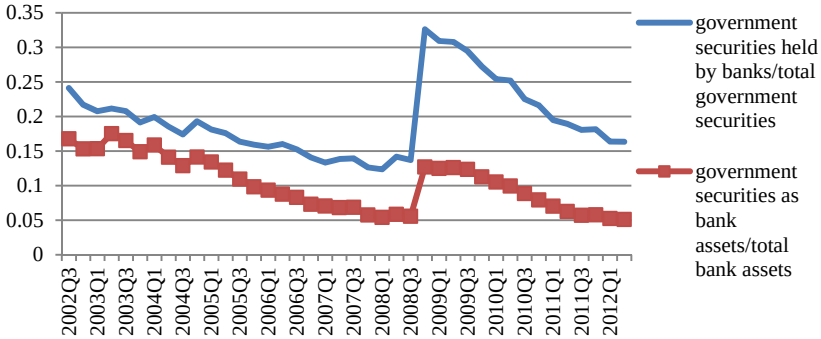

Figure 4. Government securities held by banks

Source: Central Bank of Republic Turkey.

In sum the share of the domestic and external government debt decreases as percentage of GDP in the 2002Q3-2012Q2 period. The government policy during this period can be summarized as targeting low level of total public debt as the proportion of the GDP. Additionally it's also aimed to decrease the amount of external debt as much as possible in order to minimize financial risks that could be faced during financial crises. The effect of this policy implication appears as the increasing performance of the Turkish banking sector during this period. The decreasing trend of the public debt/GDP ratio allows banks to give more credits to the private sector which supports higher economic growth.

3. Data and Methodology

We've used basically two measures in order to examine the relationship between public debt and financial development in the 2002Q3-2012Q2 period. One measure is an indicator which shows the financial development through time and the other is an indicator which represents the indebtedness of public sector historically. The financial development measures are taken from the work of Levine (2002). He constructed a component measure called FINANCE-AGGREGATE which indicates the degree of financial system's ability to provide financial services. This measure consists of three sub-indicators. The first indicator is FINANCE-ACTIVITY which equals the logarithm of the value traded ratio times private credit ratio (Note 1). The second indicator is FINANCE-SIZE which equals the logarithm of the market capitalization ratio times private credit ratio (Note 2). The third measure of the financial development is FINANCE-EFFICIENCY which equals the logarithm of the turnover ratio divided by interest rate margin (Note 3). The last measure which can be described as a summary measure is called FINANCE-AGGREGATE which will be used as the financial development indicator. This measure is the first principal component of the finance-activity, finance-size and finance-efficiency. Larger values of these four measures signify an increase in financial development.

Table 1. Financial development indicator series (Note 4)

TIME	FINACT	FINSIZE	FINEFF	FINAGG
2002Q1	-2.1466	-1.1938	N.A.	N.A.
2002Q2	-2.3232	-1.3994	0.4945	-2.2344
2002Q3	-2.4169	-1.5723	0.3047	-2.4816
2002Q4	-2.0249	-1.5828	0.2815	-2.2402
2003Q1	-2.7293	-1.6731	-0.2698	-2.9763
2003Q2	-2.0638	-1.5331	-0.5165	-2.5457
2003Q3	-2.1679	-1.5297	0.0246	-2.4003
2003Q4	-1.6116	-1.2587	0.5002	-1.6743
2004Q1	-1.7512	-1.1860	-0.2350	-2.0065
2004Q2	-1.6995	-0.9905	-0.0685	-1.7813
2004Q3	-1.5862	-0.8682	-0.0964	-1.6389
2004Q4	-1.6531	-0.8312	-0.5242	-1.8262
2005Q1	-1.4330	-0.6797	0.6238	-1.1351
2005Q2	-1.5302	-0.5962	-0.0810	-1.4207
2005Q3	-1.1750	-0.3721	0.2692	-0.9060
2005Q4	-1.1430	-0.2126	0.3760	-0.7403
2006Q1	-0.9508	0.0518	-0.0601	-0.6140
2006Q2	-0.7969	0.0076	0.6292	-0.2721
2006Q3	-1.2261	-0.0860	-1.5963	-1.4843
2006Q4	-1.2125	-0.0290	0.0116	-0.8099
2007Q1	-1.0784	0.0506	0.3248	-0.5480
2007Q2	-0.9141	0.2340	0.6069	-0.2116
2007Q3	-0.6623	0.3293	1.7518	0.4628
2007Q4	-0.7429	0.4218	-0.3669	-0.3588
2008Q1	-0.9421	0.1526	-0.9943	-0.9085
2008Q2	-1.0147	0.1311	0.1011	-0.5418
2008Q3	-0.9332	0.1986	-0.5823	-0.7119
2008Q4	-0.9522	-0.0955	0.5885	-0.4564
2009Q1	-1.0963	-0.0577	2.9586	0.4000
2009Q2	-0.3811	0.1650	0.8330	0.1820
2009Q3	-0.4207	0.3455	0.1489	0.0052

2009Q4	-0.3534	0.4069	0.8349	0.3571
2010Q1	-0.2748	0.5851	6.5800	2.7699
2010Q2	-0.2775	0.6352	-0.5883	-0.0022
2010Q3	-0.4423	0.7433	-0.5944	-0.0430
2010Q4	-0.0252	0.8666	1.0035	0.9351
2011Q1	-0.0004	0.8265	1.5309	1.1317
2011Q2	-0.0665	0.8643	6.3869	3.0113
2011Q3	-0.1967	0.7634	3.6655	1.7968
2011Q4	-0.3723	0.7199	-0.4954	0.0265
2012Q1	-0.3354	0.7839	0.1022	0.3257
2012Q2	-0.2607	0.7735	0.3191	0.4529

As expected FINAGG gives nearly the same information those old variables FINACT, FINSIZE and FINEFF give. They correlation between these variables are very strong.

Table 2. Correlations of financial structure and financial development

Correlations (t-statistic)	FINACT	FINSIZE	FINEFF	FINAGG
FINACT	1.000			
FINSIZE	0.968	1.000		
	(24.118)**			
FINEFF	0.384	0.324	1.000	
	(2.601)**	(2.142)*		
FINAGG	0.903	0.876	0.733	1.000
	(13.176)**	(11.368)**	(6.729)**	

Notes: (**) and (*) indicate significance at the 0.01and 0.05 levels, respectively.

The other component of our analysis is domestic debt. In the public debt-finance literature different indicators are used in order to analyze the impact of the public debt on the financial development. Public debt/GDP, domestic debt/GDP, external public debt/GDP, credit to public sector/total bank credits, credit to private sector/ credit to public sector are examples for these indicators. In our analysis we use the logarithm of the DOMESTIC DEBT/GDP which represents the percentage change in the public needs of funds provided by the domestic financial system. We also used the logarithm of some control variables like INFLATION (-), TURNOVER RATIO (+) and INTEREST RATE MARGIN (+) with expected signs in the parentheses. (Note 5)

4. Regression Results

In order to investigate the effect of the public debt on the financial development we established a regression analysis between DOMESTIC DEBT/GDP ratio and the principal component score of the financial indicators FINAGG. We added also some control variables like TURNOVER RATIO, INTEREST RATE MARGIN and INFLATION to our regression analysis. The expected economic signs of the explanatory control variables were thought as a checksum of the regression analysis' soundness between DOMESTIC DEBT/GDP and FINAGG. In sum the explanatory control variables of the regression analysis were DOMESTIC DEBT/GDP, TURNOVER RATIO, INTEREST RATE MARGIN and INFLATION. The regression analysis is run for the Turkish quarterly data for the period 2002:Q1- 2012:Q2. This period is selected because it includes the recovery phase after the 2001 crises in financial markets. Estimations covering more than ten years are considered sufficient in literature to make long-run interpretations and using quarterly data allows us to make 42 observations with lags. All data is obtained from the database of the Central Bank of Republic of Turkey. The data at quarterly frequencies exhibit cyclical movements that recur every quarter. So recent U.S. Census Bureau's X12 seasonal adjustment method used for removing these cyclical seasonal movements from series.

The functional form of our regression analysis is chosen as a linear model as shown in below;

$$FINAGG_t = \beta_1 + \beta_2 DDR_t + \beta_3 TOR_t + \beta_4 NIM_t + \beta_5 INF_t + u_t \quad (1)$$

where $FINAGG_t$ measures financial development, DDR_t is the domestic debt ratio, TOR_t represents turnover ratio, NIM_t is the net interest rate margin and inflation is indicated by INF_t. Subjecting our variables individually to unit root analysis by Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) tests, we found that all the variables except INF are integrated at the same order. INF has I(0) order which indicates that it's already stationary. But the rest of variables' order is I(1) which means they contain a unit root at the level. The

results are given in Table 3 as follows:

Table 3. DF and ADF unit root tests for stationarity

		DF		ADF		
Variable	Level/First Dif.	Intercept	Intercept& Trend	Intercept	Intercept& Trend	Conclusion
FINAGG	Level	-0.218 (0.198)	-0.813 (0.001)	-0.218 (0.198)	-0.813 (0.001)	
	First Diff.	-1.274 (0.000)	-1.276 (0.000)	-3.482 (0.000)	--3.477 (0.00)	I(1)
DDR	Level	-0.02 (0.820)	-0.127 (0.772)	-0.033 (0.801)	-0.161 (0.582)	
	First Diff.	-0.814 (0.000)	-0.815 (0..001)	-0.814 (0.000)	-0.815 (0.001)	I(1)
TOR	Level	-0.514 (0.008)	-0.647 (0.006)	-0.514 (0.008)	-0.647 (0.000)	
	First Diff.	-1.570 (0.000)	-1.575 (0.000)	-1.570 (0.000)	-1.575 (0.000)	I(1)
NIM	Level	-0.916 (0.105)	-0.304 (0.276)	-0.196 (0.105)	-0.304 (0.276)	
	First Diff.	-1.105 (0.000)	-1.122 (0.000)	-1.105 (0.000)	-1.122 (0.000)	I(1)
INF	Level	-0.521 (0.001)	-0.564 (0.005)	-0.521 (0.001)	-0.564 (0.005)	
	First Diff.	-1.264 (0.000)	-1.268 (0.000)	-1.264 (0.000)	-1.268 (0.000)	I(0)

Notes: (i) Unit root test were performed using E-views (Version7.0) (ii) Lag length for DF test is selected as 0 and selected as automatic-based on Schwarz information criterion (SIC), (maxlag=9) for ADF (iii) Figures in bracket indicate probability values to reject the null hypothesis that claims the variable has a unit root.

According to Engle and Granger's definition cointegration refers to variables that are integrated of the same order. Nevertheless according to Lee and Granger (1990) it is possible to find equilibrium relationship among groups of variables that are integrated of different orders (Enders, 2010, p.360). As a result the linear combination of the variables cancels the stochastic trends in all series. Economically speaking, all the variables will be cointegrated if they have a long-term equilibrium between them. The estimated parameters of the cointegration model are shown in below and the results are given in Table 4.

Table 4. Estimated long term relation model dependent variable: FINAGG

Regressors	Parameter Estimates	P-Value
INTERCEPT	4.552	0.014
DDR	-18.804	0.004
TOR	1.1067	0.012
NIM	13.448	0.033
INF	-10.764	0.102
Adj. R^2 = 0.5933		
Prob (F-Statistic) = 0.0000		
Prob (L.M.) = 0.0329		

Notes: Estimation with OLS and HAC Standard Errors.

According to Breusch-Godfrey Serial Correlation LM test autocorrelation is found in the residuals of regression. Newey-West method is used to get rid of autocorrelation and to obtain standard errors of OLS estimators that are corrected for autocorrelation (Gujarati, 2009, 441). Subjecting our residuals to unit root analysis, we found that the residuals are stationary which indicates the cointegration between variables. The Dickey-Fuller and Augmented Dickey-Fuller critical significance levels are not quite appropriate for cointegration test for residuals (Engel and Granger, 1987). In the present context Engle and Granger's calculated values used for stationarity tests labeled as Engle-Granger (EG) and Augmented Engle-Granger (AEG) tests respectively. The results are

given in Table 5. Before the interpretation of Table 4 one must remember that the dependent variable of the regression analysis was the principal component of the logarithmic variables. As a mathematical necessity the parameters of the regression analysis give the partial semi-elasticities of FINAGG with respect to independent variables. So over the quarterly period 2002:Q1 to 2012:Q2, an increase in TOR by 1 point at a quarter, on the average, leads to about 1.1067 percent increase in the FINAGG; an increase in NIM by 1 point at a quarter, on the average, leads to about 13.448 percent increase in the FINAGG. Both variables have a positive effect on FINAGG as expected. On the other hand an increase in DDR and INF by 1 point individually at a quarter, on the average, lead to decrease -18.804 percent and -10.764 percent in the FINAGG respectively. Also the economical signs of DDR and INF were satisfied as expected. Since 4.552=log of FINAGG at the beginning of the study period, by taking its antilog we obtain 94.821 as the beginning value of FINAGG.

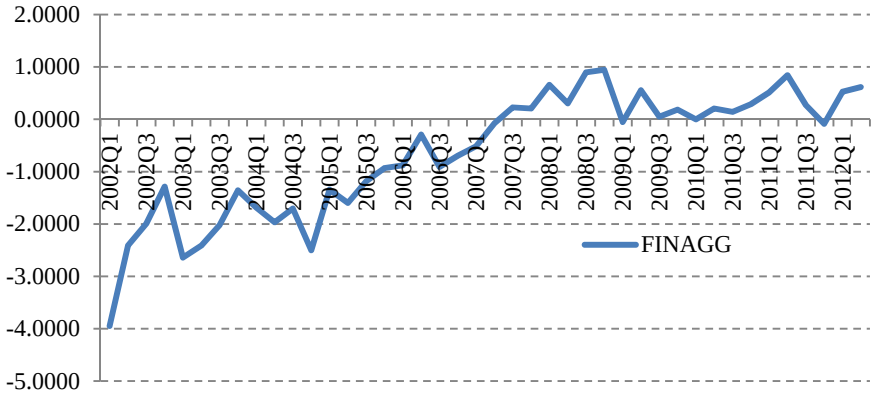

Figure 5. Estimated FINAGG values over the 2002:Q1 to 2012:Q2 period

Table 5. EG and AEG unit root tests for residuals stationarity

		EG		AEG		
Variable	Level/First Dif.	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Conclusion
RESIDUALS	Level	-3.933 (-3.34)	-4.129 (-3.78)	-3.93 (-3.34)	-4.129 (-3.78)	I(0)

Notes: (i) Unit root test were performed using E-views (Version7.0) (ii) Lag length for EG test is selected as 0 and selected as automatic-based on Schwarz information criterion (SIC), (maxlag=9) for AEG (iii) Figures in bracket indicate Engle-Granger asymptotic for cointegration values for %5. (Wooldridge, 2009, p.640).

As the variables below are cointegrated; that is, there is a long-term equilibrium relationship between them. In the short run there may be disequilibrium. Therefore, we can treat the error term in long term model as the "equilibrium error" and we can use this error term to tie the short-run behavior of FINAGG to its long-run value. The short-run relation is formulated as error correction model (ECM) as:

$$\Delta FINAGG_t = \alpha_1 + \alpha_2 \Delta DDR_t + \alpha_3 \Delta TOR_t + \alpha_4 \Delta NIM_t + \alpha_5 \Delta INF_t + \alpha_6 u_{t-1} + \varepsilon_t \quad (2)$$

And the estimated regression model is shown in Table 6.

Table 6. Estimated error-correction model, dependent variable: ΔFINAGG

Regressors	Parameter Estimates	P-Value
INTERCEPT	0.050	0.698
ΔDDR	-3.235	0.819
ΔTOR	0.646	0.062
ΔNIM	10.311	0.128
ΔINF	-1.785	0.797
LONG-TERM RESID (-1)	-0.511	0.002
Adj. R^2 = 0.334		
Prob (F-Statistic) = 0.011		
Prob (L.M.) = 0.794		

Note: Estimation with OLS and HAC Standard Errors

Table 6 shows the short-run effect of public debt effect on financial improvement by using ECM model. In the short-run residuals follow the normal distribution and there is no autocorrelation as in the long-run. In this way the basic OLS estimation conditions are satisfied. As these results show, 0.51 of the discrepancy in the two ratios is eliminated because FINAGG ratio was higher than expected a priori in the last quarter, this quarter it will be reduced by 0.51 percentage points to restore the long-run relationship between the variables.

5. Conclusion

Our main aim is to provide some results about the relationship between public debt and financial development between 2002Q1-2012Q2 for the Turkish economy. The literature that focuses on this relationship is quite new and based mainly on two opposite approaches called “safe asset” and “lazy bank” view. “Safe asset” view advocates the positive effect of the public indebtedness on the financial development while “lazy bank” view advocates the negative effect. We criticize previous works about the generalization of the results they provide. We assert that different countries will indicate different responses against the changes in the public indebtedness and these responses will also differ historically. Therefore we suggest a time-series analysis which provides to monitor country specific conditions through time. In order to denote financial development we use the financial development indicators of Ross Levine (2002) and investigate its relationship with the domestic indebtedness. Our findings support our expectations based on the graphically interpretations of these two variables. The results indicate that the increase in the domestic indebtedness has negative effect on the financial. The control variables also support our results.

The policy implication of the results indicate that decreasing level of domestic indebtedness allows Turkish banking sector to increase private sector credits which in turns has positive effect on the economic growth. This result can be evaluated as a positive support to the “lazy bank” view. On the other hand we believe that the same analysis may give different results under different country specific economic and financial conditions. Therefore we suggest country specific analysis in order to obtain sound results about the public debt-financial development relationship. In future works it may be a good way to classify countries under more specific constraints and work with small groups in order to reach more healthy results for each specific country groups.

References

Aizenman, J. (2004) Financial Opening: Evidence And Policy Options. In R. Baldwin & A. Winters (Eds.), *Challenges To Globalization*. University of Chicago Press. http://dx.doi.org/10.7208/chicago/9780226036557.003.0013

Beck, T., & Levine, R. (2004). Stock Markets, Banks, And Growth: Panel Evidence. *Journal of Banking And Finance, 28*, 423-442. http://dx.doi.org/10.1016/S0378-4266(02)00408-9

Bencivenga, V. R., & Smith, B. D. (1991). Financial Intermediation And Endogenous Growth. *Review of Economic* Studies, *58*, 195-209. http://dx.doi.org/10.2307/2297964

Benhabib, J., & Spiegel, M. M. (2000). The Role of Financial Development In Growth And Investment. *Journal of Economic Growth, 5*, 341-360. http://dx.doi.org/10.1023/A:1026599402490

Caporale, G. M., Howells, P., & Soliman, A. M. (2005). Endogenous Growth Models And Stock Market Development: Evidence From Four Countries. *Review of Development Economics, 9*, 166-176. http://dx.doi.org/10.1111/j.1467-9361.2005.00270.x

De Bonis, R., & Stacchini, M. (2010). What Determines the Size of Bank Loans in Industrialized Countries? The Role of Government Debt, Money and Finance Research Group. *Working Papers*, No. 39.

De Gregorio, J., & Guidotti, P. E. (1995). Financial Development and Economic Growth. *World Development*, 23, 433-448. http://dx.doi.org/10.1016/0305-750X(94)00132-I

Elmendorf, D., & Mankiw, N. G. (1999). Government Debt. In J. B. Taylor and M. Woodford (Eds.), *Handbook of Macroeconomics* (Vol. 1C). Amsterdam, North-Holland.

Emran, M. S., & Farazi, S. (2008). Government Borrowing and Private Credit: Evidence from Developing Countries. *World Bank Working Papers*.

Emran, M. S., & Farazi, S. (2009). Lazy Banks? Government Borrowing and Private Credit in Developing Countries. *Institute for International Economic Policy Paper Series*, WP-2009-9.

Enders, W. (2010). *Applied Econometric Time Series* (3rd ed.). Wiley.

Engle, R. F., & Granger, C. W. J. (1987). Co-integration And Error Correction: Representation, Estimation and Testing. *Econometrica, 55*, 251-276. http://dx.doi.org/10.2307/1913236

Foncerrada, L. (2005). Public Debt Sustainability. Notes on Debt Sustainability, Development of a Domestic Government Securities Market and Financial Risks. *Analisis Economico, 20*, 249-272.

Gilles, S. P. (1992). Technological Choice, Financial Markets And Economic Development. *European Economic Review, 36*(4), 763-781. http://dx.doi.org/10.1016/0014-2921(92)90056-3

Granger, C. W. J., & Lee, T. H. (1990). In Multicointegration. In G. F. Rhodes, Jr. & T. B. Fomby (Eds.), *Advances in Econometrics: Cointegration, Spurious Regressions and unit Roots*. Greenwich, CT: JAI Press.

Greenwood, J., & Jovanovic, B. (1990). Financial Development, Growth and The Distribution of Income. *Journal of Political Economy, 98*, 1076-1107. http://dx.doi.org/10.1086/261720

Gujarati, N. D., & Porter, D. C. (2009). *Basic Econometrics*. McGraw Hill.

Harris, R. D. F. (1997). Stock Markets and development: a re-assessment. *European Economic Review, 41*, 139-146. http://dx.doi.org/10.1016/S0014-2921(96)00021-9

Hauner, D. (2006). Fiscal Policy and Financial Development. *IMF Working Paper*, WP/06/26.

Hauner, D. (2009). Public Debt and Financial Development. *Journal of Development Economics, 88*, 171-183. http://dx.doi.org/10.1016/j.jdeveco.2008.02.004

King, R. G., & Levine, R. (1993). Finance and Growth: Schumpeter Might Be Right. *Quarterly Journal of Economics, 108*, 717-737. http://dx.doi.org/10.2307/2118406

Kumar, M., & Woo, J. (2010). Public Debt and Growth. *IMF Working Papers*, WP/10/174.

Kumhof, M., & Tanner, E. (2005). Government Debt: A Key Role in Financial Intermediation. *IMF Working Paper*, WP/05/57.

Kutivadze, N. (2011). Public Debt and Financial Development. *Working Papers*, No.2011-13, University of Milan.

Levine, R. (1998). The Legal Environment, Banks, And Long-Run Economic Growth. *Journal of Money, Credit, Banking, 30*, 596-613. http://dx.doi.org/10.2307/2601259

Levine, R. (2002). Bank-based or Market-based Financial Systems: Which is Better? *Journal of Financial Intermediation, 11*, 398-428. http://dx.doi.org/10.1006/jfin.2002.0341

Levine, R., & Zervos, S. (1998). Stock Markets, Banks, And Economic Growth. *The American Economic Review, 88*, 537-555.

Lucas, R. E. Jr. (1988). On The Mechanics of Economic Development. *Journal of Monetary Economics, 22*(1), 3-42. http://dx.doi.org/10.1016/0304-3932(88)90168-7

Mankiw, N. G. (1986). The Allocation of Credit And Financial Collapse. *Ouarterly Journal of Economics, 101*, 455-70.

Stiglitz, J. E. (2000). Capital Market Liberalization, Economic Growth, and Instability. *World Development, 28*, 1075-1086. http://dx.doi.org/10.1016/S0305-750X(00)00006-1

Wooldridge, J. M. (2009). *Introductory Econometrics: A Modern Approach*. South Western.

Notes

Note 1. The value traded ratio shows the activity of the stock market and private credit ratio shows the activity of the financial intermediaries.

Note 2. The market capitalization ratio shows the size of the stock market.

Note 3. The turnover ratio indicates how often shares change hands in a stock market and equals to the division of the value of stock transactions by the market capitalization. In most of the developed financial markets the turnover ratios are quite high. The interest rate margin represents the transaction cost of financial intermediation and equals the difference between borrowing and lending interest rates that banks face. The value of the margin may have different meanings under different assumptions. In a liberalized financial system higher values of the interest rate margin may be interpreted as poor competition in the banking sector and poor financial development. Under the assumption of financial repression the margin could be below its competitive level and higher values may have positive effect on the financial development (Hauner, 2006).

Note 4. Finance-Activity= Ln (total value traded ratio*private credit ratio); Finance-Size = Ln (market capitalization ratio * private credit ratio); Finance-Efficiency = Ln (turnover ratio/ interest rate margin);

Finance-Aggregate = Principal component of Finance-Activity, Finance-Size and Finance- Efficiency.

Note 5. The variables which are written with capital letters in Section 3 are used in the regression analysis.

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Political Competition and the (In)Effectiveness of Redistribution in a Federation

Ikuho Kochi[1] & Raúl Alberto Ponce Rodríguez[1]

[1] Universidad Autónoma de Ciudad Juárez, Instituto de Ciencias Sociales y Administración, Ciudad Juárez, Chihuahua, México

Correspondence: Raúl Alberto Ponce Rodríguez, Universidad Autónoma de Ciudad Juárez, Instituto de Ciencias Sociales y Administración, Heroico Colegio Militar y Av. Universidad No. 3775, Zona Chamizal, zip 32310, Ciudad Juárez, Chihuahua, México. Tel: 52-656-688-3893. E-mail: rponce@uacj.mx

Received: February 2, 2013 Accepted: April 3, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p75 URL: http://dx.doi.org/10.5539/ijef.v5n5p75

Abstract

We analyze politico-economic conditions in which the effectiveness of public redistribution might be low in a federation. In our economy, the central government redistributes income while local governments provide a pro poor public good. If local public spending falls due to the ex-post tax-transfer distribution of income engineered by the central government then public redistribution might be less effective in redistributing welfare. In this paper we address this issue. Our main findings are: first, if the party on power represents voters with a labor wage below the average wage and the aggregate net transfer from the redistributive program is negative for residents in the locality then public spending falls in this district. Second, if local governments of *all* districts are controlled by parties representing voters with high marginal utilities of income and labor wages below the nationwide average wage then public redistribution induces *all* local governments to reduce spending.

Keywords: redistributive effects, efficiency, state and local government, fiscal policy and behavior of agents, elections

1. Introduction

Governments of developed and developing economies engage in different programs that seek to redistribute income. While the benefit of public redistribution is a welfare-superior allocation of resources for the society, the literature of public economics has also recognized that redistribution leads to inefficiency costs associated with the response of households to the government's attempt to redistribute income (see Auerbach & Hines, 2002; Alm, 1996; Gravelle & Kotlikoff, 1989; Salanié, 2003, among many others). This literature also argues that these inefficiency costs reduce the effectiveness of income redistribution in increasing the welfare of the society and impose a limit to the size of the government's redistributive policy.

In this paper, we are interested in studying the response of local public spending to a change in the redistributive policy of the central government. This is an interesting issue that might be central to explain the effectiveness of the redistributive policy of the federal government for an economy with a federation. To see this, it is sufficient to recognize that public redistribution changes the distribution of welfare in the society by increasing (reducing) the full income of poor (rich) families but this policy is also likely to affect local public spending. One plausible outcome is that local public spending might be pro poor and it might fall as a result of a policy by the central government that seeks to redistribute income. In this case, the redistributive policy of the central government increases the well being of poor familes but a fall in local public spending reduces it. Hence, the net welfare of the redistributive policy of the central government is ambiguous.

The objective of this paper is to identify political and economic conditions in which the effectiveness of the redistributive policy of the central government might be undermined by the response of local governments. To do so, we develop a political economy model of a federation in which the central government redistributes income and local governments set commodity taxes to provide a pro poor local public good. In this setting, parties are political institutions that represent coalitions of voters who compete to form a local government to implement their ideal fiscal policies. Hence, the response of local governments to the fiscal policy of the central government reflects how income redistribution changes, first, the voters' demand of local spending, since the redistribution of income modifies the budget constraint of the coalition of voters who control the party in power

in the locality, and second, the redistribution of income changes the demand of private goods and the ability of local governments to raise tax revenue through indirect taxation.

The main findings of our paper are the following: first, the size of the pro poor local public good for an economy with a redistributive linear policy from the central government is lower at least in *some* district relative the size of the local public good for an economy without a centralized redistributive policy, if the net transfer from the redistributive program is positive for the coalition of voters controlling the party in power (that is to say, the party in office represents a coalition of voters with labor earning abilities below the average earning ability of the economy) and the aggregate net transfer from the redistributive policy is negative for residents of this district. In this case, a linear redistributive policy from the central government might fail to redistribute welfare in a focalized district. Second, if local governments of all districts are controlled by parties representing individuals with sufficiently high marginal utilities of income and labor earning abilities below the nationwide average labor earning ability then the redistributive program of the federal government induces *all* local governments to reduce the provision of local public goods. In this case, the redistributive policy of the central government can be universally ineffective in redistributing welfare in the federation.

The implication of these equilibriums is that the redistributive policy of the central government might cause significant inefficiency costs in the allocation of resources (due to the individuals' response to tax and transfers policies) while the benefit of public redistribution might be small due to the response of local governments in the provision of public goods. Hence, the net benefits of the redistributive policy of the federal government might be more limited than previously thought. Finally, in this paper we identify empirically verifiable hypothesis on the effects of a linear redistributive program of the central government on the spending policies of sub-national governments.

The rest of the paper is structured as follows: section 2 includes the literature review. Section 3 characterizes the politico-economic equilibrium for this economy and the size of local public spending. The comparative analysis of the distribution of local public spending for economies with and without redistribution is conducted in section 4. Section 5 concludes.

2. Literature Review

One of the main areas of research in public economics deals with the inefficiency costs from taxation and public spending (see for instance, Auerbach & Hines 2002; Auerbach & Slemrod 1997; Gravelle & Kotlikoff 1989; Salanié 2003, among many others). Our paper is related to this literature by studying how the tax and spending policies of the central government modify the gains from the fiscal exchange that local governments offer to their residents. In our economy, the redistributive policy of the central government not only changes the residents' relative prices between private versus local public goods and the relative prices between local public goods and redistributive spending but also affects the political response of the coalitions of voters who control local governments (this is the focus of our paper). We argue that the behavioral effects from public redistribution on local governments are central in explaining how effective the central government can be in redistributing welfare.

Our analysis is also related to the theory on coordination failures in a federation such as the studies of fiscal vertical and horizontal externalities. This theory highlights that the strategic interaction between self-interested governments might lead to a Pareto inefficient allocation of public resources in a federation due to presence of horizontal and vertical fiscal externalities. For the case of horizontal externalities, Wildasin (1986) argues that state governments ignore the effect of local taxes on other jurisdictions. Hence, in presence of mobility of households and firms, state governments will overestimate the marginal costs of public funds leading to too little sub-national spending. For the case of vertical fiscal externalities, the basic argument in Johnson (1988), Boadway and Keen (1996), Dahlby (1994), Boadway, Marchand and Vigneault (1998), and more recently Rizzo (2008) and Dahlby and Wilson (2003), is that the federal and sub-national governments might not take into account how their policies affect the policy of vertically differentiated governments. Therefore, these governments will underestimate the marginal costs of public funds associated with raising tax revenue leading to too much public spending.

Our paper is relevant to the fiscal vertical externality theory since our analysis suggests that, contingent to the identity of the party winning the election, there are conditions in which the fiscal vertical externality might not only lead to too much spending at the local level but also to too little local spending. These outcomes follow from the fact that the impact of the redistributive policy of the central government on sub-national spending and tax policies is contingent to the characteristics (preferences and earning abilities) of the decisive coalition of voters controlling the party on power. In particular, we provide a model of partisan electoral politics that highlights the role of local

elections in aggregating the heterogeneous preferences of individuals over fiscal policy. In our analysis elections do not affect the parties' design of fiscal policy. However, voters choose between the divergent platforms of two parties. In addition, the redistribution of income engineered by the policy of the central government changes the demand of private goods and the ability of local governments to raise tax revenue through indirect taxation.

In this context, there are, at least two types of equilibriums of interest: first, the case of coordination failures between sub-national governments and the central government (in which case public redistribution leads to too little public spending at the local level and in this case public redistribution might not effective). Second, the case of welfare-dominant allocations where the performance of local governments could increase the return of the redistributive policy of the central government (we have left this case for future research).

In particular, our paper contributes to the literature on coordination failures in a federation by identifying conditions in which a linear redistributive policy might fail to redistribute welfare in a focalized district or it is universally ineffective in redistributing welfare in the federation. That is, our paper shows that if the party that wins the local election in district i represents a coalition of voters with labor earning abilities below the average earning ability of the economy and the aggregate net transfer from the redistributive program is negative for residents in this locality, then the size of local public spending in this district falls. Moreover, if parties representing voters with sufficiently high marginal utilities of income and labor earning abilities below the nationwide average earning ability win the local elections in *all* districts then the redistributive program of the government induces *all* local governments to reduce local spending. The implication of these outcomes is that the attempt of the central government to redistribute welfare from the rich to the poor through a linear redistributive program could be ineffective.

3. Redistribution and the Decentralized Provision of Local Public Goods

In this section we study the role of politics on local elections in determining the response of local governments to changes in the distribution of income promoted by the redistributive policy of the central government. Our economy is constituted by a central government and two sub-national governments (associated with localities or districts 1 and 2). The central and sub-national governments have different tasks mandated by the constitution of the country. We take as given these constitutional mandates. Local governments provide local public goods (such as local security, education, bridges, parks, trash recollection, etc.) and the central government is engaged only in the redistribution of income. This structure of the responsibilities of the central and sub-national governments has empirical support in many developed and developing countries (see Ter-Minassian, 1997).

3.1 Preferences and Constraints of Residents

The budget constraint and preferences of a resident of locality $i = \{1,2\}$ on local public goods are given by:

$$v^i\,(t^i, g^i, n^i) \tag{1}$$

$$subject\ to\ g^i = t^i \int_{\forall n^i} h^i(n^i) x^{*i}(t^i, \tau, T, n^i)\, dn^i \tag{2}$$

Where the indirect utility is $v^i\,(t^i, g^i, n^i) = Max\,\{\,\mu^{*i} = ln(x^{*i}) + ln(1-\ell^{*i}) + g^i\,\}$ subject to $q^i x^{*i} = n^i \ell^{*i}(1-\tau) + T$, and it characterizes the indirect preferences of a resident type n^i of district i on feasible local public goods. Direct preferences on private consumption, x^i, the local public good, g^i, and leisure $(1-\ell^i)$ are defined by $\mu^i\,(x^i, (1-\ell^i), g^i) = ln(x^i) + ln(1-\ell^i) + g^i$. The individual's budget constraint is $q^i x^i = n^i \ell^i (1-\tau) + T$ where $q^i = 1 + t^i$ is the consumer's price of the private good (we have normalized the producer's price to one) and t^i is a tax on private consumption imposed by the local government of district i on its residents.

Moreover, $n^i \ell^i (1-\tau)$ is the individual's after-tax labor income, ℓ^i is the supply of labor, the parameter n^i is exogenous and represents the ability of the individual to earn labor income (the term n^i can be interpreted as a competitive wage on labor services), τ is the federal tax on labor income, and T is a per capita transfer from the central government to a resident of district i. The parameters τ and T represent a linear redistributive program of the central government. The distribution of labor skills in each district is determined by the density $h^i(n^i) > 0: n^i \in \left[n^i_{min}, n^i_{max}\right] \forall i$ such that the cumulative density in district i, $H^i(n^i)$, satisfies $H^i(n^i) = \int_{\forall n^i} h^i(n^i) dn^i = N^i/N^T$ where N^i is the population in district $i = \{1,2\}$ and $N^T = N^1 + N^2$.

Condition (2) is the budget constraint of the local government in district i. Local public goods are financed by a commodity tax rate t^i on purchases of the private good by local residents. Tax revenue of the local government in district i is given by $R(t^i) = t^i \int_{\forall n^i} h^i(n^i) x^{*i}(t^i, \tau, T, n^i)\, dn^i$. (Note 1). Moreover, we consider the following:

$$\int_{\forall n^1} h^1(n^1)n^1\,dn^1 > \int_{\forall n^2} h^2(n^2)n^2\,dn^2 \qquad A1$$

The assumption in ***A1*** simply characterizes the heterogeneity of the ability of earning labor income between residents of districts 1 and 2. Without loss of generality, we assume that the average earning ability of residents of district 1 is higher than that of residents of district 2. Now we characterize the optimal labor supply and consumption of private goods for individuals in this economy.

Proposition 1. *The optimal supply of labor and consumption of the private good for individual type* n^i *in district* i *are given by:*

$$\ell^{*i}(\tau, T, n^i) = \frac{1}{2} - \frac{T}{2n^i(1-\tau)} \qquad (3)$$

And

$$x^{*i}(t^i, \tau, T, n^i) = \frac{n^i(1-\tau)}{2q^i} + \frac{T}{2q^i} \qquad (4)$$

Proof

Results follow by defining the following maximization problem for individual type n^i: $Max\ \delta^i = ln(x^i) + ln(1-\ell^i) + g^i + \alpha^i\{n^i\ell^i(1-\tau) + T - q^i x^i\}$ where α^i is a Lagrange multiplier. Obtain $\partial\delta^i/\partial x^i = 0$ for $x^{*i} > 0$, $\partial\delta^i/\partial\ell^i = 0$ for $\ell^{*i} > 0$, and $\partial\delta^i/\partial\alpha^i = 0$ for $\alpha^{*i} > 0$. Re-arrange terms to show that $\ell^{*i} = \frac{1}{2} - \frac{T}{2n^i(1-\tau)}$ and $x^{*i} = \frac{n^i(1-\tau)}{2q^i} + \frac{T}{2q^i}$.

3.2 Political Equilibrium and the Design of Local Public Spending

In this economy, the heterogeneity of the individuals' labor earning abilities leads to conflicts among voters of the same district over the size of local public spending. Therefore, the social choice problem for local governments is to find the society's ideal size of local public goods. The political institution that solves this social choice problem is a local election in which candidates of political parties propose the size of the government's spending and voters elect a public official. The party winning the election by simple majority in the locality has the right to design and implement the party's platform on local public spending.

We assume that parties have preferences over the size of the government's spending. Wittman (1973, 1983) argues that parties might be controlled by some coalition of voters of the electorate. Because voters have preferences over economic policies, parties want to design and implement the policy on local public goods that maximizes the preferences of the representative coalition of voters controlling the party. (Note 2). In this setting, we are interested in the response of local governments to the fiscal policy of the central government. In particular, we argue that income redistribution affects the ideal policy of parties over local spending by changing the total income of the coalition of voters controlling the party on power and by changing the distribution of total income and private consumption of residents in the locality, which in turn, affects both the demand of residents of public goods and the ability of local governments to raise tax revenue. (Note 3)

For this economy the politico-economic equilibrium is characterized by the sub-game perfect Nash equilibrium shown in definition 1. For this characterization, consider a cumulative distribution function given by $\boldsymbol{\Omega}$: $\{\chi^i(n^i)\}_{\forall n^i} \longrightarrow [0,1]$,where $\boldsymbol{\Omega}$ is a non decreasing function of the sequence $\{\chi^i(n^i) = v^{Li}(t^{*Li}, g^{*Li}, n^i) - v^{Ri}(t^{*Ri}, g^{*Ri}, n^i)\}_{\forall n^i}$, where $\chi^i(n^i)$ reflects a rational choice of the vote for individual type n^i in the election of locality i, and $v^{Li}(t^{*Li}, g^{*Li}, n^i)$ is the welfare of individual type n^i if party L in district i wins the local election and implements policies t^{*Li}, g^{*Li} in the district. A similar interpretation is given to $v^{Ri}(t^{*Ri}, g^{*Ri}, n^i)$.

Definition 1 The electoral-economic equilibrium for an economy with a decentralized provision of local public goods in districts $i = 1,2$ and parties with preferences on local public spending is characterized as follows: In the first scenario nature announces the type of coalitions of voters who run parties $Z = \{L, R\}$ which in this case they are characterized by $n^{Zi}\ \forall\ Z = \{L, R\}, \forall i$. The nature´s move is common knowledge. In the second scenario two parties, denoted as parties L and R, announce local tax and spending policy platforms. In the third stage, citizens vote in each locality for a party based on the type of spending policies that these parties would implement if they win the election. (Note 4) In the fourth stage, the party winning the election in each district takes control of the government and the policies g^{*Li}, t^{*Li} or g^{*Ri}, t^{*Ri} are implemented. Formally:

1) In the second scenario of the local election in district i, parties announce policies that maximize the party's

preferences for local public spending $g^{*Zi}, t^{*Zi}\ \forall\ Z = \{L, R\}, \forall i$: (Note 5)

$$g^{*Zi}, t^{*Zi} \in argmax\ v^{Zi}\ (t^i, g^i, n^{Zi})\ \forall\ Z, \forall i$$

$$subject\ to\ g^{*Zi} = t^{*Zi} \int_{\forall n^i} h^i(n^i)\ x^{*i}(t^{*Zi}, \tau, T, n^i)\ dn^i$$

2) In the third scenario of the local election, the voter type n^i in district i votes

$$For\ party\ \ L\ if\ \chi^i(\ n^i) = v^{Li}(t^{*Li}, g^{*Li}, n^i) - v^{Ri}(t^{*Ri}, g^{*Ri}, n^i) > 0$$

$$For\ party\ R\ if\ \ \chi^i(\ n^i) < 0$$

3) Moreover, $\boldsymbol{\Omega}$ is a non decreasing cumulative distribution of the sequence $\{\chi^i(\ n^i)\}_{\forall\ n^i}$.Therefore, in the fourth scenario, if there exists a majority of voters $n^i \in \left[n^i_{min}, n^i_{max}\right]: \chi^i(\ n^i) > 0$ then it is satisfied

$$\boldsymbol{\Omega}\big(\ \forall\ n^i \in\ \left[n^i_{min}, n^i_{max}\right]: \chi^i(\ n^i) > 0\big) > 1/2$$

In this case party L wins the local election in district i in the fourth scenario and implements g^{*Li}, t^{*Li}. In contrast, if

$$\boldsymbol{\Omega}\big(\ \forall\ n^i \in\ \left[n^i_{min}, n^i_{max}\right]: \chi^i(\ n^i) < 0\big) > 1/2$$

then party R wins the local election in district i and implements g^{*Ri}, t^{*Ri}.

3.3 The Distribution of Local Public Goods in a Federation

In this section we characterize the general case of the decentralized provision of local public spending when the redistributive instruments of the central government are $\tau \geq 0$ and $T \geq 0$.

Proposition 2 *With a coalition of voters type n^{Zi} controlling party $Z = \{L\ or\ R\}$, the ideal size of the local public good provided in district i by party Z is:*

$$g^{*Zi}(n^{Zi})\ =\ \frac{1}{2}\left\{\int_{\forall n^i} h^i(n^i) n^i\ dn^i - \frac{n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\}$$

$$+\ \tfrac{1}{2}\left\{TH^i(n^i) - \tau \textstyle\int_{\forall n^i} h^i(n^i) n^i\ dn^i - \left\{\frac{T-\tau n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\}\right\}\ \forall Z, \forall i \qquad (5)$$

Where $E[n^i] = \int_{\forall n^i} h^i(n^i) n^i\ dn^i$ is the average labor earning ability of residents of district i, n^{Zi} and $MRS_{g^{Zi}-\alpha^{Zi}}$ are, correspondingly, the labor earning ability and the marginal rate of substitution between the local public good and income of the coalition of voters controlling party Z in district i, and $H^i(n^i) = \int_{\forall n^i} h^i(n^i)\ dn^i = N^i/N^T$ is the density of the population of district i.

Proof

The problem for party $Z = \{L\ or\ R\}$ in district i is to choose t^{*Zi}, g^{*Zi} to

$$Max\ v^{Zi}\ (t^i, g^i, n^{Zi})$$

$$subject\ to\ g^i = t^i \textstyle\int_{\forall n^i} h^i(n^i)\ x^{*i}(t^i, \tau, T, n^i)\ dn^i \qquad (6)$$

Where

$$v^{Zi}\ (t^i, g^i, n^{Zi}) =$$

$$= Max\{\ ln(x^{*Zi}) + ln(1 - \ell^{*Zi}) + g^{Zi}\ st\colon\ q^i x^{*Zi}\ =\ n^i \ell^{*Zi}(1-\tau) +\ T\} \qquad (7)$$

Define γ^{Zi} as follows:

$$\gamma^{Zi} = v^{Zi}\ (t^{Zi}, g^i, n^{Zi}) + \lambda^{Zi}\left\{\ g^{Zi} - t^{Zi} \textstyle\int_{\forall n^i} h^i(n^i) x^{*i}(t^{Zi}, \tau, T, n^i)\ dn^i\ \right\} \qquad (8)$$

The first order conditions for the party's policy problem are:

$$\frac{\partial \gamma^{Zi}}{\partial t^{Zi}} = \frac{\partial v^{Zi}}{\partial t^{Zi}} - \lambda^{Zi}\left\{\ \textstyle\int_{\forall n^i} h^i(n^i) x^{*i}(t^i, \tau, T, n^i) + t^{*Zi} \int_{\forall n^i} h^i(n^i) \frac{\partial x^{*i}}{\partial t^{Zi}} dn^i\right\} = 0 \qquad (9)$$

And

$$\frac{\partial \gamma^{Zi}}{\partial g^{Zi}} = \frac{\partial v^{Zi}}{\partial g^{Zi}}\ +\ \lambda^{Zi} = 0 \qquad (10)$$

Define $q^{*Zi} = 1 + t^{*Zi}$ and use (4) to express

$$\partial v^{Zi}/\partial t^{Zi} = -\alpha^{Zi} x^{*i}(t^i, \tau, T, n^i) = -\alpha^{Zi}\{\, n^{Zi}(1-\tau)/2q^{*Zi} + T/2q^{*Zi}\,\} \tag{11}$$

Moreover,

$$MRS_{g^{Zi}-\alpha^{Zi}} = \frac{\partial v^{Zi}}{\partial g^{Zi}} \,/\, \alpha^{Zi} = \, 1 \,/\, \alpha^{Zi} \tag{12}$$

$$\int_{\forall n^i} h^i(n^i)\, x^{*i}(t^i, \tau, T, n^i)\, dn^i = \frac{(1-\tau)}{2q^{*Zi}} \int_{\forall n^i} h^i(n^i) n^i\, dn^i + \frac{T}{2q^{*Zi}} H^i(n^i) \tag{13}$$

$$H^i(n^i) \;=\; \int_{\forall n^i} h^i(n^i) dn^i \;=\; N^i/N^T \tag{14}$$

$$\int_{\forall n^i} h^i(n^i) \frac{\partial x^{*i}}{\partial t^{Zi}} dn^i = -\frac{(1-\tau)}{2\left(q^{*Zi}\right)^2} \int_{\forall n^i} h^i(n^i) n^i\, dn^i - \frac{T}{2\left(q^{*Zi}\right)^2}\, H^i(n^i) \tag{15}$$

Use conditions (10) to (15) into (9) and re-arrange terms to show that t^{*Zi}/q^{*Zi} is given by

$$\frac{t^{*Zi}}{q^{*Zi}} = \frac{(1-\tau)\left\{\int_{\forall n^i} h^i(n^i) n^i dn^i - \frac{n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\} - T\left\{\frac{1}{MRS_{g^{Zi}-\alpha^{Zi}}} - H^i(n^i)\right\}}{(1-\tau)\int_{\forall n^i} h^i(n^i) n^i dn^i + T\, H^i(n^i)} \tag{16}$$

From the government's budget constraint

$$g^{*Zi} = t^{*Zi} \int_{\forall n^i} h^i(n^i)\, x^{*i}(t^{*Zi}, \tau, T, n^i)\, dn^i \tag{17}$$

$$g^{*Zi} = \frac{1}{2}\frac{t^{*Zi}}{q^{*Zi}} \left\{(1-\tau) \int_{\forall n^i} h^i(n^i) n^i\, dn^i + T\, H^i(n^i)\right\} \tag{18}$$

Use (16) into (18) to show that the platform of party *Z* on the local public good of district $i, \forall i,$ is given by

$$g^{*Zi}(n^{Zi}) \;=\; \frac{1}{2}\left\{\int_{\forall n^i} h^i(n^i) n^i\, dn^i - \frac{n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\}$$

$$+\, \frac{1}{2}\left\{TH^i(n^i) - \tau \int_{\forall n^i} h^i(n^i) n^i\, dn^i - \left\{\frac{T - \tau n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\}\right\} \forall Z, \forall i \tag{19}$$

Condition (5) says that the ideal size of the local public good for party Z in district i depends positively on the difference between the average labor income in the locality and a normalized income of the coalition of voters controlling party *Z*, that is $\left\{\int_{\forall n^i} h^i(n^i) n^i\, dn^i - \frac{n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\}$, on whether the locality is a net winner or loser of the redistributive program of the central government, this term is $\left\{TH^i(n^i) - \tau \int_{\forall n^i} h^i(n^i) n^i\, dn^i\right\} \gtreqless 0$ where $TH^i(n^i)$ represent the aggregate transfers from the redistributive program to residents of locality i while $\tau \int_{\forall n^i} h^i(n^i) n^i\, dn^i$ are the aggregate tax payments of residents of the district that finance the redistributive program of the central government. Finally, $g^{*Zi}(n^{Zi})$, also depends on whether the coalition that controls party Z in district i is a net winner or loser from the redistributive program of the central government, this term is $\{T - \tau n^{Zi}\} \gtreqless 0$. (Note 6)

The comparative analysis also suggests the following:

Proposition 3 For a large economy, the ideal size of local public spending is a non increasing function of the voter's earning ability, that is for all $\check{n}^i, \dot{n}^i \in \left[n^i_{min}, n^i_{max}\right]$: $\check{n}^i \geq \dot{n}^i$ then $g^*(\check{n}^i) \leq g^*(\dot{n}^i)$ where $g^*(\check{n}^i)$ and $g^*(\dot{n}^i)$ are the ideal size of local public spending of voters with earning abilities $\check{n}^i$ and $\dot{n}^i$.

In addition, transfers, T , tend to increase the size of the local public good in district i when

i. The density of the population of the district is high relative the overall population of the economy, and (or)

ii. The decisive coalition of voters controlling the party on office has a sufficiently low marginal utility of income (i.e., a high willingness to pay for the local public good).

Moreover, an increase in the labor income tax, τ reduces the size of the local public good in district i when

iii. The labor earning ability of the average voter in district i is sufficiently high, and (or)

iv. The decisive coalition of voters controlling the party on office has a sufficiently low marginal utility of income (i.e., a high willingness to pay for the local public good), and (or)

v. The labor earning ability of the decisive coalition of voters controlling the party on office on district i is sufficiently low.

Proof

The first part of the proposition states that for all $\check{n}^i, \dot{n}^i \in \left[n^i_{min}, n^i_{max}\right]$: $\check{n}^i \geq \dot{n}^i$ then $g^*(\check{n}^i) \leq g^*(\dot{n}^i)$. This result follows directly from the fact that we can generalize condition (5) for any voter in every district. Hence, $\forall\, n^i \in \left[n^i_{min}, n^i_{max}\right]$, the ideal size of local public spending for a voter type n^i,$g^*(n^i)$, is given by $g^*(n^i) = \frac{1}{2}\left\{ E[n^i] - \frac{n^i}{MRS_{g-\alpha^{ni}}} + TH^i(n^i) - \tau E[n^i] - \left\{ \frac{T-\tau n^i}{MRS_{g-\alpha^{ni}}} \right\} \right\}$ where $E[n^i] = \int_{\forall n^i} h^i(n^i) n^i \, dn^i$. It follows that $\partial g^*(n^i)/\partial n^i = \frac{1}{2}\{1-\tau\}\left\{ h^i(n^i) - \frac{1}{MRS_{g-\alpha^{ni}}} \right\} \leq 0$ since for a large economy $h^i(n^i) \cong 0, \{1-\tau\} \geq 0$, and $MRS_{g-\alpha^{ni}} > 0$. Therefore, the ideal size of local public spending is a non increasing function of the voter's earning ability.

Now, recall from (5) that the ideal size of the local public good for party Z in district i is g^{*Zi}:

$$g^{*Zi} = \frac{1}{2}\left\{ \int_{\forall n^i} h^i(n^i) n^i \, dn^i - \frac{n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}} \right\} + \frac{1}{2}\left\{ TH^i(n^i) - \tau \int_{\forall n^i} h^i(n^i) n^i \, dn^i - \left(\frac{T-\tau n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}} \right) \right\} \forall i \tag{20}$$

It is simple to verify that

$$\frac{\partial g^{*Zi}}{\partial T} = H^i(n^i) - \frac{1}{MRS_{g^{Zi}-\alpha^{Zi}}} \gtreqless 0 \tag{21}$$

Where $MRS_{g^{Zi}-\alpha^{Zi}} = \frac{\partial v^{Zi}}{\partial g^{Zi}} \Big/ \alpha^{Zi} = 1 \,/\, \alpha^{Zi}$ is the willingness to pay for the local public good by the decisive coalition of voters controlling the party in power. Hence as $MRS_{g^{Zi}-\alpha^{Zi}} \longrightarrow \infty$ then $\partial g^{*Zi}/\partial T > 0$, or if $H^i(n^i) \longrightarrow 1$ while $MRS_{g^{Zi}-\alpha^{Zi}}$ is sufficiently low then $\partial g^{*Zi}/\partial T > 0$. Moreover,

$$\frac{\partial g^{*Zi}}{\partial \tau} = -\int_{\forall n^i} h^i(n^i) n^i \, dn^i + \frac{n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}} \gtreqless 0 \tag{22}$$

Hence a sufficiently high $\int_{\forall n^i} h^i(n^i) n^i \, dn^i$, and (or) $MRS_{g^{Zi}-\alpha^{Zi}} \longrightarrow \infty$, and (or) a sufficiently low n^{Zi} then $\partial g^{*Zi}/\partial \tau < 0$.

Proposition 2 characterizes the set of politically feasible local public goods in district i and proposition 3 provides a comparative static analysis of g^{*Zi}. In particular, proposition 3 says that an increase in the size of transfers from the redistributive program of the federal government does not necessarily increases the provision of the local public in district *i*. To see this, condition (21) shows that an increase in T might lead to a higher provision of the local public good when the density of the population of the district is high relative the overall population of the economy, and (or), the decisive coalition of voters controlling the party on power has a sufficiently high willingness to pay for the local public good.

A higher density of the population of the district means that a higher share of the resources of the redistributive program is allocated to the district. This in turn increases the demand of residents for private goods, the district's tax collection, and the provision of the local public good. Simultaneously, a higher transfer of the central government increases the full income of the decisive coalition of voters controlling the party on office and it induces the members of the party to substitute private goods for public goods. Hence, this effect of the redistributive program on the coalition of voters controlling the party on office tends to reduce the provision of the local public good.

Proposition 3 also says that the marginal increase in g^{*Zi} due to an increase of the federal income tax depends negatively on the difference between the average labor earning ability in the locality and a normalized income of the coalition of voters controlling party Z in office (see condition 22). Hence, an increase of the federal income tax tends to reduce the provision of the local public good in district i if: first, the labor earning ability of the average voter is high (because in this case the district is a net contributor to the redistributive program and the federal program induces an aggregate negative income effect on residents that reduces the district's tax revenue). Second, the decisive coalition of voters controlling the party on power has a sufficiently high willingness to pay for the

local public good. Third, the labor earning ability of the decisive coalition of voters controlling the party on power on district i is sufficiently low.

3.4 The Divergence of the Parties' Policies

In proposition 4 we identify conditions that guarantee that party L or R wins the local election in each district by simple majority. We also identify the sources of the divergence of the parties' fiscal policies at the political equilibrium. Hence propositions 2 and 4 represent a set of politico-economic conditions that identify the design and implementation of local public spending.

Proposition 4 *Assume* $\tau \geq 0, T \geq 0$, *if*

Condition 4.1 $n^{Ri} > n^{Li}, \alpha^{Ri} < \alpha^{Li}$ *such that* $\alpha^{Ri}n^{Ri} > \alpha^{Li}n^{Li}$ *then* $\left\{\frac{\alpha^{Ri}n^{Ri} - \alpha^{Li}n^{Li}}{\alpha^{Li} - \alpha^{Ri}}\right\} \gtreqless \left\{\frac{T}{1-\tau}\right\}$ *implies* $\hat{g}^{*Li} \gtreqless \hat{g}^{*Ri}$

Moreover, if

$$\mathbf{\Omega}\left(\forall n^i \in \left[n^i_{min}, n^i_{max}\right]: \chi^i(n^i) > 0\right) > 1/2 \tag{23}$$

Then party L wins the local election in district i and implements $\hat{g}^{*Li}$. In contrast, if

$$\mathbf{\Omega}\left(\forall n^i \in \left[n^i_{min}, n^i_{max}\right]: \chi^i(n^i) < 0\right) > 1/2 \tag{24}$$

Then party R wins the local election in district i and implements $\hat{g}^{*Ri}$. (Note 7)

Proof

The equilibrium condition (5) means that

$$\hat{g}^{*Li} - \hat{g}^{*Ri} = \frac{1}{2}\left\{\frac{T - (1-\tau)n^{Ri}}{MRS_{g^{Ri}-\alpha^{Ri}}} - \frac{T - (1-\tau)n^{Li}}{MRS_{g^{Li}-\alpha^{Li}}}\right\} =$$

$$= \tfrac{1}{2}\{(\alpha^{Ri} - \alpha^{Li})T - (1-\tau)\{\alpha^{Ri}n^{Ri} - \alpha^{Li}n^{Li}\}\} \tag{25}$$

By (1), $n^{Ri} > n^{Li}, \alpha^{Ri} < \alpha^{Li} \Leftrightarrow \alpha^{Ri}n^{Ri} > \alpha^{Li}n^{Li}$. (Note 8). Hence condition 4.1 implies that if $\left\{\frac{\alpha^{Ri}n^{Ri} - \alpha^{Li}n^{Li}}{\alpha^{Ri} - \alpha^{Li}}\right\} \gtreqless \left\{\frac{T}{1-\tau}\right\} \Rightarrow \hat{g}^{*Li} \gtreqless \hat{g}^{*Ri}$. Moreover, $\mathbf{\Omega}$ is a non decreasing cumulative distribution of the sequence $\{\chi^i(n^i)\}_{\forall n^i}$. Therefore, if there exists a majority of voters $n^i \in \left[n^i_{min}, n^i_{max}\right]: \chi^i(n^i) > 0$ then it is satisfied

$$\mathbf{\Omega}\left(\forall n^i \in \left[n^i_{min}, n^i_{max}\right]: \chi^i(n^i) > 0\right) > 1/2 \tag{26}$$

In this case party L wins the local election in district i and implements g^{*Li}, t^{*Li}. In contrast, if $\mathbf{\Omega}\left(\forall n^i \in \left[n^i_{min}, n^i_{max}\right]: \chi^i(n^i) < 0\right) > 1/2$ then party R wins the local election in district i and implements g^{*Ri}, t^{*Ri}.

In proposition 4, the term $\alpha^{Zi}n^{Zi}\ \forall Z, \forall i$ can be interpreted as elasticity between welfare and wage. (Note 9). With $\tau = T = 0$, $\alpha^{Ri}n^{Ri} \gtreqless \alpha^{Li}n^{Li}$ implies $\hat{g}^{*Li} \gtreqless \hat{g}^{*Ri}$. The divergence of the parties' policies is the result of the heterogeneity of the voters' earning abilities and preferences. Since the redistributive policy of the central government tends to equalize full income then proposition 4 says that, the divergence of the parties' policies when $\tau > 0, T > 0$ are related with the difference between the normalized elasticity of welfare-wage between the left and right party characterized in condition 4.1. This difference must be higher or lower than a normalized transfer from the central government given by $T/(1-\tau)$. Therefore, $\left\{\frac{\alpha^{Ri}n^{Ri} - \alpha^{Li}n^{Li}}{\alpha^{Li} - \alpha^{Ri}}\right\} \gtreqless \left\{\frac{T}{1-\tau}\right\}$ implies $\hat{g}^{*Li} \gtreqless \hat{g}^{*Ri}$.

4. Effect of Public Redistribution on Local Public Spending

The equilibrium conditions in (5), (23) and (24) allow a comparative analysis on the size and distribution of local public goods for economies with and without a linear redistributive policy by the central government. In this section, proposition 5 identifies the size of local public goods provided by sub-national governments for the special case of an economy with $\tau = T = 0$. Proposition 6 shows that the effects of the redistributive policy on the provision of local public goods by sub-national governments depend on: first, how the linear redistributive policy affects both the distribution of full income of local residents and the budget constraint of the local government, and second, on the net effect of the redistributive policy on full income of the coalition of voters controlling the party that rules the local government.

As we mentioned before, the net transfer from the redistributive program for the voter represented by the party in

office in district i is $T-\tau n^{Zi}$ and the aggregate net transfer for residents in the district is $TH^i(n^i)-\tau\int_{\forall n^i}h^i(n^i)n^i\,dn^i$. Moreover, we define the size of the local public good in district i for an economy with public redistribution is, g^{*Zi}, while the size of the public good for an economy without a centralized redistributive policy is $\hat{g}^{*Zi}$.

Proposition 5 Consider the case in which the federal government does not redistribute income. In this case, the ideal size of public spending of party $Z=\{L\ or\ R\}$ in district i is given by $\hat{g}^{*Zi}$ which satisfies the following:

$$\hat{g}^{*Zi}=\frac{1}{2}\left\{\int_{\forall n^i}h^i(n^i)n^i\,dn^i-\frac{n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\}\ \forall Z,\forall i \tag{27}$$

Proof

The result in (27) follows trivially by imposing $\tau=T=0$ in proposition 2.

Proposition 6 The redistributive linear policy from the central government induces the local government of district i to produce $g^{*Zi}:\ g^{*Zi}<\hat{g}^{*Zi}$, if

Condition 6.1 $T-\tau n^{Zi}>0$

And

Condition 6.1 $TH^i(n^i)-\tau\int_{\forall n^i}h^i(n^i)n^i\,dn^i<0$

Proof

From (5), g^{*Zi} is given by:

$$g^{*Zi}=\frac{1}{2}\left\{\int_{\forall n^i}h^i(n^i)n^i\,dn^i-\frac{n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\}$$
$$+\frac{1}{2}\left\{TH^i(n^i)-\tau\int_{\forall n^i}h^i(n^i)n^i\,dn^i-\left(\frac{T-\tau n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right)\right\}\ \forall i \tag{28}$$

From (27), $\hat{g}^{*Zi}=\frac{1}{2}\left\{\int_{\forall n^i}h^i(n^i)n^i\,dn^i-\frac{n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\}\ \forall i$. Hence

$$g^{*Zi}-\hat{g}^{*Zi}=\frac{1}{2}\left\{TH^i(n^i)-\tau\int_{\forall n^i}h^i(n^i)n^i\,dn^i-\left\{\frac{T-\tau n^{Zi}}{MRS_{g^{Zi}-\alpha^{Zi}}}\right\}\right\}\ \forall i \tag{29}$$

Since $\alpha^{Zi}\in\mathbb{R}_+\Longrightarrow MRS_{g^{Zi}-\alpha^{Zi}}\in\mathbb{R}_+$. Therefore, conditions 6.1 and 6.2 imply $g^{*Zi}<\hat{g}^{*Zi}$.

In this economy the redistributive policy of the central government provides a positive net transfer to any voter with a labor earning ability that is lower to the average labor earning ability of the economy. (Note 10). This implies two (in some occasions conflicting) outcomes that explain the final effect of public redistribution on the local provision of public goods. First, if the coalition of voters controlling the local government has a labor earning ability lower than the average labor earning ability of the economy then the redistributive program increases the after tax-transfer income and private consumption of this coalition of voters. This in turn, increases the party's political costs of providing a local public good since the tax burden of the coalition of voters controlling the party on power increases. As a result, the demand of local public goods by the coalition controlling the party on power falls which leads to a lower provision of the local public good in the district. (Note 11)

This outcome depends on the local political process. In this economy, voters have preferences over the size of the local public good in their district. Parties represent different sets of coalitions of voters. This, in turn, determines the political platform on local public goods advanced by parties L and R. The first part of proposition 4 says that if a majority of individuals prefer the size of local public goods advanced by party L over the fiscal platform of party R then party L will be elected and this party will be able to implement the desired spending policy of the coalition of voters controlling the elected party. Proposition 4 also identifies conditions in which $\hat{g}^{*Li}>\hat{g}^{*Ri}$.

The second outcome of the redistributive policy of the central government on the provision of local public goods is related with the fact that the redistributive policy increases the aggregate after tax-transfer income of residents of the low ability district (district 2) and reduces the aggregate after tax-transfer income of residents of the high ability district (district 1). This in turn induces an aggregate negative income effect in the high earning ability district (this effect is condition 6.2 in proposition 6) which reduces both the aggregate private purchases of individuals and the government's tax revenue in this district. As a result, this effect tends to reduce the provision of

the public good in this district.

Proposition 7 The linear redistributive program of the central government crowds out the provision of local public goods in all districts if

Condition 7.1 $T - \tau n^{Zi} > 0 \; \forall Z, \forall i$

Condition 7.2 $\exists \, \theta, \varepsilon, \{\alpha^{Zi}\}_{\forall n^i} \in \mathbb{R}_{++} : \varepsilon \longrightarrow 0, \theta \longrightarrow 0 \; and \left\{MRS_{g^{Zi}-\alpha^{Zi}}\right\}_{\forall \alpha^{Zi}} \in \mathbb{R}_{++} : \left| MRS_{g^{Zi}-\alpha^{Zi}} - \theta \right| < \varepsilon \; \forall Z, \forall i$

Proof

In each district the size of $g^{*Zi} \; \forall i$ is

$$g^{*Zi} - \hat{g}^{*Zi} = \frac{1}{2}\left\{ TH^i(n^i) - \tau \int_{\forall n^i} h^i(n^i) n^i \, dn^i - \frac{\{T - \tau n^{Zi}\}}{MRS_{g^{Zi}-\alpha^{Zi}}} \right\} \forall Z, \forall i \tag{30}$$

Conditions (8.1) and (8.2) characterize a set of equilibriums in which $MRS_{g^{Zi}-\alpha^{Zi}}$ is sufficiently low to guarantee $g^{*Zi} < \hat{g}^{*Zi} \; \forall Z, \forall i$.

Proposition 7 says that if local governments in each district are controlled by parties representing the preferences of individuals with sufficiently high marginal utilities of income and labor earning abilities below the nationwide average labor earning ability then the redistributive program of the central government induces *all* local governments to reduce the provision of public goods.

This is the case because public redistribution will provide a positive net transfer to the coalition of voters in control of local governments that induces this coalition to substitute the private good over the public good. Moreover, this effect could be large enough because low income voters are likely to show a high marginal utility of private consumption which also leads to a sufficiently low willingness to pay for local public goods (that is $\exists \, \theta, \varepsilon, \{\alpha^{Zi}\}_{\forall n^i} \in \mathbb{R}_{++} : \varepsilon \longrightarrow 0, \theta \longrightarrow 0 \wedge \left\{MRS_{g^{Zi}-\alpha^{Zi}}\right\}_{\forall \alpha^{Zi}} \in \mathbb{R}_{++} : \left| MRS_{g^{Zi}-\alpha^{Zi}} - \theta \right| < \varepsilon$). In this case, the redistributive program of the central government provides strong incentives for all local governments to reduce the provision of public goods.

Proposition 6 and 7 also highlight the relevance of the distribution of the population as a determinant of the success of the redistributive policy of the central government. To see this, consider the case in which the high income district is controlled by a party representing voters with sufficiently high marginal utilities of income and labor earning abilities below the nationwide average labor earning ability and the population in this economy is sorted unevenly in a way in which a small density of the population of the country is living in the low income district. In this case, it is also simple to demonstrate that the redistributive policy of the government is likely to reduce the supply of local public goods in all districts.

The implication of these outcomes is that the attempt of the central government to redistribute welfare from the rich to the poor through public policy can be undermined by the response of local governments to the ex-post distribution of income engineered by the redistributive policy of the central government. (Note 12). As a result, the redistributive policy of the central government might cause significant inefficiency costs in the allocation of resources (due to the individuals' response to the tax and transfers policies) while the benefits in redistributing welfare might be limited due to the response of local governments in the provision of public goods.

5. Conclusion

While the benefit of public redistribution is a welfare superior allocation of resources for the society, it is well known that the deadweight social costs that arise from the behavioral responses of firms and households are central in determining the net effectiveness of the government's programs that seek to redistribute income and welfare. In this paper, we extend this literature by identifying political and economic conditions in which the benefits of redistributing income might also be limited by the response of local public spending to the ex-post distribution of income engineered by a linear redistributive program of the central government.

In this paper we develop a political economy model of a federation in which the central government redistributes income and local governments set commodity taxes to provide a pro poor local public good. In our economy, parties are political institutions that represent coalitions of voters who compete to form a local government to implement their ideal fiscal policies. This process of preference aggregation by parties is central to explain the response of local governments to the redistributive policy of the central government. In this setting, one outcome of interest is whether pro poor local public spending falls as a result of the redistributive policy of the central government. The implication of this outcome is that the attempt of the central government to redistribute welfare

from the rich to the poor through a linear redistributive program could be ineffective.

Hence, our paper contributes to the literature on coordination failures in a federation by identifying conditions in which: first, a linear redistributive policy might fail to redistribute welfare in a focalized district and, second, the redistributive policy is universally ineffective in redistributing welfare in the federation. In particular, for the case of focalized ineffective redistribution, we identify that, if local public spending is pro poor, the party in office in some district i represents a coalition of voters with labor earning abilities below the average earning ability of the economy and the aggregate net transfer from the redistributive program is negative for residents in this locality, then the size of local public spending in this district falls. In this case, redistribution increases the well being of poor familes but a fall in local spending reduces it leading to a net ambigous welfare effect of redistribution on poor households. For the case of universally ineffective redistribution, we identify that if local public spending is pro poor, local governments in all districts are controlled by parties representing voters with sufficiently high marginal utilities of income and labor earning abilities below the nationwide average earning ability then the redistributive program of the government induces *all* local governments to reduce local spending. It follows that the redistributive policy of the central government is universally ineffective in redistributing welfare in the federation. Finally, in this paper we also identify empirically verifiable hypothesis on the effects of a linear redistributive program of the central government on the spending policies of sub-national governments.

References

Alm, J. (1996). What is an optimal tax system? *National Tax Journal*, *49*, 117-133.

Auerbach, A. J., & Hines, J. R. Jr. (2002). Taxation and economic efficiency. In Auerbach A. J. & Feldstein, M. (Eds.), *Handbook of Public Economics* (Vol. 3, pp. 1348-1416). Amsterdan: Elsevier Science. http://dx.doi.org/10.1016/S1573-4420(02)80025-8

Auerbach, A. J., & Slemrod, J. (1997). The economic effects of the tax reform act of 1986. *The Journal of Economic Literature*, *35*, 589-632.

Boadway, R., & Keen, M. (1996). Efficiency and the optimal direction for federal-state transfers. *International Tax and Public Finance*, *3*, 137-155. http://dx.doi.org/10.1007/BF00399907

Dahlby, B., & Wilson, L. S. (1994). Fiscal capacity, tax effort, and optimal equalization grants. *Canadian Journal of Economics*, *27*, 657-672. http://dx.doi.org/10.2307/135789

Dahlby, B., & Wilson, L. S. (2003). Vertical fiscal externalities in a federation. *Journal of Public Economics*, *87*, 917-930. http://dx.doi.org/10.1016/S0047-2727(01)00137-2

Gravelle, J. G., & Kotlikoff, L. J. (1989). The incidence and efficiency effects of corporate taxation when corporate and noncorporate firms produce the same good. *Journal of Political Economy*, *97*, 749-780. http://dx.doi.org/10.1086/261627

Johnson, W. R. (1988). Income redistribution in a federal system. *American Economic Review*, *78*, 570-573.

Roemer, J. E. (1997). Political-economic equilibrium when parties represent constituents: The unidimensional case. *Social Choice and Welfare*, *14*, 479-502. http://dx.doi.org/10.1007/s003550050082

Roemer, J. E. (2001). *Political competition theory and applications*. Cambridge, Massachusetts: Harvard University Press.

Salanié, B. (2003). *The economics of taxation*. Cambridge, Massashusetts: MIT Press.

Ter-Minassian, T. (1997). *Fiscal federalism in theory and practice*. Washington, DC: International Monetary Fund.

Wittman, D. A. (1973). Parties as utility maximizers. *American Political Science Review*, *67*, 490-498. http://dx.doi.org/10.2307/1958779

Wittman, D. A. (1983). Candidate motivation: A synthesis of alternative theories. *The American Political Science Review*, *77*, 142-157. http://dx.doi.org/10.2307/1956016

Notes

Note 1. The private purchases are given by the Marshallian demand $x^{*i}(t^i, \tau, T, n^i)$ defined by $x^{*i}(t^i, \tau, T, n^i) \in argmax\{\ \mu^i\ (x^i, (1-\ell^i), g^i)$ subject to $q^i x^i\ =\ n^i \ell^i (1-\tau) +\ T\ \}$.

Note 2. For some applications of this view of the political process to the analysis of public finance see Roemer (1997, 2001).

Note 3. In this paper we provide a comparative static analysis only for the case in which public redistribution

does not lead to a change of the party that holds office. We leave the analysis of the impact of the redistributive policy of the central government on party regime for future analysis.

Note 4. In our economy all citizens vote and voting is sequentially rational.

Note 5. In our economy there is complete information about the parties' types. Hence there is no gain for parties to hide their true preferences over feasible local public spending. This means that parties have no incentives to announce the median voter policy in each locality in the second scenario while implementing the parties' ideal size of public spending in the fourth scenario (this issue is better known as the dynamic inconsistency problem).

Note 6. The coalition of voters that control the party has a net gain from the redistributive program of the central government if $T - \tau n^{Zi} > 0$.

Note 7. For simplicity of the analysis we assume that in the event $\boldsymbol{\Omega}\big(\forall\, n^i \in \left[n^i_{min}, n^i_{max}\right]\colon \chi^i(n^i) < 0\big) = 1/2$ then nature flips a coin and the party winning the bet takes control of the government.

Note 8. To see that $n^{Ri} > n^{Li}$, $\alpha^{Ri} < \alpha^{Li} \Leftrightarrow \alpha^{Ri} n^{Ri} > \alpha^{Li} n^{Li}$ start at $\{1/n^{Ri} < 1/n^{Li}\} \Rightarrow \{T/n^{Ri} < T/n^{Li}\}$ and then add $(1-\tau)$ to show $\left\{(1-\tau) + \frac{T}{n^{Ri}} < (1-\tau) + \frac{T}{n^{Li}}\right\}$ which is equivalent to $\frac{n^{Li}}{(1-\tau)n^{Li}+T} < \frac{n^{Ri}}{(1-\tau)n^{Ri}+T}$. Now multiply both sides by $2q^i/q^i$ hence $\frac{1}{q^i}\left\{\frac{2q^i n^{Ri}}{(1-\tau)n^{Ri}+T}\right\} > \frac{1}{q^i}\left\{\frac{2q^i n^{Li}}{(1-\tau)n^{Li}+T}\right\}$ which means $\left\{\frac{n^{Ri}}{q^i x^{*Ri}}\right\} > \left\{\frac{n^{Li}}{q^i x^{*Li}}\right\}$ since by proposition 1 $x^{*Zi} = \frac{n^{Zi}(1-\tau)}{2q^i} + \frac{T}{2q^i}\ \forall Z$. By the first order conditions of the individual's choice problem $\alpha^{Zi} = \frac{1}{q^i x^{*Zi}}\ \forall Z$. Therefore, $\left\{\frac{n^{Ri}}{q^i x^{*Ri}}\right\} > \left\{\frac{n^{Li}}{q^i x^{*Li}}\right\} \Rightarrow \alpha^{Ri} n^{Ri} > \alpha^{Li} n^{Li}$.

Note 9. This is the case if we normalize values of $\mu^i = 1, \ell^i = 1$ and $\tau = 0$.

Note 10. It is simple to see this. An individual in district i with a labor earning ability of n^i receives a net positive transfer from the redistributive program of the central government if $T - \tau n^i \ell^{*i}(\tau, T, n^i) > 0$. Use condition (3) to show that $T - \tau n^i \ell^{*i}(\tau, T, n^i) > 0$ is equivalent to $n^i < T[(2-\tau)/\tau(1-\tau)]$. Now from the budget constraint of the federal government $T = \tau \sum_{\forall i} \int_{\forall n^i} h^i(n^i) n^i \ell^{*i}(\tau, T, n^i)\, dn^i$. Use again (3) in the budget constraint of the government to show that $T = [\tau(1-\tau)/(2-\tau)]E[n]$ where $E[n] = \sum_{\forall i} \int_{\forall n^i} h^i(n^i) n^i\, dn^i$ is the average labor earning ability in the economy. Use this last expression into $n^i < T[(2-\tau)/\tau(1-\tau)]$ to show that an individual in district i with a labor earning ability of n^i receives a net positive transfer from the redistributive program of the central government when $n^i < E[n]$.

Note 11. This effect is formally characterized in proposition 6 by equation (6.1).

Note 12. This is the case because on the one hand the redistributive policy of the central government increases the full income, private consumption and the wellbeing of low wage earners. On the other hand, if the redistributive policy of the central government also reduces the supply of local public goods then the welfare of low wage earners also falls.

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Investment in Jordan's Health Sector and Future Financial Requirements

Basem M. Hamouri[1]

[1] Department of Economics and Banking & Financial Sciences, Faculty of Planning & Management, Balqa Applied University, Jordan

Correspondence: Basem M. Hamouri, Assistant Professor, Department of Economics and Banking & Financial Sciences, Faculty of Planning & Management, Balqa Applied University, Salt, Jordan. Tel: 96-277-999-9428. E-mail: basemhamouri@yahoo.com

Received: March 4, 2013 Accepted: April 10, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p87 URL: http://dx.doi.org/10.5539/ijef.v5n5p87

Abstract

The primary objective of this paper is to analyze the impact of demographic changes on future financial requirements and demand for health care services in Jordan. The study anticipates the number of medical personnel and hospital beds required in each governorate until the year 2020 under different sets of population projections. However, the study shows the total expenditure on health services in 1994 and the projected values until the year 2020 using constant and declining fertility rates. Meanwhile, the financial requirements as a percentage of the GDP have been undertaken in this study.

In view of the problem identified, this study recommends that a larger proportion of the GDP and government revenues should be channeled into the health sector. In addition to that, the introduction of highly effective health measures should be accompanied by effective population control programs to sustain the gains from the improvement of health services.

Keywords: financing, investment, demographic changes, health sector, budgetary requirements

1. Introduction

Health service is defined as the physical, the mental, and the social well being. To insure this, we are supposed to provide, not just financial support, but personnel services such as doctors, nurses, and health technicians and some others services such as environmental, information and research.

Government spending on health from domestic sources is an important indicator of a government's commitment to the health of its people, and is essential for the sustainability of health programs. This study aimed to systematically analyze data sources available for government spending on health sector in Jordan; describe trends in public financing of health; and test the extent to which they were related to changes in gross domestic product (GDP). The global health community has recognized that public spending on health in developing countries is essential for meeting the development goals, reducing poverty, and fighting major diseases (UN, 2001; WHO, 2001). As a result, increasing amounts of international aid have been given to health sectors in developing countries. The assistance for health to the developing countries has risen steadily since 1995 from about US$8 billion (constant 2007) to nearly $19 billion in 2006 (Ravishankar, Gubbins, & Cooley, 2009).

Improvement of government expenditure on health services is very essential for the future financial sustainability of health sector. The domestic government financial support is become necessary if donor funding on health services is diminishing. However, it is very important to treat the health aid as a complementary not as a substitutability for government spending on health services. In addition, citizen people will find themselves enforced to pay from their own living income which will lead them to be below the acceptable standard of living (Van Doorslaer, O'Donnell, & Rannan-Eliya,2006; Xu, et al., 2003). However, almost all types of expenditures on social services are affected in one way or another by population's changes. Health is one of the salient types that are particularly sensitive to demographic changes of citizens.

Our concern in this study is to see the effects of population growth on budgetary requirements and the health services in Jordan during the years 1994-2020. In this context, different fertility rates are utilized in projecting budgetary requirements and the demand for health personnel and facilities.

2. Literature Review

Reviews of health planning and programs in a world perspective document marked differences in approaches (Maddox, 1982). The welfare of centrally planned and mixed economics, for example, pivots upon centralized national health planning, while in the United States of America, market forces are stressed in the development and allocation of health resources, and approximately 30% of health care services are financed by the government (Hatcher, 1989).

Alike to the thought of this study, there are two international studies of the health sector which illustrate the impact of demographic changes on government resources required for health care services. One study is an analysis of a developing country, Thailand, while the other is focused upon a developed country, Japan. Both studies have substantially utilized a new population projection technique but based on comparable methodological approaches (Ogawa, 1990; Ogawa, 1989; Ogawa et al., 1989).

Moreover, a number of health sector studies, have estimated the total government medical expenditure without explicitly incorporating the age compositional change of a population. Most of these studies show that the government has played an almost exclusive role in providing health services to the people, except in some places, where the private sector also plays a significant role. For example, the Government of Thailand, from 1979 to 1983, total government health care expenditures increased from.98 billion to 1.30 billion baht. These expenditures represented 1.17% of the real GNP in 1979, but grew to 1.43% in 1983 (Myers et al., 1985; Robinson, 1996; Ichikawa, 1985). Although, the World Health Organization (WHO) states that the increased flows of financial aid to health are important, most public spending on health in developing countries comes from domestic sources. Domestically financed health spending is vital for improving health in the developing countries, (WHO, 2001).

Results from many studies have suggested that a country's gross domestic product (GDP), government size, and external health resources might affect government health financing (Mishra & Newhouse, 2007; Yontcheva & Masud, 2005).

Other studies demonstrate that taking into account the factors that contribute to development in governmental financing of health is a crucial issue, mainly the responsibility of ministries of finance. While ministries of health, are devoted to increase the size of health resources. Meanwhile the ministries of finance try to reduce financing of health in the existence of large Development Assistant for Health (DAH) to government (Farag, Nandakumar, Wallack, Gaumer, & Hodgkin, 2009; Yontcheva & Masud, 2005; Gottret & Schieber, 2006).

General Health Expenditure (GHE) is increasing rapidly in the non- developed countries all over the world. DAH is the main answer to the decrease in government expenditure on health services from domestic resources in some developing countries. The improvement in GHE is not simply due to high growth in GDP but is also attributed to increasing General Government Expenditure (GGE) committed to health sector, even as overall size of the government spending in most sectors is diminishing. If this trend keeps on, we assume that the portion of GDP spent by governments on health services will be likely to increase, leading to extended health programs financed throughout government- mediate risk-pooling. Enlarge in the proposed share of government expenditure on health services are expected to take place gradually with time. In the nations where GHE as a proportion of GGE does not raise, additional growth may take long time to catch up with most other nations where increases have take place gradually. A better consideration of issues that might be negatively influencing the share of GGE devoted to health services and discouraging the sustainability of the health sector, such as DAH to government, is required (IHP, 2008).

3. Methodology

To understand the effect of different population trends on health service requirements in Jordan, it is necessary to go beyond crude personnel/population ratios and examine the effect of changing population composition on health needs. Two aspects of population composition are likely to have a bearing on health service requirements: the age-sex structure of the population and its regional distribution – specifically large cities, urban, and rural areas.

Different age and sex groups of the population have widely differing probabilities of sickness and recourse to medical attention. Infants and old people are the groups with the highest incidence of sickness and hospitalization. At ages over 50, rates of sickness and hospitalization tend to be high and over 60 they are substantially higher (Ogawa, 1990). Nevertheless, illness among young children constitutes a very significant proportion of the demand for health service because, in a high-fertility population, the number of children, aged five and under, exceeds the total number of people aged 45 and above (see table 1). Therefore, we will see

whether or not there are big savings in health expenditures which result when the fertility rate falls steadily over a period of more than a decade in Jordan.

In examining the implications of population trends for health needs, the changes in geographic distribution of the population also needs to be taken into account. If some areas are growing faster than others due to more rapid natural increase or immigration, the geographic distribution of health service requirements should be taken into account in health planning.

More important for the strategy of economic health planning is the worldwide tendency towards urbanization. In Jordan, health service ratios are much higher in the cities than in the rest of the country. In most countries, attention is being given to the possibility of narrowing the gap between rural and urban areas with regard to the availability of health services. The goal of simply holding health service ratios constant in the country, as a whole, will mean a decline in health service ratios in urban areas, or in rural areas, or in both.

Table 1. Percentage of age distribution, alternative projections (Jordan 1994*-2020)

Projections	1994	2014	2020
Constant fertility			
0-4	14.9	16.8	16.0
5-14	26.5	27.4	26.4
15-44	46.3	42.0	42.3
45-64	9.7	10.4	12.5
65+	2.6	3.4	2.8
Declining fertility			
0-4	14.9	15.0	13.5
5-14	26.5	26.7	24.4
15-44	46.3	44.5	45.3
45-64	9.7	11.0	13.8
65+	2.6	2.8	3.1

Source: Projected by the Author.

Note: *Year 1994 is the year of the latest population census.

From the above table we can see that, by virtue of population growth, health costs will raise in Jordan whether or not health service ratios are increased. How likely is it that such cost increases can be sustained? One way to examine this question is to compare the trends in costs with the expected grown of the GDP during the period 1994-2020.

The bulk of the data required for the preceding projections that are necessary for health planning can be summarized as follows:

1) The age distribution of the population of the base year.

2) The abridged life tables for males and females of Jordan's population (see table A.1, and A.2). These contain tables which group the following information:

a. $q(x)$ shows the probabilities of death between ages x and $x+n$ and computed by using

$$q(x) = l-(lx+n \ / \ lx) \quad (1)$$

where lx and $lx+n$ are taken from the $l(x)$.

b. $l(x)$ shows the number of people who survive out of a cohort of 100,000 live births.

c. $d(x)$ shows the number of deaths in each group, calculated by multiplying the number in $q(x)$ by the number in $l(x)$ for each age interval.

d. $l(x)$ indicates the number of persons who lived between age x and $x+n$, which is approximately equal to

$$L(x) + (n/2) (lx+n/lx) \quad (2)$$

e. $S(x)$ is the probability of surviving between two groups of completed years.

f. $T(x)$ is the total number of people in $L(x)$ in the indicated age interval and all subsequent age intervals. In other words, $T(x)$ = sum $L(x)$.

g. $e(x)$ is the life expectancy, calculated as

$$e(x) = T(x)/l(x) \quad (3)$$

h. *m(x)* shows the mortality rates for each group. This is the number of death divided by the total population in every age group.

3) Age specific fertility rates (ASFR) for women aged 15 through 49 are required for the analysis.

4) The sex ratio at birth.

By utilizing the preceding data, (in Ralph Sells' model which uses the cohort-component technique for demographic projections), we obtain population projections that show most of the demographic statistics needed for budgetary and personnel requirements of health services. It is also worth mentioning that, to my knowledge, this is the first study which utilizes the population data in the latest population census of 1994 which was released in 1996 to analyze the impact of demographic changes on future financial requirements and demand for health care services in Jordan.

The output of population projections shown in table 2 illustrates that, even if the total fertility rate declines to about (4 children per women) in the year 2020, the population will be more than double during the 26-year period. The role of fertility rates can be demonstrated by comparing the total population projected under a declining fertility with that resulting from a continuation of a constant fertility rate.

Table 2. Population size, alternative projections (Jordan) 1994-2020 (in millions)

Projections	1994*	2014	2020
Constant fertility	4.139	7.677	9.817
Declining fertility	4.139	7.293	8.896

Source: Projected by the Author.

Note: *From the latest population census.

Nevertheless, the declining fertility rates have effects on the age structure of Jordan's population (see table 3). During the projected period, a decline in fertility will lead to a slow down of the increase in the number of infants and children, but this will have no impact on the number of old people for generations.

Table 3. Percent distribution of population for male female

	C	D	C	D	C	D
Age/Year	1994	1994	2014	2014	2020	2020
0-4	14.90	14.90	17.94	15.79	16.03	13.46
5-9	13.68	13.68	15.85	14.78	13.92	12.50
10-14	12.78	12.78	13.53	13.32	12.48	11.91
50-54	2.76	2.76	3.03	3.16	3.72	4.11
55-59	2.21	2.21	2.05	2.14	2.63	2.90
60-64	1.64	1.64	1.56	1.62	1.70	1.87
65-69	1.05	1.05	1.30	1.36	1.10	1.22
70-74	0.74	0.74	0.94	0.98	0.80	0.88
75-79	0.44	0.44	0.55	0.58	0.53	0.59
80-84	0.22	0.22	0.22	0.23	0.24	0.26
85-89	0.11	0.11	0.08	0.08	0.09	0.10
90-94	0.04	0.04	0.03	0.03	0.02	0.03
95-99	0.01	0.01	0.00	0.01	0.00	0.01
100+	00.00	00.00	0.00	0.00	0.00	0.00
Total %	100.00	100.00	106.00	106.60	100.00	100.00

Source: Projected by the Author using (Sell, 1990), computer software packages.

Notes: C: Constant fertility rate. D: Declining fertility rate.

4. Jordan's Health Sector

Jordan is characterized by one of the best fashionable health care infrastructure in the region. Similarly, Jordan's health care system is improved dramatically over the last two decades. The health care system in Jordan includes two major sectors: Public and private. The public sector includes the Ministry of Health (MOH) and Royal Medical Services (RMS). In addition, other small public health institutions, such as Jordan University Hospital

(JUH) and King Abdullah Hospital, are a part of public universities.

Jordan's public health has focused on primary health care in all districts of the country, while leaving tertiary health care mostly to the private sector. Over the past two decades, Jordan's fundamental health indicators have enhanced significantly. The major financer and provider of health services in Jordan is the public sector, which represented by the MOH, complemented by the private sector.

According to the Jordanian Public Health Law No.54, the (MOH) is responsible for all health issues in the country, particularly in (Royal decree, 2002):

- Protecting health through providing preventive and curative services as well as monitoring responsibilities.

- Organizing and supervising health services provided by the public and private sectors.

- Providing health insurance for citizens within available resources.

- Establishing educational and training health institutions managed by the MOH.

Article 4 of the Law illustrates areas of duty for the Ministry including "health promotion and healthy lifestyles, disease control, prevention of nutritional deficiencies, maternal and child health, school health, health of the elderly and prevention and control of no communicable diseases" (Royal decree, 2002). The Law encloses provisions on the practice of medical and health professions, private health care institutions, mental health and drug addiction, communicable diseases, immunization, pharmaceuticals, water and sanitation.

The private sector plays a significant job regarding both the financing and delivery of health services. Many private institutes provide health care insurance for their employees by either self-insuring or the pay for private insurance. Many individuals including those with public health insurance obtain services from private health sector through direct self-payment.

5. Demand for Health Personnel and Facilities

Table (4) demonstrates the number of medical personnel and hospital beds required during the years 1994-2020 under two different fertility assumptions and constant service ratios. However, if the fertility rate remains constant, during a 26-year period, almost a 2.4-fold increase in the case of medical personnel and hospital beds will be needed. On the other hand if the fertility rate declines during the same period, the required increase will be about 2.1-fold in medical personnel and hospital beds. It is worth mentioning that, under these circumstances, training requirements, for medical personnel during the coming two decades will be even greater because of the rapid increase in population attrition. However, this depends on both the capacity of Jordan's training institutions to graduate sufficient trained personnel and the cost of training and employing such a large number of required employees.

Column D in table 4 shows the personnel and hospital beds required under a declining fertility rate. The difference between the numbers under constant and declining fertility rates demonstrates the relative savings in requirements for health personnel during different periods of years. For example, requirements in the year 2020 in the declining fertility projection are about 10% below those in the constant fertility projection. It is important to mention that, whether health services are kept constant or increased, it will not offset the benefit of fertility reduction.

Table 5, panels A, and B, show the projected health personnel and hospital beds required during the years 2014, and 2020 by governorate under different fertility rates. In this table the geographic distribution includes Amman, Balqa, Zarqa, Irbid, Mafraq, Karak, and the rest of Jordan (ROJ). The data in these panels show the number of medical personnel and hospital beds required in each governorate during the 26-year period.

It should be noted that Amman governorate has more than 60% of personnel services and hospital beds compared with other governorate in the country. This high percentage refers to the population size in Amman which constitutes 38% of the population of the whole country, followed by the population size of the governorate of Irbid, Zarqa, Balqa, Mafraq, and Karak respectively (Department of Statistics, 1994).

Table 4. Projected health personnel and hospital beds

Personnel and facilities	1994*	2014		2020	
		C	D	C	D
Physicians					
MOH	2217	4146	3436	5301	4804
Others	4379	8138	7727	10406	14234
Total	6596	12283	11663	15707	14234
Dentists					
MOH	239	461	437	590	533
Others	1359	2535	2405	3241	2933
Total	1598	2996	2842	3831	3466
Pharmacists					
MOH	170	307	291	393	356
Others	2856	5299	5030	6776	6135
Total	3026	2996	2842	3831	3466
Staff nurses					
MOH	1342	2458	2333	3143	2845
Others	2411	4531	4301	5793	5250
Total	3753	6989	6634	8936	8095
Midwives					
MOH	538	998	948	1276	1157
Others	284	538	510	687	623
Total	822	1536	1458	1963	1780
Assistant Nurses					
MOH	2044	3763	3572	4812	4360
Others	2537	4762	4520	6088	5518
Total	4581	8525	8092	10900	9878
Practical Nurses					
MOH	2512	4685	4447	5990	5430
Others	700	1229	1166	1427	1424
Total	3212	5914	5613	7417	6854
Hospital Beds					
MOH	2681	4992	4738	6383	5785
Others	4120	7603	7217	9313	8811
Total	6801	12595	11955	16096	14596

Source: Projected by the Author.

Notes: * Ministry of Health, Statistical year book, P. 10, 1994. Others: Mean Royal Medical Services, Jordan University Hospital, and Private Sector.

Table 5. Projected health personnel and hospital beds by governorate and different rates

Panel A: Year (2014) (in thousands)

Governorate	A		B		P		S		E		F		G		H	
	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D
Amman	4.7	4.4	1.1	1.1	2.1	2.0	2.7	2.5	0.6	0.5	3.2	3.0	2.3	2.1	4.8	4.6
Balqa	0.8	0.8	0.2	0.2	0.4	0.4	0.5	0.5	0.1	0.1	0.6	0.5	0.4	0.4	0.8	0.8
Zarqa	1.9	1.8	0.5	0.5	0.9	0.9	1.1	1.1	0.2	0.2	1.3	1.2	0.9	0.9	1.9	1.8
Irbid	2.2	2.1	0.5	0.5	1.0	1.0	1.3	1.3	0.3	0.3	1.6	1.5	1.1	1.0	2.3	2.2
Mafraq	0.5	0.5	0.1	0.1	0.2	0.2	0.3	0.3	0.1	0.1	0.4	0.4	0.3	0.2	0.5	0.5
Karak	0.5	0.5	0.1	0.1	0.2	0.2	0.3	0.3	0.1	0.1	0.3	0.3	0.2	0.2	0.5	0.5
ROJ	1.6	1.5	0.4	0.4	0.7	0.7	0.9	0.9	0.2	0.2	1.1	1.1	0.8	0.7	1.7	1.6

Panel B: Year (2020)

Governorate	A		B		P		S		E		F		G		H	
	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D
Amman	6.0	5.4	1.5	1.3	2.7	2.5	3.4	3.1	0.8	0.7	4.2	3.8	2.8	2.6	6.1	5.6
Balqa	1.1	1.0	0.3	0.2	0.5	0.4	0.6	0.5	0.1	0.1	0.7	0.7	0.5	0.5	1.1	1.0
Zarqa	2.4	2.2	0.6	0.5	1.1	1.0	1.4	1.2	0.3	0.3	1.7	1.5	1.1	1.0	2.5	2.2
Irbid	2.9	2.6	0.7	0.6	1.3	1.2	1.6	1.5	0.4	0.3	2.0	1.8	1.3	1.2	2.9	2.7
Mafraq	0.7	0.6	0.2	0.1	0.3	0.3	0.4	0.3	0.1	0.1	0.5	0.4	0.3	0.3	0.7	0.6
Karak	0.6	6.0	0.2	0.1	0.3	0.3	0.4	0.3	0.1	0.1	0.4	0.4	0.3	0.3	0.7	0.6
ROJ	2.1	1.9	0.5	0.5	1.0	0.9	1.2	1.1	0.3	0.2	1.4	1.3	1.0	0.9	2.1	1.9

Source: Projected by Author.

Notes: A: Physicians, B: Dentists, P: Pharmacists, S: Staff nurses, E: Midwives, F: Assistant nurses, G: Practical nurses, H: Hospital beds, ROJ: Rest of Jordan.

6. Health Costs

In this respect, we compare the trends in health costs with the expected growth of the GDP during the time period 1994-2020. Table 6 shows the total expenditure on health services in 1994 and the projected values until year 2020 using constant and declining fertility rates. The data in this table show that the total expenditures on health services under a constant fertility rate will increase from 230 million JD's in 1994 to 426.5 and 545.4 million JD s in the year 2014 and 2020 respectively. Meanwhile this expenditure will increase under a declining fertility rate from 230 million JD's in 1994 to 405.1 and 494.1 million JD's in the years 2014 and 2020 respectively.

If the constant population projection obtains, the total expenditure on health services as a percentage of the GDP, assuming a 5% growth rate in GDP, will decrease from 8.93% in the year 1994 to 5.96% in 2020; while under a declining fertility rate projection it will decrease from 8.93% to 5.39% during the same period (see table 7). However, if we assume a 7% growth rate per annum in the GDP, the total expenditure on health services, as a percentage of the GDP under a constant fertility rate will decrease from 8.93% in the year 1994 to 3.64% in 2020; while under a declining fertility rate, the total expenditure will decrease from 8.93% to 3.3% during the same period (see table 7).

Table 6. Total expenditure on health services, alternative assumptions, 1994-2020 (in millions)

	1994	2014	2020
Total expenditure on health services under a constant fertility rate	*230.0	426.5	545.4
Total expenditure on health services under a declining fertility rate	230.0	405.1	494.1

Source: Projected by Author.

Note: * Ministry of Health, Statistical year book, P. 4, 1994.

The following data show that the share of GDP required under a declining fertility rate (declining population projection) will be less than the share of GDP required under a constant fertility rate. Improving health service ratios in Jordan requires a substantially larger share of the GDP which must be channeled into health services.

Table 7. Total expenditure on health services as a percentage of the GDP at constant prices, alternative assumptions, 1994-2020

Assumptions	1994*	2014	2020
GDP grows at 5% per annum			
Constant projection	8.93	6.88	5.96
Declining projection	8.93	6.53	5.39
GDP grows at 7% per annum			
Constant projection	8.93	4.90	3.64
Declining projection	8.93	4.65	3.30

Source: projected by the Author.

Note: *GDP values estimated by referring to the Central Bank of Jordan, monthly statistical bulletin, vol.33, no. 4, 1997.

7. Conclusions and Recommendations

The provision of adequate health services is of vital importance to the welfare of the population of Jordan. It is unarguable that increased investment in health services would yield high returns, if returns are measured in ways that reflect the real welfare of the population rather than the more usual measures of output. However, returns from health investment will be much greater, despite the level of expenditures decided if health services are planned to meet health conditions of the country.

The study concluded that general health services and family planning programs should promote and sustain each other, especially if they are set in the context of socioeconomic development. A reduction in fertility rates would not only help directly to ameliorate health problems, but would also make for substantial savings in the cost of providing an adequate level of health care.

The adequacy of health services provided by a given level of expenditure will be greater if the population of Jordan is growing slowly. The following recommendations are proposed to facilitate a better health service in Jordan:

1) Larger proportions of the GDP and government revenues should be channeled into the health sector.

2) A decline in population growth is essential, even if health service ratios in Jordan are to be improved.

3) From a macroeconomic standpoint and for health planning considerations, the introduction of highly effective population control programs to sustain the gains from the improvement of health services.

4) Higher attention should be given to rural areas in the provision of health services.

References

Central Bank of Jordan. (1997, April). *Monthly statistical bulletin.* Department of research and studies. Amman.

Department Of Statistics. (1994). The census of population and housing. Amman.

Farag, M., Nandakumar, A. K., Wallack, S. S., Gaumer, G., & Hodgkin, D. (2009). Does funding from donors displace government spending for health in developing countries. *Health Affairs, 28,* 1045-1055. http://dx.doi.org/10.1377/hlthaff.28.4.1045

Gottret, P. E., & Schieber, G. (2006). *Health Financing Revisited: A Practitioner's Guide*. Washington, DC: World Bank. http://dx.doi.org/10.1596/978-0-8213-6585-4

Hatcher, C. R. (1989, October). The role of government and the private sectors in health care systems. Paper presented at *the meeting of the first Japan-United States health care system*, Tokyo.

Ichikawa, H. (1985). Future financial requirements for health and pension programmer: Study on the structural change and policies of health economics. In M. Shinohara (Ed.), *Tokyo Social Insurance and Welfare Association.*

IHP. (2008). High level taskforce on innovative international financing for health systems: Terms of reference and management arrangements. *International health partnership*. New York.

Institute for Resource Development. (1995). Microcomputer programs for demographic analysis [software]. Columbia, USA.

Maddox, G. (1982). Challenges for health policy and planning, in international perspectives aging: Population and policy challenges. In Robert H. Binstock, Chow Wing-Sun & James H. Schulz (Eds.), *Policy Development Studies* (No.7). New York, NY: United Nations Fund for Population Activities.

Mishra, P., & Newhouse, D. (2007). *Health aid and infant mortality*. Washington DC: International Monetary Fund.

MOH, & Department of Statistics. (1990). *Jordan Population and Family Health Survey.* Amman, Jordan.

MOH. (1994). *Statistical Year Book*. Jordan.

Myers, C. N., & Others. (1985). Financing health services and medical care in Thailand. *Development Discussion Papers, No. 209,* Cambridge, Massachusetts, Harvard Institute for International Development.

Ogawa, & Others. (1989). Forecasts of health care costs in Thailand. Paper prepared for the National Economic and Social Development Board of the government of Thailand.

Ogawa, N. (1989). Population aging and its impact upon health resource requirements at government familial levels in Japan. *Aging and society, 9*(4), 383-405.

Ogawa, N. (1990). Economic factors affecting the health of the elderly in improving the health of older people: A world view. In Robert, L. K., J. Grimley Evans & David Macfayden (Eds.), *A World Health Organization publication*. Oxford, United Kingdom, and New York: Oxford University Press.

Ravishankar, N., Gubbins, P., & Cooley, R. J. (2009). Financing of global health: Tracking development assistance for health from 1990 to 2007. *Lancet, 373*, 2113-2124. http://dx.doi.org/10.1016/S0140-6736(09)60881-3

Robinson, W. C. (1996). The economic and social impacts of declining fertility in Thailand and the policy options. paper prepared for the National Economic and Social Development Board of the government of Thailand.

Royal Decree. (2002). *Public Health Law No.54*. Ministry of Health, Jordan.

Sell, R. (1990). Future population, a demographic projection system for microcomputers, [software], W. Brown, Iowa.

UN. (2001). African summit on HIV/AIDS, Tuberculosis and other related infectious diseases: Abuja declaration on HIV/AIDS, tuberculosis, and other infectious diseases. New York, United Nations.

University of Jordan. (1995). Universal health insurance study, submitted to the World Bank, Center for Consultation, Technical Services and Studies, Amman, Jordan.

Van Doorslaer, E., O'Donnell, O., & Rannan-Eliya, R. P. (2006). Effect of payments for health care on poverty estimates in 11 countries in Asia: An analysis of household survey data. *Lancet, 368*, 1357-1364. http://dx.doi.org/10.1016/S0140-6736(06)69560-3

WHO. (2001). WHO Commission on macroeconomics and health, macroeconomics and health: Investing in health for economic development, World Health Organization, Geneva.

Xu, K., Evans, D. B., Kawabata, K., Zeramdini, R., Klavus, J., & Murray, C. J. L. (2003). Household catastrophic health expenditure: A multi-country analysis. *Lancet, 362*, 111-117. http://dx.doi.org/10.1016/S0140-6736(03)13861-5

Yontcheva, B., & Masud, N. (2005). Does foreign aid reduce poverty? Empirical evidence from nongovernmental and bilateral aid. International Monetary Fund, Washington DC.

Appendix

Table A1. Abridged life table for Jordan, males Coale–Demeny west region

Age	Q(x)	D(x)	M(x)	l(x)	L(x)	S(x)	T(x)	E(x)
0	.03681	3681	03799	100000	96900	.96048	6699995	67.00
1	.00815	785	.00205	96319	383339	.99255	6603095	68.55
5	.00423	404	.00085	95534	476661	.99617	6219756	65.11
10	.00342	326	.00069	95130	474837	.99519	5743095	60.37
15	.00620	588	.00124	94804	472552	.99257	5268259	55.57
20	.00867	817	.00174	94216	469040	.99126	4795706	50.90
25	.00881	823	.00177	93400	464940	.99061	4326666	46.32
30	.00997	923	.00200	92576	460574	.98865	3861727	41.71
35	.01274	1168	.00256	91653	455347	.98443	3401152	37.11
40	.01844	1668	.00372	90486	448257	.97644	2945805	32.56
45	.02877	2555	.00584	88817	437697	.96323	2497549	28.12
50	.04501	3883	.00921	86262	421602	.94233	2p5852	23.88
55	.07093	5843	.01471	82379	397287	.91075	1638250	19.89
60	.10896	8340	.02305	76536	361830	.86420	1240963	16.21
65	.16591	11315	.03618	68196	312695	.79521	879133	12.89
70	.25141	14301	.05751	56882	248657	.69715	566438	9.96
75	.37157	15822	.09127	42581	173350	.45450	317781	7.46
80	1.00000	26759	.18527	26759	144431	.00000	144431	5.40

Source: Projected by the Author.

Table A2. Abridged life table for Jordan, females, Coale-Demeny west region

Age	Q(x)	D(x)	M(x)	l(x)	L(x)	S(x)	T(x)	E(x)
0	.03481	3481	.03587	100000	97068	.96196	6900000	69.00
1	.00908	877	.00228	96519	383911	.99228	6802932	70.48
5	.00395	378	.00079	95642	477265	.99648	6419021	67.12
10	.00309	295	.00062	95264	475585	.99587	5941755	62.37
15	.00516	490	.00104	94970	473622	.99379	5466171	57.56
20	.00727	687	.00146	94479	470679	.99200	4992549	52.84
25	.00873	819	.00175	93792	466914	.99046	4521870	48.21
30	.01036	963	.00208	92973	462457	.98833	4054956	43.61
35	.01300	1196	.00262	92010	457059	.98492	3592499	39.04
40	.01720	1562	.00347	90814	450166	.97918	3135439	34.53
45	.02451	2187	.00496	89252	440794	.96994	2685274	30.09
50	.03576	3113	.00728	87065	427542	.95587	2244480	25.78
55	.05281	4434	.01085	83952	408675	.93299	1816938	21.64
60	.08199	6520	.01710	79518	381290	.89437	1408263	17.71
65	.13138	9590	.02812	72998	341015	.83105	1026972	14.07
70	.21220	13455	.04748	63408	283402	.73532	685957	10.82
75	.33130	16549	.07941	49953	208390	.48233	402556	8.06
80	1.00000	33404	.17204	33404	194165	.00000	194165	5.81

Source: Projected by the Author.

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

A Production Function Explanation of Saudi Economic Growth 1984-2011

Mohammed Abdullah Aljebrin[1]

[1] College of Business Administration, Majmaah University, Saudi Arabia

Correspondence: Mohammed Abdullah Aljebrin, College of Business Administration, Majmaah University, PO Box 11952, Majmaah, Saudi Arabia. E-mail: maljebrin@mu.edu.sa

Received: March 20, 2013 Accepted: April 2, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p97 URL: http://dx.doi.org/10.5539/ijef.v5n5p97

Abstract

This paper attempts at an explanation of Saudi economic growth along the lines proposed by the neo-classical growth theory. Production function estimates for gross domestic product is provided using Cobb-Douglas function. A wide range of econometric testing is employed. The functional form is estimated using a constant to express the technical progress. The result shows an elasticity of output with respect to capital and labor of about 0.67 and 0.57 respectively. Technical progress has positive contribution to growth rate of output of 8.67% a year. Therefore, it is a difficult task for the policy makers to determine the best policies for the enhancement of capital and labor on economic growth. The major policy implications and recommendations are that Saudi Arabia needs to improve the rate of return to education in order to raise the productivity of labor. That may be occurred by investing large amount of resources in increasing and improving educational attainment for men and women, and by increasing the training levels in industrial and services sectors.

Keywords: production function, Cobb-Douglas Production Function, FMOLS model, Saudi Arabia

1. Introduction

As global economic recovery lifted up oil prices in 2010, the Saudi economy recorded high growth and enlarged fiscal spending by the government boosted domestic demand and accelerated the growth in non-oil GDP. On the same line, the actual budget recorded a surplus of SAR 87.7 billion or 5.4 percent of GDP in 2010 against a deficit of SAR 86.6 billion or 6.2 percent of GDP in the previous year. On the other hand, the ratio of public debt to GDP declined from 16.1 percent in 2009 to 9.9 percent in 2010. The current account of the balance of payments recorded a surplus for the twelfth year consecutively amounting to SAR 250.3 billion or 14.9 percent of GDP in 2010 (Saudi Arabian Monetary Agency (SAMA, 2011).

Figures 1, 2 and 3 illustrate the developments of real GDP, real capital formation and total number of employees in Saudi Arabia during the period 1984-2011. The Figures indicate that there are similar directions among real GDP and Gross capital formation and a less degree of similarity with the number of employees.

This study aims at determining the contribution of capital and labor in Saudi economy by applying Cobb-Douglas Production Function in order to determine how the growth rate can be maximized.

Table 1 and Figure 2 illustrate the structure of gross capital formation, it indicates that non-oil private sector absorb the highest share in Saudi capital formation with a percentage reached 42.8% in 2011. While the oil sector ranked second in terms of relative importance and finally the government sector.

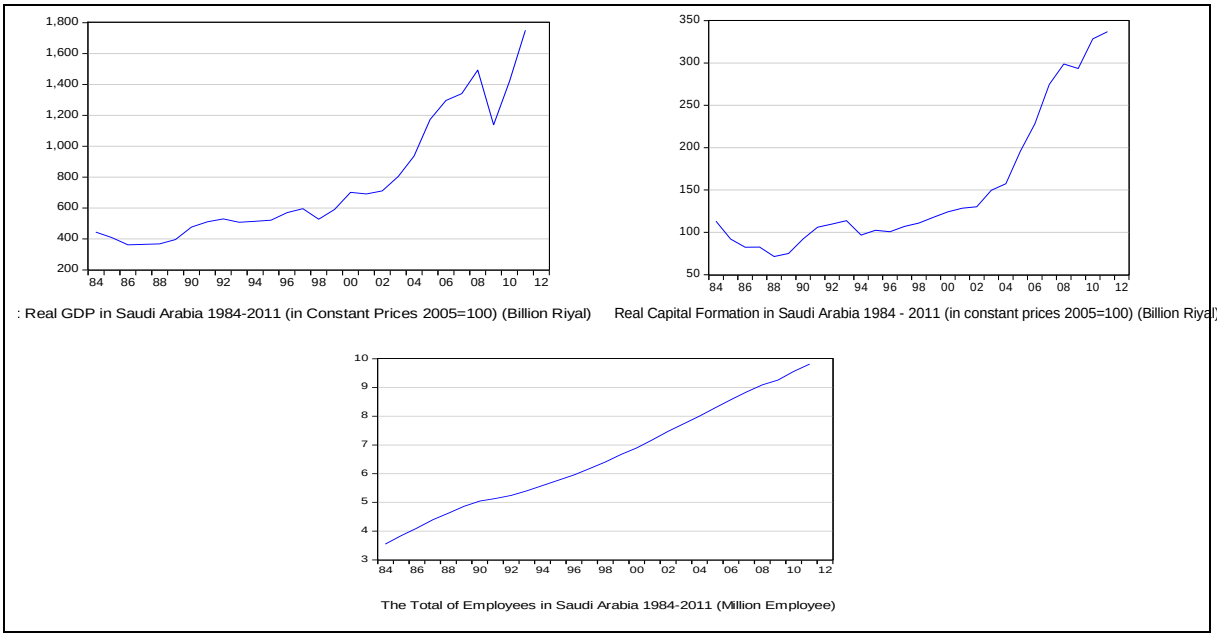

Figure 1. Real GDP, real capital formation and total number of employees in Saudi Arabia (1984-2011)

Source: Table (A-1) in the appendix.

Table 1. Gross capital formation structure in Saudi Arabia 1984-2011 (constant prices 2005=100) (Billion Riyals)

Year	Government Sector	Non-Oil Private Sector	Oil Sector	Change in Stock	Gross Fixed Capital Formation
1984	49.301	43.244	10.170	33.183	135.898
1985	35.989	38.692	9.116	-3.449	80.348
1986	28.569	36.339	10.127	-11.380	63.654
1987	31.574	35.774	7.781	-17.050	58.079
1988	27.438	36.131	1.424	2.875	67.869
1989	29.707	36.833	1.734	3.435	71.709
1990	47.046	31.088	4.688	-19.210	63.612
1991	47.727	38.861	4.757	-5.110	86.234
1992	34.120	57.786	7.397	11.628	110.931
1993	31.400	63.179	8.365	13.471	116.416
1994	24.923	54.156	8.478	7.150	94.707
1995	24.954	53.164	14.643	2.249	95.010
1996	12.650	79.733	8.361	3.975	104.719
1997	15.764	82.084	9.098	3.755	110.701
1998	12.219	87.497	11.265	9.428	120.409
1999	12.905	91.715	13.093	9.383	127.096
2000	16.472	93.627	14.120	8.968	133.185
2001	17.833	96.100	14.505	3.562	132.001
2002	18.415	99.042	12.689	11.222	141.368
2003	23.531	104.745	21.349	11.492	161.116
2004	30.599	109.803	17.039	23.976	181.416
2005	54.940	118.461	22.231	20.055	215.687
2006	57.472	127.137	43.422	16.669	244.700
2007	78.936	137.511	61.008	13.117	290.572
2008	93.936	146.978	56.594	40.992	338.500
2009	91.201	136.841	44.8	20.807	293.649
2010	103.169	144.917	47.175	33.051	328.312
2011	145.705	143.474	46.343	1.247	336.769

Note: Saudi Arabian Monetary Agency (SAMA), *Annual Report*, No. 48. World Bank, *World Bank Development Indicator*.

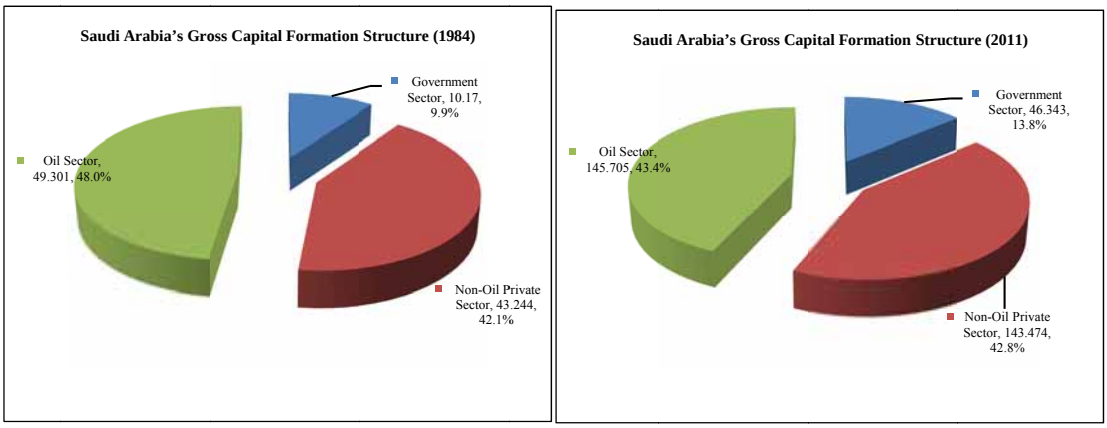

Figure 2. The structure of Gross Capital Formation in Saudi Arabia 1984-2011

Table 2 shows that the services sector is the most sectors that absorb labor in Saudi Arabia, as it accounted for three-quarters of employees during the period 1999-2009. While the industrial sector absorbed about fifth of employees, finally the agriculture sector absorbed only about 5% of total employment during the same period.

Table 2. Employment structure by economic activities in Saudi Arabia (% of total employment)

Year	Agriculture (%)	Industry (%)	Services (%)
1999	6.3	21	72.7
2000	6.1	19.9	74
2001	6.1	21.1	72.8
2002	4.6	21	74.4
2006	4	20.2	75.8
2007	4.3	20.8	74.9
2008	4.3	19.8	75.9
2009	4.1	20.4	75.5

Notes: Saudi Arabian Monetary Agency (SAMA), *Annual Report*, No. 48. World Bank, *World Bank Development Indicator*.

2. Literature Review

Cobb-Douglas Production Function is one of the most widely used production function in Economics and Management research (Douglas 1934 and 1948). This production function not only satisfies the basic economic law but also easy in its computation and interpretation of the estimated parameters. The objectives of applying Cobb- Douglas production function is to estimate the co-efficient of inputs, their marginal productivities, factor shares in total output and degree of returns to scale. It is based on unitary elasticity of substitution of inputs and this production function has been widely applied in empirical studies.

Given the Cobb-Douglass function components, for the capital factor (K) we have used data of the gross capital formation, for labor (L) the number of employees. The data series is for the period 1984-2011, the value expressions for GDP and K are expressed in billions of riyal in constant prices (2005=100). Labor is expressed in millions of workers employed.

In our analysis, we have assumed the general form of Cobb-Douglass production function:

$$Y_t = A\, K_t^{\alpha}\, L_t^{\beta} \quad (1)$$

Where:

Y_t = gross domestic product for year t

K_t = fixed capital formation for year t

L_t = labor employed for year t;

t = time

We also mention that A, α, β, shows the overall significance related to the function, namely "A" is the size factor reflecting overall productivity of production factors, "α" is the elasticity of output relative to the capital formation, and finally "β" is the elasticity of output in relation to work. The factors that influence the productivity level are different and with different impact on the outcome.

If $\alpha + \beta > 1$, it would imply that the output increase would be more than proportionate to the increase in inputs, if $\alpha + \beta < 1$, it would imply that the output increase would be less than proportionate to the increase in inputs and if $\alpha + \beta = 1$ the output would just increase proportionately to the rate of increase of inputs. Therefore there will be economies of scale, constant returns to scale or diseconomies of scale depending upon whether $\alpha + \beta$ is greater than 1, equal to 1, or less than 1 respectively.

3. The Model and the Methods

The logarithm of both sides of the above Cobb-Douglass production function was taken to convert the equation into linear form; its log transformation is specified below, which is to be estimated by Fully Modified Ordinary Least Squares (FMOLS) approach. FMOLS was originally designed first time by Philips and Hansen (1990) and Philips and Moon (1999) to provide optimal estimates of Co-integration regressions. This technique employs kernal estimators of the Nuisance parameters that affect the asymptotic distribution of the OLS estimator. In order to achieve asymptotic efficiency, this technique modifies least squares to account for serial correlation effects and test for the endogeneity in the regressors that result from the existence of a Co-integrating Relationships. The model that has been estimated is:

$$\log(Y) = \log(A) + \alpha \log(K) + \beta \log(L) + \varepsilon \quad (2)$$

The variable of "Y" has been expressed by the real Gross Domestic Product, while "K" has been be proxied by real gross capital formation and finally, labor force "L" has been expressed by the number of employees and "ε" is the error term.

4. Data

This study used the annual data from 1984 to 2008 for Saudi Arabia. All data in this study was obtained from Saudi Arabian Monetary Agency (SAMA) and World Bank Development Indicator, the data has been converted to real values (2005 constant prices) by using consumer price index (2005=100). All these factors are illustrated at Table (A-1) in the appendix.

5. Empirical Results

5.1 Unit Root and Cointegration Tests

Augmented Dickey- Fuller unit root test is calculated for individual series to provide evidence as to whether the variables are stationary and integrated of the same order.

The results of Augmented Dickey-Fuller (ADF) test for each variable appear in Table 2. The lag parameter in the ADF test is selected by Akaike information criterion (AIC) to eliminate the serial correlation in residual (Akaike, 1973). As shown in Table 3, the null hypothesis of a unit root can't be rejected for all series. However, the unit root hypothesis is rejected for all variables in the first-differenced data. Therefore, we conclude that the series are integrated of order one.

Table 3. Unit root test

		ADF
Log(Y)	Level	0.916719
	First Diff.	-4.592865[a]
Log(K)	Level	0.005893
	First Diff.	-3.164287[b]
Log(L)	Level	-0.674087
	First Diff.	-3.201651[b]

Notes: ADF-Dickey DA, Fuller WA., (1979) unit root test with the Ho: Variables are I (1); a, b and c indicate significance at the 1%, 5% and 10% levels, respectively.

The linear combination of the variables may however be stationary. This claim is being supported by the cointegrating relationships explored using 5% critical value. The Johansen approach in Tables 4 and 5 under the trace and Maximal Eigenvalue statistics indicate only one cointegrating equation testifying to the long run

relationship among the variables with Y as the dependent variable. The parameter instability approach in Table 5 further confirms this claim of long run relationship among the variables with probability value greater than 0.2 thereby accepting the null hypothesis of existence of cointegrating relationship.

Table 4. Cointegration test based on trace of the stochastic matrix

Hypothesized No. of E(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.997885	187.7262	29.79707	0.0001
At most 1	0.420682	15.28659	15.49471	0.0537
At most 2	4.65E-05	0.001302	3.841466	0.9703

Notes: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values.

Table 5. Cointegration test based on maximal eigenvalue of the stochastic matrix

Hypothesized No. of E(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.997885	172.4396	21.13162	0.0001
At most 1 *	0.420682	15.28529	14.26460	0.0344
At most 2	4.65E-05	0.001302	3.841466	0.9703

Notes: Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values.

Table 6. Cointegration result of Hansen parameter instability approach

Lc statistic	Trends (m)	Trends (k)	Trends (p2)	Prob.*
0.150597	2	0	0	> 0.2

Notes: *Hansen (1992) Lc(m2=2, k=0) p-values, where m2=m-p2 is the number of stochastic trends in the asymptotic distribution.

Since the two variables are cointegrated, they can be represented equivalently in terms of a long run FMOLS framework.

5.2 Model Results

In Table 7, we see the results of the long run FMOLS estimates for equation 3. The explanatory power is high (R^2=97.4). All the explanatory variables are significant at 1% level.

$$\log(Y) = 2.16 + 0.67\log(K) + 0.57\log(L) + \varepsilon \quad (3)$$

$$\widehat{A} = e^{2.16} = 8.67$$

Then,

$$Y_t = 8.67\, K_t^{0.67}\, L_t^{0.57}$$

According to above results, A = 8.67, α = 0.67, β = 0.57, provided that α + β >1 and α, β> 0. We also saw that the influence of the capital on the production of GDP is much higher than in the case of labor. We therefore conclude that the national economy is one more capital-intensive and less based on the use of labor in the production process.

Table 7. FMOLS estimates in the long run (1984-2011)

Variable	**Coefficient**
C	2.16[a]
LOG(K)	0.67[a]
LOG(L)	0.57[a]
	R^2 = 97.4
	Durbin-Watson: 1.47

Source: Table (A-2) in Appendix. a indicates significance at the 1% level.

The 0.67 estimate for α indicates that a 10 percent increase in the capital leads to a 6.7 percent increase in the

output level, which implies there is diminishing returns to capital. Similarly, the 0.57 estimate for β indicates that a 10 percent increase in the labor leads to a 5.7 percent increase in the output level, which implies there is diminishing returns to labor. However, the sum $\alpha+\beta=0.67+0.57=1.24$ is greater than one, which implies production exhibits "increasing returns to scale". Increasing returns to scale means a proportionate increase in all inputs leads to a more than proportional increase in the output. For example, doubling all inputs would lead to more than a doubling of output. In this case, $\alpha+\beta=1.24$ indicates a one hundred percent increase in (or doubling of) the inputs leads to a 124 percent increase in the output level.

6. Concluding Remarks and Policy Implications

This paper introduces an explanation of Saudi economic growth along the lines proposed by the neo-classical growth theory. Production function estimates for gross domestic product is provided using Cobb-Douglas function. A wide range of econometric testing is employed. The functional form is estimated using a constant to express the technical progress. The result shows an elasticity of output with respect to capital and labor of about 0.67 and 0.57 respectively. Technical progress has positive contribution to growth rate of output of 8.67% a year.

Production in Saudi Arabia exhibits "increasing returns to scale." Increasing returns to scale means a proportionate increase in all inputs leads to a more than proportional increase the output. Therefore, it is a difficult task for the policy makers to determine the best policies for the enhancement of capital and labor on economic growth. The major policy implications and recommendations from our analysis are that Saudi Arabia needs to improve the rate of return to education in order to raise the productivity of labor. That may be occurred by investing large amount of resources in increasing and improving educational attainment for men and women, and by increasing the training levels in industrial and services sectors.

References

Akaike, H. (1973). Information theory as an extension of the maximum likelihood principle. In B. N. Petrov & F. Csaki (Eds.), *Second international symposium on information theory* (pp. 267-281). Akademiai Kiado, Budapest, Hungary.

Dickey, D., & Fuller, W. (1979). Distributions of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of American Statistical Association, 74*, 427-431.

Douglas, P. H. (1948). Are There Laws of Production? *American Economic Review, 38*(1), 1-41.

Douglas, P. H. (1934). *The Theory of Wages*. New York: Macmillan.

Hansen, B. E. (1992). Testing for Parameter Instability in Linear Models. *Journal of Policy Modeling, 14*(4), 517-533.

Philips, P. C. B., & Hansen, B. E. (1990). Statistical Inference in Instrumental Variables Regression with I(1), Processes. *Review of Economic Studies, 57*, 99-125. http://dx.doi.org/10.2307/2297545

Phillips, P. C. B., & Moon, H. R. (1999). Linear Regression Limit Theory for Nonstationary Panel Data. *Econometrica, 67*, 1057-1111. Retrieved from http://cowles.econ.yale.edu/P/cd/d12a/d1222.pdf

Saudi Arabian Monetary Agency (SAMA). *Annual Report,* No. 48. Retrieved from http://www.sama.gov.sa

World Bank, World Bank Development Indicator. Retrieved from http://data.worldbank.org/indicator/

Appendix

Table A1. Economic data (1984-2011)

Period	Real Gross Domestic Product (RGDP) (2005=100) (Billion Riyal)	Real Gross Capital Formation (RI) (2005=100) (Billion Riyal)	Number of Employees (L) (Million)
1984	443.27	112.89	3.55
1985	408.93	92.10	3.85
1986	361.62	82.47	4.11
1987	365.81	82.57	4.39
1988	368.01	71.43	4.63
1989	395.94	75.04	4.87
1990	476.47	92.18	5.05
1991	511.95	106.09	5.14
1992	529.78	109.85	5.24
1993	507.80	113.79	5.40
1994	514.45	96.70	5.59
1995	521.54	102.44	5.77
1996	569.97	100.74	5.96
1997	596.01	106.95	6.18
1998	527.24	110.98	6.40
1999	591.53	117.71	6.67
2000	702.06	124.22	6.90
2001	691.78	128.44	7.18
2002	711.04	130.15	7.48
2003	804.78	149.63	7.74
2004	936.45	157.44	8.01
2005	1172.40	195.63	8.29
2006	1295.95	228.03	8.57
2007	1340.98	274.58	8.85
2008	1492.63	298.69	9.09
2009	1138.88	293.69	9.26
2010	1422.83	328.31	9.56
2011	1749.11	336.77	9.81

Source: Saudi Arabian Monetary Agency (SAMA), *Annual Report*, No. 48. World Bank, *World Bank Development Indicator*.

Table A2. Fully modified ordinary least squares (fmols) regression results

Dependent Variable: LOG(RY)
Method: Fully Modified Least Squares (FMOLS)
Date: 03/18/13 Time: 19:48
Sample (adjusted): 1984 2011
Included observations: 28 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth= 4.0000)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LOG(RI)	0.670715	0.062295	10.76671	0.0000
LOG(L)	0.571598	0.099364	5.752579	0.0000
C	2.163141	0.172901	12.51090	0.0000
R-squared	0.973838	Mean dependent var	6.510146	
Adjusted R-squared	0.971745	S.D. dependent var	0.477476	
S.E. of regression	0.080260	Sum squared resid	0.161043	
Durbin-Watson stat	1.468732	Long-run variance	0.005634	

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

What Operational Characteristics of Mutual Funds Affect Exit Decisions and When? Evidence from Taiwan

Nan-Yu Wang[1] & Chih-Jen Huang[2]

[1] Department of Finance, Ta Hwa University of Science and Technology, Hsinchu, Taiwan

[2] Department of Finance, Providence University, Taichung, Taiwan

Correspondence: Nan-Yu Wang, Department of Finance, Ta Hwa University of Science and Technology, 1, Dahua Rd., Qionglin Shiang Hsinchu County, 30740 Taiwan. Tel: 866-3-592-7700 ext. 3102. E-mail: nanyu@tust.edu.tw

Received: March 13, 2013 Accepted: March 28, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p104 URL: http://dx.doi.org/10.5539/ijef.v5n5p104

Abstract

We investigated fund operating characteristics that cause fund companies to perform fund exit decisions and at what point of funds' lifecycles apply to fund liquidation or mergers. We also examined whether extra variable causes an important determinant effect and how fund operating characteristics before and after fund liquidations or mergers change. The empirical results show that: (1) the factors that affect within-family mergers are fund performance and flow from both cross-section and time-series views. The total net assets affect within-family mergers just in a cross-section analysis, not a lifecycle characteristic in a time-series analysis. Moreover, we found that performance volatility also affects exit decisions. The expense ratio and fund age are not the determinants for three type fund exits in Taiwanese onshore funds. (2) For the liquidation, total net assets, flow, performance volatility, and mid-term buy-hold returns have a significantly negative relationship with the fund liquidations from both the cross-section and time-series views. (3) In general, cross-family fund mergers are potentially conducted for strategic considerations rather than based on specific factors. (4) The performance volatility level before and following mergers was substantial and significant for within-family fund mergers; the expense ratio level before mergers was significant greater than following mergers for cross-family fund mergers.

Keywords: fund liquidation, fund merger, fund flow, fund performance, logistic regression

1. Introduction

Mutual funds continue to be popular investment vehicles. In fact, according to Taiwan's Securities Investment Trust and Consulting Association, the total numbers of mutual funds increased from 157 in 1997 to 973 as of December 2010. Exit strategies among mutual funds are a relatively recent phenomenon, but given rapid growth in the fund industry, reducing excess funds is understandable. The U.S. Morningstar Investment Research Center indicated that fund mergers were once widely practiced in the U.S., causing many investors to encounter fund liquidations and mergers. Regarding funds in Taiwan, mergers have become increasingly widespread since the Securities and Futures Commission under the Ministry of Finance enacted the Guidelines for Mergers of Securities Investment Trust Funds on November 1, 2001. Wang and Chen (2009) found that by the end of 2007, approximately 30% of funds had been liquidated or merged. In 2008 alone, unique phenomenon occurred in that 81 funds were liquidated or merged, outnumbering newly raised funds that year, which numbered 63. Given these circumstances, the exit decisions act as an important term in the mutual fund industry.

Previous studies have analyzed mutual fund exit decisions. Overall, they found that the different determinants for the different exit decisions. For mergers, fund families use within-family mergers to disguise the poor past performance of the target funds (Jayaraman et al., 2002; Allen and Parwada, 2006; Gruber and Blake, 1996); cross-family mergers are motivated by other strategic reasons (Jayaraman et al., 2002). Zhou and Chiang (2007) additionally sampled external fund acquisitions and found that mutual-fund acquisitions facilitated the separation of managers from the funds they manage. Cakici and Chatterjee (2007) indicated the characteristics of hedge fund mergers are underperformed, lower money-flow, larger and older funds. Other studies have focused on fund termination. The factors that contributed to U.S. mutual funds disappearing are performance, scales or expense ratios (Brown and Goetzmann, 1995; Bu and Lacey, 2009; Evans, 2004). Existing literature has focused on termination probabilities (Lunde et al., 1999; Cameron and Hall, 2003; Horst et al., 2001). Zhao (2005)

discussed both liquidated and merged funds because fund families may consider alternative exit forms. Accordingly, our study aims to clarify the following three types of exit strategies within our samples: liquidation, within-family mergers, and cross-family mergers.

To analyze the determinants of mutual fund mergers and liquidation, previous research focused on cross-section analysis alone. For example, previous studies used logistic and multinomial logistic regression to report the factors of mergers (Jayaraman et al., 2002; Zhao, 2005), whereas Brown and Goetzmann (1995) studied which characteristics affected fund disappearance using the probit model. In the present paper, however, we not only want to identify more precisely what kinds of funds merge or liquidate, but also want to know "when" they choose to do so. The fund company could subsequently consider market penetration strategies and decide the types of funds and fund characteristics that could depend on the product's life cycle to merge or liquidate their funds (Muga and Santamaria, 2010). After a new fund is established, when do domestic investment trust companies decide to liquidate or merge? And, on what characteristics during a fund's lifecycle do they make this decision? Cooper et al. (2005) discussed at what point in the life cycle the funds choose to change their names. Ahmad and Kashian (2010) also used the time series dimension to discuss the time varying covariates in their estimation to supply the lack of cross-sectional observations. Thus, examining the time-series views for each merger or liquidation fund is essential to the joint study of the full spectrum of revealing the factors that influence exits.

Most of the existing literature on what determines fund mergers or liquidations aims to clarify performance, asset flows, fund size, expense, ratio, and so on. Furthermore, the direct influence of the determinant causes exit decisions. What distinguishes the present study from previous studies is that in addition to fund characteristics, we also consider performance volatility as a determinate for the cross-section and time-series views. This issues been addressed in previous studies on fund liquidations and mergers. Huang et al. (2012) mentioned that performance volatility is an important factor of a fund's operating characteristics for investor learning and mutual fund flow. Brown et al. (1992) verified the tendency for one fund to persist in outperforming another if its volatility was higher. In other words, when the performance volatility was lower, the poorer the fund performed. In particular, fund performance is very susceptible in Taiwan, because the development time of the mutual fund industry is relatively short. Hence, we conjecture that the volatility of returns may play an important explanatory role of fund mergers and liquidation and may have negative effects on fund exits.

The present study investigated the relationship between fund liquidations/mergers and fund operating characteristics by using data published by the *Taiwan Economic Journal* (TEJ) from January 1, 2001 to December 31, 2010. According to data regarding the status of fund liquidations and mergers in the database, 170 onshore funds had been liquidated, and 155 had been merged (i.e., dissolved funds) into surviving funds by December 31, 2010. From both the cross-sectional and longitudinal views, the empirical results indicate as following. First, within-family mergers (exits that may take the form of a liquidation or a merger with another portfolio within the same fund family) tended to eliminate funds that had small total assets, low flows, and poor performance. In addition, the mean flows of the acquiring and acquired funds during six-months period before the merger were lower compared with their flows at other points in the lifecycles. Second, one year following cross-family mergers (liquidation or a merger with another portfolio within a different fund family), flows increased and operating costs decreased. However, the expense ratio charged to the shareholders of the dissolved funds increased, whereas the expense ratio charge to the original shareholders of the surviving funds decreased. The quality of returns that investors gained following mergers was uncertain and performance volatility was greater than before. In general, fund companies' considerations for liquidations and mergers were strategic rather than specific factors. Third, the factors that influenced onshore fund liquidations in Taiwan were small-scale, low, short-term flows, poor short-term performance, low performance volatility, poor medium-term (i.e., six months) buy-and-hold returns, and poor long-term performance. The total assets in the month preceding the month of the merger, the performance volatility during the past 12 months, mean flows during the past six months, and the buy-and-hold returns for the past six months were all lower compared with those at other points in the fund's lifecycle.

To summarize, the present research contributes to the literature at minimum in the following ways. First, it differs from the aforementioned studies in using a broader view to analyze three types of exit strategies of Taiwanese onshore funds that underwent liquidation or mergers. Second, we used relatively complete analysis (multinomial and time-series logistic regression analysis) to discuss the operating characteristics of funds that merge or liquidate and when (in other words, what characteristics of the fund lifecycle cause investment trust companies to perform fund liquidations or mergers). We show cross-section and times-serices views to provide richer information. Third, in addition to the common present variables discussed for mutual fund mergers and

liquidations, the present study tests whether performance volatility also causes an important determinant effect. Fourth, previous domestic or international studies have focused primarily on issues such as fund performance, fund manager salaries, fund development, and fund management and governance, whereas few studies have been conducted to analyze fund liquidations and mergers. The present study compensates for the dearth on these aspects of the fund industry. Moreover, this is the first study to use cross-sectional and longitudinal analysis to examine fund characteristics, which seldom address fund liquidations and mergers. Finally, fund companies frequently tell their shareholders that mergers can increase the economies of scale for single fund management, adjust the flexibilities of operating strategies, reduce fund-related charges and operating costs, and "can" enhance fund business benefits by considering investors' best interests. Can investment trust companies achieve the expected benefits that they promise to fund beneficiaries as reasons for mergers? The present study explores the influences that the exit strategies of Taiwanese onshore funds have on the changes in fund's characteristics. The results can serve as references for investors in formulating investment strategies.

The remainder of this paper is organized as follows. Section 2 constitutes a literature review of relevant domestic and international studies. Section 3 comprises the study's hypotheses, the research scope, and methods used in the analysis. Section 4 explains the basic descriptive statistics for the data and discussions the empirical results. Section 5 provides a conclusion and discussion for future studies.

2. Types of Fund Exit Strategies and Testable Hypotheses

The present study sampled three types of Taiwanese onshore funds that underwent liquidation or mergers: (1) funds that were merged across families, (2) funds that were merged within families, and (3) liquidated funds. First, a within-family merger fund involves combining two funds within the same fund family. In Taiwan, the majority of within-family mergers were bond and stock fund mergers. Bond funds might have been targeted because a competent authority ruled that bond funds must be transformed or distributed, or investment trust considerations were influenced by increased global interest rates. Stock fund mergers may have occurred because global stock markets performed poorly in the years leading up to 2008, and the Taiwanese stock market was affected by various factors. In contrast, a merger can occur across two different fund families. An example of cross-family funds is managing four funds changed from the Industrial Bank of Taiwan Investment Trust Co. (a dissolved company) to the Taishin Securities Investment Trust Co., Ltd. (a surviving company). Cross-family fund mergers might not depend only on its own cross-section attributes, but may consider the time-series of lifecycle development of fund families. The product life cycle and portfolio matrix can be combined to provide a more comprehensive framework for strategic analysis (Barksdale and Harris, 1982). Thus, we are interested in at what point in their lifecycle funds choose to merger to another family. Another exit form is liquidation, when fund scales are small, because this can significantly reduce the stock selling pressure that results from fund liquidations. In Taiwan, fund liquidations actually outnumbered mergers during the past decade. Among various fund exit strategies, the market prefers fund companies that perform mergers rather than liquidations. This is because investment trust companies should enhance the quality of their operations during early fundraising or the subsequent management processes to prevent their funds from being closed. Otherwise, fund companies do not have to pay for their mistakes, and investors must continually suffer losses. So, to consider liquidations as the present study's scope is essential.

The existing literature on fund exits has noted that several hypotheses regarding mergers and liquidations, such as the effect of fund size, inflows, performance, and expense ratios are drawn directly from Jayaraman et al. (2002) and Bu and Lacey (2009). We introduce these and other relevant motives for fund exit mechanisms within this section.

2.1 Fund Performance

One potential motivation for fund mergers and liquidations is that the original fund has performed poorly. In mergers, surviving funds maintain superior performance when they are merged with dissolved funds that have poor performance (Elton et al., 1996). Fund companies can use within-family mergers to hide the previous poor performance of the dissolved fund (Jayaraman et al., 2002). Regarding fund liquidation, the termination probabilities of U.K. funds were negatively correlated with fund returns (Lunde et al., 1999). Previous quarterly returns affected fund disappearance in U.S. mutual funds (Horst et al., 2001). Funds with high returns were less likely to be terminated (Cameron and Hall, 2003). Liquidation can occur after poor performance and or for random reasons (Vayanos, 2004). When a fund family member is performing poorly, it may also likely to be sold to other fund families to reduce the relevant costs spent on research projects and marketing. Thus, we hypothesize that the motives for undertaking a within-family fund merger may differ from those for an across family merger. To eliminate the poor performance of dissolved funds, the performance would be a significant

motivation for a within-family merger and a liquidation fund. Moreover, we also hypothesize that the performance was less compared with those at other points of the lifecycles.

2.2 Fund Flows

One of the common explanations provided for fund exits is the desire to fund flows. Fund flows can rationally reflect previous performance (Berk and Green, 2004). The fund flows and performance characteristics of Greek bond funds impacted returns (Dritsakis et al., 2006). During fund closure periods, these funds had superior performance and flows (Bris et al., 2007). Kempf and Ruenzi (2008) examined the effects that a fund's position within a fund family had on subsequent net inflows. Allen and Parwada (2006) used cross-sectional regression to examine investors' responses to the mergers of Australian fund companies and the influences of excess capital inflows and outflows in open-ended mutual fund. Significantly lower capital flows before merging were more likely to be merged (Cakici and Chatterjee, 2007). The net asset flows of the dissolved funds were lower compared with those of the acquiring funds (Khorana et al., 2007). Thus, if the fund flow is lower before the merger or liquidation, this may cause fewer economies of scale in the fund company. We hypothesize, therefore, that net asset flows may be significant in predicting the likelihood of the three forms of fund exits. It would be a significant motivation for a within-family merger and a liquidation fund. Moreover, we also hypothesize that the flows were less compared with those at other points of the lifecycles.

2.3 Fund Size

The motivation for fund exits may differ based on fund size. Much of the existing academic research on fund size has focused on fund mergers and liquidations. Funds that have larger scales, for example, are less likely to be terminated (Brown and Goetzmann, 1995). Regardless of whether the mergers were within-family or cross-family, all mergers negatively correlated with fund scale (Jayaraman et al., 2002). The investment portfolios of all dissolved funds had relatively small scales and few capital inflows; only funds that had the smallest scale (i.e., small market shares or rates) (Zhao, 2005). In Taiwan, on average, if the fund size is too small (average size is lower than 300 million dollars), the fund company would consider the operation costs to be inefficient and would merge funds with the same category of funds. But, if the fund could not maintain or has difficulty on resale, the fund company would likely start to consider liquidating the single fund. In our analysis, we hypothesize, therefore, that fund size is a determinant for a within-family merger and a liquidation fund. Moreover, we also hypothesize that the total net assets were not difference compared with those at other points of the lifecycles because the fund size has no large change in the short time.

2.4 Expense Ratios

Fund companies frequently declare that mergers can increase the economies of scale for managing single funds, reduce fund-related charges, and reduce operating costs by considering investors' best interests. Funds that have higher expense ratios increase the likelihood that a fund will be terminated (Brown and Goetzmann, 1995). The expense ratios of dissolved funds were higher compared with those of general funds. In contrast, the fees of the surviving funds were higher compared with those of matching funds and the dissolved funds (Elton et al., 1996). The expense ratios of these funds decreased, whereas the performance of the acquiring or surviving funds deteriorated significantly following mergers (Jayaraman et al., 2002). For the shareholders of dissolved funds, fees following mergers significantly decreased, whereas the fees of the acquiring funds did not (Khorana et al., 2007). In Taiwan, the expense ratios may not affect the merger of funds because the acquiring and acquired fund's expense ratios are similar and the different is small. We would expect, therefore, to observer no effects on mergers or liquidations.

2.5 Performance Volatility

The existing literature suggests that performance volatility is also an important factor for mutual fund industry. For example, Bekaert and Harvey (2002) believed that the volatility of capital flows became larger and larger by provoking capital market liberalization; thus, they discussed the volatility effect in their research. The literature therefore studied that the moving capital and volatility of fund flows also gradually increased. For example, Huang et al. (2007) and Ping (2001) investigated the effects and relationship between performance and fund flows for the actively managed mutual funds. Huang et al. (2012) illustrated theoretically that when some sophisticated investors learn from past fund performance to form their posterior expectations of managerial ability, the flow-performance sensitivity should be weaker for funds with more volatile past performance and longer track records. Cameron and Anthony (2003) also discussed the survival analysis of Australian equity mutual funds using the volatility of fund performance. Massa and Patgiri (2009) found that the probability of a fund's survival relates positively to the volatility of the fund return. Hence, we hypothesize the volatility of fund performance as a determinant and an effect on fund exits. Moreover, we also hypothesize that the performance

volatility was a determinant compared with those at other points of the lifecycles.

2.6 Fund Age

Previous studies have documented the relationship between fund age and fund exits. For example, Brown and Goetzmann (1995) showed that younger funds that are more likely to be terminated or dissolved. Lunde et al. (1999) found that both young and extremely old funds were those most likely to be closed, whereas funds that had superior track records were less likely to be closed. Horst et al. (2001) found that previous quarterly returns and fund ages affected fund disappearance. Zhao (2005) found that newly established funds were likely to be liquidated. Considering that old funds with longer histories can increase market share, fund companies prefer to merge funds that are within the same families rather than liquidating funds. Cakici and Chatterjee (2007) found that the majority of merged funds in their sample were old funds. Therefore, fund age may be significant in predicting the likelihood of a fund exit in Taiwan.

3. Research Method

In the present study, we investigate (1) what fund operating characteristics and when are likely to cause fund companies to apply for fund liquidations or mergers, and (2) the effects on flows and subsequent returns for surviving and dissolved funds before and following mergers.

3.1 Multinomial and Time-Series Logistic Regressions

In the broad sense, linear models use logistic link functions, which are primarily employed in situations in which the response variables are binary data, such as "success" or "failure." In addition, μ is between 0 and 1 (Agresti, 1996). The model, therefore, was:

$$\log(\frac{\mu}{1-\mu}) = \alpha + \beta_1 x_1 + ... + \beta_m x_m \tag{1}$$

Cox (1970) proposed that from a mathematics perspective, logistic regression is an extremely flexible and easy-to-use function that can be employed to solve problems involving categorical data. This type of analysis is adopted mainly to identify the response variables of the categorical data and to explore the relationships among a series of explanatory variables.

To elucidate the relationships between the characteristics of merged funds and unmerged funds, we assumed that the dummy variable was 1 for fund mergers and 0 for unmerged funds, and set the response variable as $\pi(x) = p(y = 1 \mid x)$, where $\pi(x)$ was a parameter of the Bernoulli distribution. Therefore, the logistic model for the univariates was:

$$\log it \quad [\pi(x)] = \log[\frac{\pi(x)}{1-\pi(x)}] \tag{2}$$

$$E[y \mid x] = \pi(x) = \frac{\exp(\beta_0 + \beta_1 x)}{1 + \exp(\beta_0 + \beta_1 x)} \tag{3}$$

Johnsen and Melicher (1994) compared the predictive abilities or power of logit models and multinomial logit models (MNLM), as well as type I and II errors in both models, which can be used as evaluation criteria for model prediction accuracy. The empirical results showed that the performance of the MNLM was superior to that of the logit model. Regarding the use of estimation methods, because MNLM are non-linear models, we used the maximum likelihood estimation method to estimate the parameters. We attempted to use numerical methods to obtain the estimated value that could maximize the likelihood function. The logarithmic likelihood function was $\ln L = \sum_{i=1}^{N}\sum_{j=1}^{J} d_{ij} \ln P_{ij}$, where i was the number of samples, j represented a fund category, P_{ij} was the likelihood of Fund i appearing in Category j, and d_{ij} was a set of dummy variables. If $Y_i = j$, $d_{ij} = 1$.

In addition, McFadden (1973) indicated that using MNLM must satisfy the independence of the irrelevant alternatives (IIA), meaning that the opportunity ratio of the two alternatives should be irrelevant to the probabilities of the other alternatives. In other words, the probability ratio of the two categories in the explained variables should not be influenced by other categories. We used the Hausman test proposed by Hausman and McFadden (1984) for independence verifications. The Hausman-Mcfadden test assumes that because the opportunity ratio of the two alternatives is not influenced by or correlated to a certain alternative category, removing this category from the samples should not cause systematic changes to the estimated values of the parameters. Furthermore, the parameter estimated values of these alternative categories should be consistent. However, if the removed alternative categories are not truly independent of the remaining categories, the

parameter estimated values obtained after removing certain alternative categories becomes inconsistent. The test statistics are $H_{IIA} = \left(\hat{\beta}_R - \hat{\beta}_F^*\right)\left[\hat{Var}\left(\hat{\beta}_R\right) - \hat{Var}\left(\hat{\beta}_F^*\right)\right]^{-1}\left(\hat{\beta}_R - \beta_F^*\right)$, where the values approach the χ^2 distribution and the degree of freedom is the number of series or columns in $\hat{\beta}_R$. If the test statistics are greater than the critical value, the IIA assumption does not hold.

We divided the fund exit strategies into three categories—liquidation, within-family mergers, and cross-family mergers—to explore the objective determinants of fund liquidations and mergers in Taiwan. We investigated the fund operating characteristics that caused fund companies to perform fund mergers and at what point in the funds' lifecycles the fund companies applied for fund liquidation or mergers. We conducted cross-sectional multiple and time-series logistic regression analyses on the overall funds. In the cross-sectional multiple logistic regression analysis, we used fund operating characteristics as the explanatory variables. These included previous returns, previous total assets, previous flows, expense ratio, the buy-and-hold returns during the past six months, the annualized standard deviations during the past 12 months, the average flows during the past six months, Jensen's α during the past 12 months, and years of establishment. For the regression analyses, we defined the dummy variable of the liquidated/merged funds as 1 and that of non-liquidated/unmerged funds as 0.

In the time-series logistic regression analysis, we used various fund operating characteristics (i.e., previous total net value, the buy-and-hold returns during the past six months, the annualized standard deviations during the past 12 months, the average flows during the past six months, Jensen's α during the past 24 months, and the buy-and-hold returns of the corresponding matching funds during the past six months) as the explanatory variable combinations for merged funds (i.e., surviving funds). The corresponding matching funds all had the same investment objects. We employed time-series logistic regression to analyze the liquidated or merged funds using all of the funds' available or applicable lifecycle data as the time-series data. We defined the value of the month during which the fund liquidation or merger was performed as 1 and the lifecycle of the remaining months as 0.

3.2 Sample Descriptions

We sampled all Taiwanese funds that were liquidated and merged to examine the degree to which fund companies achieved the benefits they promised beneficiaries when announcing the merger (i.e., claims that mergers would improve overall fund performances). We used data published by the TEJ from January 1, 2001 to December 31, 2010 and extracted the attributes of Taiwanese funds. According to data regarding fund liquidations and mergers in the database, 170 funds were liquidated and 155 were merged (i.e., dissolved) into surviving funds by December 31, 2010.

The names of the dissolved funds were changed following the mergers, although the fund types remained the same. We examined changes to the number of funds that Taiwanese fund management companies managed before and following liquidations or mergers. We found that only 10 funds were managed by a different management company following mergers. The remaining sampled funds were within-family mergers. For the following fund management companies, 100% of the funds they managed were liquidated: Ta Chong Bank; JihSun International Commercial Bank Co., Ltd.; Fubon Financial; Bank SinoPac; and Bowa Successful Management Co., Ltd. For the following fund management companies, less than 10% of the funds they managed were liquidated or merged: Taishin International Bank Co., Ltd.; Fuh Hwa Securities Investment Trust Co., Ltd.; JPMorgan Asset Management; and Prudential. Thirty-three securities fund companies had more than 30% of their funds liquidated or merged, which accounted for 70% of the 47 fund companies in Taiwan.

We used TEJ fund-ranking database, fund fee and bond fund income database, and fund turnover rate database to collect the variables of the fund performances and various fund operating characteristics. The variables included returns, total net value, flows, expense ratio, performance volatility levels, and performance indicators, which comprise the original rate of return, Jensen's α, the Sharpe index, and information ratio. We adopted monthly data from these databases and compared the empirical results of within-family and cross-family mergers.

Table 1 includes the descriptive statistics of the within-family and cross-family mergers and categories of the investment targets of Taiwanese funds. As of December 31, 2010, the majority of these mergers were within-family mergers (145 of 155, accounting for 93.55% of the total mergers), whereas cross-family mergers were rare (10 of 155, accounting for 6.45% of the total mergers). Regarding the types of investment targets following mergers, the majority were equity funds (52 + 4 = 56, which was 56 of the 155, accounting for 36.13% of the total mergers), followed by bond funds (35 of 155, accounting for 22.58%), and then stock and bond balanced funds (30 of 155, accounting for 19.36%).

Table 1. Descriptive statistics of the within-family and cross-family mergers and categories of the investment targets of Taiwanese funds

Year	Within / Cross family mergers										Liquidations					
	Stock		Balanced funds		Bond		Others		Total		Total	Equity	Balanced funds	Bond	Others	Total
	Within	Cross	Within	Cross	Within	Cross	Within	Cross	Within	Cross						
2001	1	0	0	0	0	0	1	1	2	1	3	8	0	0	1	9
2002	11	0	0	0	1	0	4	0	16	0	16	1	0	0	1	2
2003	4	0	1	0	0	0	1	0	6	0	6	2	0	0	1	3
2004	2	0	1	0	1	0	1	0	5	0	5	3	0	1	3	7
2005	5	3	2	0	0	0	1	1	8	4	12	4	1	7	2	14
2006	2	0	9	1	12	0	4	0	27	1	28	4	9	7	10	30
2007	5	1	7	0	13	0	1	0	26	1	27	4	4	10	8	26
2008	15	0	4	0	6	1	7	1	32	2	34	11	15	2	19	47
2009	4	0	1	0	0	1	4	0	9	1	10	3	3	0	1	7
2010	3	0	8	0	0	0	3	0	14	0	14	2	5	2	4	13
Total	52	4	33	1	33	2	27	3	145	10	155	52	37	30	51	170

Description: This study samples fund attributes from the TEJ data that were published or available before December 31, 2010. After reviewing fund liquidations and within-family or cross-family mergers over the years, we obtained 155 merged funds and 170 liquidated funds based on the number of funds that had different types of investment targets before mergers. These statistics were obtained from January 1, 2001 to December 31, 2010.

Ten Taiwanese stock and bond balanced funds were merged in 2006. This was possibly because (1) companies that managed this type of fund converted their outright bond purchasing and selling transactions for cash assets into actual bond holdings; (2) when the fund scales reached NT$200 million, government bonds accounted for 25%; and (3) the corporate bond market was not active during 2006. Therefore, managers of other types of funds could not manage these funds. Although the scales of these funds are small, they required specialized managers. Consequently, these funds were likely to be merged when considering the benefits.

The majority of mergers between 2006 and 2007 were bond fund mergers, totaling 25 cases. This was the case because (1) the competent authority ruled that bond funds must be transformed or distributed or (2) investment trust considerations were influenced by increased global interest rates, causing investors to gradually abandon conservative investment strategies. Consequently, fund scales decreased. Therefore, fund companies decided to merge their funds to reduce selling pressure resulting from fund realization. The majority of mergers in 2008 were equity fund mergers, and 47 funds were liquidated. This may have been the case because global stock markets performed poorly in the years leading up to 2008, and the Taiwanese stock market was affected by other factors. In this year alone, 15 funds were merged and 11 were liquidated. Many equity funds were merged under the influence of a bear market. Furthermore, the majority of the balanced funds involved outright bond purchasing and sales transactions of cash assets, which must be transformed into actual bond holdings within a given time frame. Although fund companies were granted a buffer period, they decided to liquidate or merge balanced funds after considering the benefits. This was possibly the case because the market was inactive and these funds could not be managed by managers that had been managing other types of funds.

4. Empirical Results

4.1 Descriptive Statistics

To examine the relationship between Taiwanese fund liquidations and mergers and fund characteristics, we first summarized the descriptive statistics of the operating characteristics of the overall liquidated and merged funds and unmerged funds, including previous returns, previous total assets, previous flows, expense ratio, buy-and-hold returns during the past six months, annualized standard deviations during the past 12 months, average flows during the past six months, and Jensen's α during the past 12 months. We compared the statistics of the liquidated and merged funds with those of funds that were not liquidated or merged.

Table 2 includes the means of the fund characteristics for the liquidated funds, within-family and cross-family mergers, and other non-liquidated or unmerged funds. We used statistics for the months when the liquidations or mergers occurred as the basis for fund matching. The fund characteristics consisted of the total assets in the month preceding the liquidation or merger; performances (i.e., in the preceding month, during the last six months preceding the liquidation or merger, returns during the first six months of holdings, and Jensen's α during the past 24 months); flows (i.e., in the preceding month and the preceding six months); measurement indices for cost

structures; and the annualized standard deviation of the returns. We obtained the annualized standard deviations based on the monthly rate of return in the past 12 months, without calculating the statistics of the funds that were founded less than 12 months prior. The equation was $\sigma_i * \sqrt{12}$. In particular, the performance measurement indices comprised Jensen's α, the Sharpe index, and the information ratio. The measurement indices for the cost structures consisted of expense ratios (i.e., manager fees, custodial fees, guarantee fees, and other fees). Finally, r_t is the fluctuation range of the unit net values in the last month during Term t.

The data in Table 2 shows that in within-family and cross-family mergers, the performance measurement indices of the dissolved funds before mergers, except for the Sharpe index, were all inferior compared to those of the surviving funds. When the asset scales of the funds are small, fund companies might not be able to pay or cope with fixed costs and thus fail to make a profit. Therefore, fund companies are likely to liquidate these funds. Fund performances during the six months preceding liquidation or elimination were primarily negative, and the returns of these funds tended to be lower compared with those of the funds that were not liquidated or merged. The performance volatility of the liquidated or merged funds was inferior compared with that of the funds that were not liquidated or merged. More crucially, the fund flows during the six months preceding liquidation or merger were primarily negative and lower compared to the fund flows of the funds that were not liquidated or merged. Furthermore, the fund flows of the dissolved funds prior to mergers were inferior compared with those of the surviving funds. Examining the cost structures showed that in the within-family mergers, the expense ratios of the previous month for the dissolved funds all exceeded those of the surviving funds (Elton et al., 1996). Therefore, funds with high cost or expense ratios are likely to be within-family mergers.

Table 2. The descriptive statistics of the liquidated and merged funds compared with all funds

Fund operation characteristics	Within-family mergers		Cross-family mergers		Liquidations	Others
	Surviving	Dissolved	Surviving	Dissolved		
Fund one month lagged total net assets	4526.090	1855.826	2581.100	1476.400	252.103	4826.344
Fund one month lagged Jensen index	-0.043	-0.440	-0.065	-0.295	-0.530	0.084
Fund one month lagged Sharp index	-1.823	-1.877	-0.786	-0.547	-0.322	-0.426
Fund one month lagged information ratio	0.036	-0.123	-0.089	-0.212	-0.156	0.022
Fund one month lagged flow	-0.024	-0.101	0.040	-0.111	-0.473	-0.004
Fund one month lagged expense ratio	0.113	0.118	0.126	0.119	1.059	0.124
Jensen index over past 6 months	-0.079	-0.390	-0.216	-0.394	-0.379	0.094
Sharp index over past 6 months	-1.808	-1.693	-1.289	-1.153	-0.252	-0.405
Information ratio over past 6 months	0.029	-0.103	0.006	-0.117	-0.137	0.023
Fund buy-hold returns over past 6 months	-0.014	-0.048	0.003	-0.032	-0.083	0.030
Stand deviation of fund returns over past 12 months	15.174	14.640	14.842	16.244	11.948	16.719
Mean fund flow over past 6 months	-0.029	-0.060	0.002	-0.049	-0.132	-0.004
Jensen alpha calculated over past 24 months	-0.011	-0.259	0.134	-0.392	-0.255	0.096

Description: This table shows the sample characteristics of the liquidated and merged funds compared with other funds that were not liquidated or merged. These characteristics included the mean operation characteristics, the matching of which was based on the month of liquidation and merger. The operation characteristics comprised the total asset in the previous month (i.e., the fund's total asset values at the end of each month, measured in millions of NT dollars), performance (i.e., original rates of return, Jensen's α, the Sharpe index, and information ratio), fund flow ([we used the equation proposed by Sirri and Tufano (1998), i.e., $[TNA_t - (1+r_t)TNA_{t-1}] / TNA_{t-1}$, measurement indices for cost structures (expense ratios), and annualized standard deviation (which we obtained based on the monthly rate of return in the past 12 months without calculating the statistics of funds that were established less than 12 months before).

4.2 Multinomial Logit Model

Considering the factors influencing differences in fund liquidation and merger methods, we used the multinomial logit model to establish an empirical framework to explore the fund characteristics that are likely to cause fund companies to liquidate or merge their funds. The fund family can dispose of funds in one of four ways: (1) a within-family mutual fund merger; (2) a without-family mutual fund merger; (3) liquidate the fund; (4) keep the fund in the family. The regression variables included the fund's one-month lagged total net assets, the fund's one-month lagged Jensen index, the fund's one-month lagged Sharp index, the fund's one-month lagged information ratio, the fund's one-month lagged flow, mean fund flow over the past six months, standard deviation of the fund's returns over the past 12 months, the fund's one-month lagged expense ratio, the fund's buy-hold returns over the past six months, Jensen α calculated over the past 24 months, and fund age.

To depict the linear relations between explanatory variables, we calculated the simple correlation coefficients. We computed the variance inflation factor (VIF) and conditional index to diagnose whether collinearity existed

between variables (See Table 3). If the VIF is greater than 10 or the conditional index is greater than 15, then multicollinearity exists. The results show no evidence of multicollinearity. To get the multionomial logit model, we first tested the assumption of the independence of irrelevant alternatives, which states that the relative probabilities of two options being chosen are unaffected by removing the other alternatives.

Table 3. Collinearity diagnostics

Variables	VIF	Conditional index
fund one month lagged total net assets	2.637	2.165
fund one month lagged raw return	2.769	2.234
fund one month lagged flow	1.376	2.557
mean fund flow over past 6 months	2.114	2.727
stand deviation of fund returns over past twelve months	1.866	3.129
fund one month lagged direct transaction costs rate	1.464	3.824
fund one month lagged expense ratio	1.696	4.448
fund one month lagged cost ratio	1.294	4.984
fund buy-hold returns over past 6 months	1.328	5.858
Jensen alpha calculated over past 24 months	1.163	8.292
fund age	1.318	10.602

Description:This table reports the variance inflation factor (VIF) and Conditional index to diagnose whether there are collinear between variables. If VIF>10 or conditional index >15, the multicollinearity exists.

We also contend the test of independence of irrelevant alternatives (IIA) property cannot be rejected at the 1% significant level (See Table 4). Therefore, the multinomial logit model is an appropriate model for estimating this data. As such, we investigated the fund exit determinants using the MNLM. We considered three models, each with different fund performance. Table 5 shows the results of the cross-sectional multinomial logit model. The total assets in the previous month, mean flow, Sharpe index, and performance in the last 24 months in the within-family mergers tended to be significantly negative. This indicates that in Taiwanese fund mergers, fund companies are likely to merge a particular fund with other funds in the same family when the short-term fund flow (that is, in the previous month) is negative, and the long-term (that is, 24 months) fund performance is inferior compared with that of the surviving fund. Therefore, the characteristics that can cause within-family mergers in Taiwanese funds include small or low total assets, low short-term fund flow, and poor previous performance.

Table 4. Test of independence of irrelevant alternatives (IIA)

Alternative dropped	Chi-Square	Probability	evidence
Liquidation	-9.716	1	no reject H0
Within-family merge	3.896	1	no reject H0
With-out family merge	0.984	1	no reject H0
keep the fund	-48.39	1	no reject H0

Description: This table reports the results for Hausman specification test with three of the alternative dropped. The result indicates that IIA property cannot be rejected at 1% significant level. Therefore, multinomial Logit model is an appropriate model for estimation of this data.

Table 5 presents that the total net assets, short-term performance, the fund's one-month lagged flow, and Jensen α calculated over the past 24 months have a significantly negative relationship with within-family merged funds. When fund performances are extremely poor, fund companies are likely to terminate the sales and merge the same family funds to dissolve funds with poor performances (Brown and Goetzmann, 1995; Elton et al., 1996; Jayaraman et al., 2002). However, previous low performance, total net assets and flow, cost structure, and performance volatility do not determine whether family companies conduct cross-family mergers. Instead, cross-family mergers are potentially conducted for other strategic motivations. When funds have small scales, low fund flow in the previous month, low performance volatility, and poor buy-hold return over the past six months and long-term performance, fund companies tend to liquidate these funds. Investors are not interested in investing in funds that perform poorly. Therefore, fund companies are likely to eliminate these funds through liquidation and within-family mergers to improve investors' overall impressions of the fund families.

Table 5. Multinomial logit model estimates of merger and liquidation

Fund operation characteristics	Within-family mergers			Cross-family mergers			Liquidations		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Constant	2.476***	4.214***	2.422***	-0.271	-0.853	-0.700	3.91***	4.003***	3.996***
Fund one month lagged total net assets	-0.943***	-1.639***	-0.889***	-0.939	-0.725	-0.84	-1.87***	-1.885***	-1.858***
Fund one month lagged Jensen index	-0.398			0.219			-0.441		
Fund one month lagged Sharp index		-0.203***			0.152			0.060	
Fund one month lagged information ratio			-0.409			-1.078			-0.063
Fund one month lagged flow	-3.388***	-2.646**	-3.108***	-4.719	-5.134	-4.663	-8.494***	-8.487***	-8.256***
Mean fund flow over past 6 months	-0.347	0.929	-0.678	3.577	2.683	2.879	4.696	4.831	4.649
Stand deviation of fund returns over past twelve months	-0.024	-0.017	-0.023	-0.023	-0.022	-0.018	-0.066***	-0.062***	-0.064***
Fund one month lagged expense ratio	-3.036	-1.537	-3.254	-3.403	-4.981	-4.492	-0.089	-0.083	-0.076
Fund buy-hold returns over past 6 months	0.167	-0.210	-0.472	0.054	0.300	0.777	-1.560	-2.473**	-2.259**
Jensen alpha calculated over past 24 months	-0.403	-0.646**	-0.671**	-1.325	-1.152**	-0.903	-0.458	-0.863**	-0.851**
Fund age	0.04	0.011	0.034	0.05	0.073	0.063	0.011	0.006	0.002

Description: A three-outcome multinomial logit model was used to investigate the distinction among different exit forms. The fund family can dispose funds by four choices: (1) a within-family mutual fund merge; (2) a cross-family mutual fund merge; (3) liquidate the fund; (4) keep the fund in the family. The variables included fund one month lagged total net assets, fund one month lagged Jensen index, fund one month lagged Sharp index, fund one month lagged information ratio, fund one month lagged flow, mean fund flow over past 6 months, stand deviation of fund returns over past twelve months, fund one month lagged expense ratio, fund buy-hold returns over past 6 months, Jensen alpha calculated over past 24 months, and fund age. *** and ** indicate significant at the one and five percent, respectively. We use the three models with different explanation variables in merger/liquidation funds. M1: model 1; M2: model 2; M3: model 3.

In summary, performance is a significant motivation for a within-family merger and a liquidation fund in Taiwan. Poor short-term performance (Sharp index) and long-term performance (Jensen α) are determinants on within family mergers. This conclusion is consistent with those proposed by Elton et al. (1996) and Jayaraman et al. (2002). On the other hand, poor short-term performance (Sharp index), mid-term performance (buy-hold returns), and long-term performance (Jensen α) are determinants on liquidations. This conclusion is similar with those proposed by Lunde et al. (1999), Horst et al. (2001), and Vayanos (2004). Fund flows and fund size are significant in predicting the likelihood of the within-family merge and liquidation, but it is not a determinant and effect for a cross-family merge fund. Interestingly, the expense ratio is not a determinant for fund exits in Taiwanese onshore funds. These results differ from the previous literature in that the higher expense ratios increase the likelihood of terminating the fund (Brown and Goetzmann, 1995; Jayaraman et al., 2002; Zhao, 2005). This verifies that our pervious prediction is correct. The expense ratios do not affect the merger or liquidation of funds because the acquiring and acquired fund's expense ratios are similar and are not significantly different. Moreover, some scholars have argued that young and extremely old funds are the most likely to be closed (Lunde et al., 1999). This study found that fund age is also not a determining factor in Taiwanese fund mergers and liquidations. The result also differs from the previous literature (Brown and Goetzmann, 1995; Lunde et al., 1999; Horst et al., 2001; Zhao, 2005; Cakici and Chatterjee, 2007). These previous studies found that old or young funds intended to be merged or liquidated. It is worth mentioning that the volatility of fund performance is a determinant and effect on fund liquidation and had a significantly negative effect on fund liquidation for Taiwanese onshore funds. This result is similar with Massa and Patgiri's (2009) finding that the probability of a fund's survival relates positively to the volatility of fund return.

4.3 Time-Series Logistic Regression Model

Table 6 shows that the surviving funds in within-family mergers had significantly negative mean flows during the previous six months (with a coefficient of -6.791). This indicates that a fund company tend to merge a fund with other funds within its family when the surviving fund has a lower mean flow (in the prior six months) compared to other points in its lifecycle. Regarding the influencing factors for dissolved funds during within-family mergers, in addition to the effects of mean flow in the previous six months (with a coefficient of -4.747), funds that have poorer long-term performance (i.e., Jensen's α during the prior 24 months, with a coefficient of -0.430) compared to those at other points of the funds' lifecycles are likely to be merged with (dissolved by) other funds within the families. Furthermore, the lifecycle characteristics that are likely to result

in fund liquidation of Taiwanese funds include small total assets in the previous month, low annualized standard deviation in the last 12 months, low mean flows in the previous six months, and lower buy-and-hold returns in the prior six months compared to other lifecycle points.

In summary, the factors that affect within-family mergers are fund performance and flow from both cross-section and time-series views. The total net assets affect within-family mergers just in a cross-section analysis, not a lifecycle characteristic in a time-series analysis. For the liquidation, total net assets, flow, performance volatility, and mid-term buy-hold returns have a significantly negative relationship with the fund liquidations from both the cross-section and time-series views. Poor long-term performance only affects the fund liquidation from a cross-section view, but it is not relevant for the lifecycle itself. Worth mentioning is that we also did not find any common fund operation characteristics such as a significant motivation for cross-family mergers, although we did observe them from the time-series view. In general, fund mergers between fund companies are possibly conducted for strategic considerations (e.g., changes in global capital markets or the need to lower the risks of single-market fund operations), rather than being based on specific factors (e.g., performance and flow).

Table 6. Determinants of fund liquidation and merger (results of the time-series logistic regression)

Fund operation characteristics	Within-family mergers		Cross-family mergers		Liquidations
	Surviving fund	Dissolved funds	Surviving fund	Dissolved funds	
Constant	-4.336 ***	-4.070 ***	-3.584 ***	-1.454	0.237
Fund one month lagged total net assets	0.000	0.000	0.000	0.000	-0.012 ***
Stand deviation of fund returns over past twelve months	0.010	0.006	-0.050	-0.051	-0.051 ***
Mean fund flow over past 6 months	-6.791 ***	-4.747 **	2.939	0.150	-4.384 **
Fund buy-hold returns over past 6 months	-0.960	-1.425	1.733	0.245	-4.405 ***
Jensen alpha calculated over past 24 months	-0.104	-0.430 ***	0.257	0.037	-0.281
Buy-hold return of corresponding style over the past 6 months	-0.819	-1.541	-19.186	-27.916	-9.561

Description: We examined the surviving funds and dissolved funds in within-family and cross-family mergers and liquidated funds to elucidate at what points of a fund's lifecycle and based on what characteristics fund companies perform fund liquidation or mergers. Table VII shows the results of the time-series logistic regression analysis of the fund characteristics. We used data from the two years preceding the month of the liquidation or merger to calculate Jensen's α. We considered all of the usable lifecycle data of the liquidated or merged funds and defined the value of the month during which fund liquidation or merger was performed as 1, and the lifecycle of the remaining months as 0 to calculate logistic regression analysis results. The explanatory variables comprised previous total assets, performances, flows, expense ratios, and buy-and-hold returns. The corresponding style funds are all of the same investment object funds. *** indicates that the α reached a level of significance at 1%; ** indicates that the α reached a level of significance at 5%.

4.4 Changes in Fund Characteristics for Fund Liquidation or Mergers

Using the average monthly changes in fund characteristics in the year before liquidation and merger and the year following liquidation and merger (Table 7), we explored short-term changes following mergers. The surviving funds in within-family and cross-family mergers both experienced increased fund flows following mergers. Allen and Parwada (2006) argued that rather than increasing fund flows, mergers cause investors to withdraw capital from the dissolved funds. However, we found no such phenomena. Nevertheless, the flows following the within-family mergers were negative, indicating that mergers cannot alter investors' net redemption tendencies. In contrast, the fund flows following cross-family mergers changed from negative (−0.011) to positive (0.015). The flows of the dissolved funds in within-family or cross-family mergers and the flows of the liquidated funds were all negative before the mergers. In addition, the flows of the dissolved funds were lower compared with those of the surviving funds.

In within-family and cross-family mergers, the total assets of surviving funds, flows, and performance volatility all increased, whereas expense ratios decreased (Kumar and Bansal, 2008). This indicates that mergers can increase fund management scales and reduce fees one year following a merger and verifies fund companies' claims to investors that mergers can reduce management costs. Increases in fund scales and flows following mergers indicate that mergers can reduce investors' regular purchases or redemption transactions and prevent significant asset management fluctuations or volatility. Fund performances varied depending on various performance measurement indices, and operational performances did not necessarily improve. This indicates that although fund companies expect to use mergers to reduce administrative costs and return a reasonable sum of costs to investors, they do not necessarily achieve these effects in later performance. The dissolved funds in within-family mergers all had negative performance, indicating that fund companies were likely to perform

within-family mergers to erase records of poor performance for certain funds and hide unsuccessful records (Jayaraman et al., 2002; Zhao, 2005; Khorana et al., 2007). In contrast, cross-family merger factors were not meant to eliminate funds exhibiting poor performance. The performances of the liquidated funds before liquidation were all negative, which was similar to the result proposed by Brown and Goetzmann (1995). In other words, loser funds are more likely to be liquidated or merged, but not all loser funds are eliminated.

The performance of the surviving funds following mergers varied depending on the performance measurement indices. Performance following mergers did not necessarily improve, which is consistent with the assertions of Agrawal et al. (1992) and Khorana et al. (2007). These studies showed that following mergers, the assets or wealth of the shareholders of the surviving companies were reduced. The shareholders of the dissolved funds in within-family and cross-family mergers tended to benefit from the mergers. The surviving funds had superior performance compared with the dissolved funds following mergers potentially because the surviving funds had superior assets or their fund managers had superior operational skills compared with those of the dissolved funds. Khorana et al. (2007) confirmed that dissolved funds that performed poorly showed substantially improved performance following mergers and that this phenomenon was particularly evident in within-family mergers.

The flow of surviving funds prior to mergers was negative (−0.024), implying that fund companies may desire to eliminate the poor performance of dissolved funds to increase surviving funds and attract the investment of additional assets. The flow of surviving funds in within-family mergers increased from −0.024 to −0.003 following mergers. The fund flows following mergers were negative, indicating that investors were likely to redeem their money from the surviving funds following mergers. Furthermore, consistent with increases in fund flows, the total net assets also increased and showed significance, with the volatility level before and following mergers being substantial and significant. In contrast, the flow of surviving funds in cross-family mergers increased from −0.011 to 0.015. The fund flow of surviving funds following mergers changed from negative to positive, indicating the increased flows of the surviving funds following cross-family mergers. However, fund performance did not necessarily improve, whereas volatility levels were more substantial and expense ratios decreased overall and were significant (Khorana et al., 2007). In general, cross-family fund mergers are potentially conducted for strategic considerations rather than based on specific factors. For example, Namvar and Phillips (2013) suggested that mutual fund mergers create collaborative benefits between funds with similar strategies.

Table 7. Changes in fund characteristics before and following fund liquidation or mergers

Fund operation characteristics	Within-family mergers					Cross-family mergers					Liquidations
	Surviving fund				Dissolved funds	Surviving fund				Dissolved funds	
	Before	After	P value	Sig.	Before	Before	After	P value	Sig.	Before	Before
Total assets	5431	7154	0.011	**	2541	3097	4917	0.312	-	1251	502.
Jensen index	-0.048	-0.155	0.141	-	-0.316	-0.136	0.233	0.384	-	-0.335	-0.285
Sharp index	-1.710	-1.755	0.871	-	-1.500	-1.412	-1.029	0.359	-	-1.622	-0.188
Information ration	0.020	-0.002	0.611	-	-0.087	0.032	-0.083	0.389	-	-0.093	-0.137
Fund flows	-0.024	-0.003	0.930	-	-0.045	-0.011	0.015	0.620	-	-0.025	-0.090
Stand deviation of fund returns	14.738	16.378	0.004	***	13.463	15.847	17.877	0.418	-	16.497	9.869
Expense ratio	0.113	0.112	0.384	-	0.116	0.122	0.116	0.046	**	0.114	0.182
Excess returns over matching fund	-0.001	0.005	0.052	-	-0.004	0.002	0.007	0.637	-	-0.002	-0.008
Excess flows	-0.019	-0.001	0.963	-	-0.032	-0.013	0.014	0.581	-	-0.012	-0.055

Description: We examined the changes in liquidated funds and the surviving funds and dissolved funds that underwent within-family or cross-family mergers during the year before and the year following liquidations or mergers. We adopted the formula proposed by Sirri and Tufano (1998) to define fund flow, that is, $[TNA_t - (1+r_t)TNA_{t-1}] / TNA_{t-1}$. Expense ratio = [(manager fees + custodial fees + guarantee fees + other fees) / 1000] / fund net asset (thousands of NT dollars) X 100%. The performance indices comprised the original rate of return, Jensen's α, Sharpe index, and information ratio. Abnormal flow was obtained based on calculations of the matching funds that had similar investment objectives or targets. The corresponding matching funds are all of the same investment object funds. *** indicates that the α reached a level of significance at 1%; ** indicates that the α reached a level of significance at 5%. Significant (Sig.).

4.5 The Robustness Test

According to Table I, which includes the statistics of the fund liquidations and mergers, the number of fund liquidations did not exceed 10 until 2005, which was the beginning of a wave of fund liquidations and mergers. Considering that samples before 2005 are rare and that the causes of early fund liquidations might differ from

those of recent liquidations, we excluded early samples and retested the statistics. We again employed cross-sectional and time-series regression in the robustness test.

The results of the cross-sectional multinomial logit regression analysis of the within-family and cross-family mergers showed that when the statistics reached a significance level of 0.05, the results did not differ significantly from those that included samples from 2005. Despite a slight difference in the statistical significance results obtained through the multinomial logit regression coefficient test for within-family mergers and although low performance volatility became significant, the remaining variables were identical to the results obtained before the robust test. Therefore, we conclude that in addition to small total assets, low short-term fund flows, and poor previous performance, another characteristic of Taiwanese within-family mergers following 2006 is low performance volatility. Among the factors that affect cross-family mergers, none of the variables changed significantly except for the long-term (that is, 24 months) performance in Model 2, which became insignificant. The characteristics of the liquidated funds did not change, with one exception. In Model 1, the regression coefficient of Jensen's α in the previous month changed to a statistically significant negative correlation. The results of the time-series logistic regression of the cross-family mergers and liquidations did not differ significantly from those obtained without excluding samples from 2005. This does not change the conclusion that variations in particular fund characteristics can cause fund companies to merge or liquidate certain funds rapidly.

5. Conclusion and Discussion

The present study explored the relationship between fund flows and fund exit strategies of Taiwanese funds. We employed multinomial and time-series logit regression analysis for the empirical analysis to (1) identify the operating characteristics that cause fund companies to liquidate or merge certain funds and (2) test whether fund companies can achieve the promises and benefits they describe when they announce mergers.

The empirical results and analysis conclusions of this study are as follows. First, in general, fund companies claimed that because fund scales were excessively small, they were unable to pay for the funds' fixed expenses. This inability would affect the quality of fund operations and jeopardize the clients' rights and interests. Therefore, fund companies opted for fund mergers. However, although expense ratios declined following mergers and fund flows increased, the quality of the funds' operational performance was not necessarily enhanced. Investors should therefore consider carefully and rationally whether they want to continue investing in surviving funds. Fund performance varied depending on various performance measurement indices, and operational performance did not necessarily improve. This indicates that although fund companies expect to use mergers to reduce administrative costs and return a reasonable sum of costs to investors, they do not necessarily achieve these goals in subsequent performance.

Second, among various fund exit strategies, the market prefers that fund companies perform mergers rather than liquidations when fund scales are small. This is the case because mergers can significantly reduce the stock selling pressure that results from fund liquidations. Notably, fund liquidations outnumbered mergers during the decade between 2001 and 2010. Fund companies should enhance the quality of their operations during early fund raising or the subsequent management processes to prevent their funds from being closed. Otherwise, fund companies do not have to pay for their mistakes, and investors must continually suffer losses.

Third, before conducting within-family mergers, fund companies should examine the performance records of the surviving and the dissolved funds. Fund companies tend to eliminate funds that have poor previous records, small total assets, and low flows. Fund flows increased and operating costs decreased one year following the merger. Although the expense ratios declined, the shareholders of the dissolved and surviving funds did not gain higher returns from the mergers. When surviving funds in within-family mergers have lower mean flows during the six months preceding a merger compared to other points in the lifecycle, the fund companies tend to merge funds with other funds within the same families. Similarly, when the dissolved funds in within-family mergers have lower mean flows during the six months preceding a merger compared to those at other points in the lifecycle, fund companies tend to merge (eliminate) these funds.

Fourth, fund flows increased and operating costs decreased one year following cross-family mergers. For the shareholders of the dissolved funds, however, although the expense ratios increased, this did not determine fund exits. In contrast, total assets, previous flows, and previous performance are crucial factors for fund exits. For the shareholders of the surviving funds, although expense ratios declined, the potential quality of the returns following mergers was uncertain and volatility levels were significant. However, these factors do not determine fund exits. In general, the considerations for fund exits were strategic rather than based on specific factors.

Fifth, Brown and Goetzmann (1995), Horst et al. (2001), and Zhao (2005) found that newly established funds

were more likely to be liquidated, whereas Lunde et al. (1999) argued that young or extremely old funds were likely to be closed. However, the fund's age was not a factor among Taiwanese fund exit strategies. When fund companies liquidate funds that have been established for a relatively long period simply because of small fund scales, fund investors who engage in long-term investments (Barber et al., 2005) are forced to sell their funds during stock market lows. Clearly, this is against the "buy low, sell high" investment philosophy. We recommend, therefore, that Taiwanese domestic long-term investors pay increased attention to fund scale, performance volatility, long-term performance, fund flow, and whether the mean flow of a fund during the six months prior to a certain point in its lifecycle is low compared with these factors at other points of the fund's lifecycle. Investors should base investment decisions on these factors to avoid being forced to terminate their investments at any particular point. By so doing, they can avoid incurring long-term investment losses and the negative consequences that result from fund termination or mergers.

Sixth, during within-family and cross-family mergers, the total assets of the surviving funds increased, which was consistent with the increases in flows, whereas expense ratios declined (Kumar and Bansal, 2008). In within-family mergers, the mean flows during the prior six months were lower compared to those at other points of the lifecycle. Therefore, such funds were likely to merge with or acquire other funds. In cross-family mergers, we did not identify any fund characteristic-related lifecycle characteristics that contributed to fund exits. Seventh, funds that had small total assets, low previous flows, and poor long-term performance were likely to be eliminated. Furthermore, the mean flow during the prior six months and poor long-term (that is, 24 months) performance compared to those of other outside-family funds are factors that determine within-family mergers. In contrast, we did not find any fund characteristic-related lifecycle characteristics that affected cross-family mergers.

The majority of the investors tend to purchase funds that have superior recent performance (Sirri and Tufano, 1998), and they tend to believe that funds that fund companies rename and beautify yield extraordinary returns. Indeed, the opposite is true (Cooper et al., 2005). In addition, we found that the investing public tends to be relatively passive. When fund companies perform simple and appropriate mergers, public investors of the dissolved fund and the surviving fund can be convinced easily that the merger will yield superior performance or that the funds can be transformed into funds that have more popular investment targets. In general, however, although fund flows increase following mergers, performance is not necessarily improved, indicating that Taiwanese investors' misjudgments or inappropriate behavior (Chen et al., 2011) are influenced potentially by trusting fund companies' claims that liquidations and mergers will yield expected benefits. In fact, fund managers may benefit from mergers because investors tend to focus on the proclaimed benefits of liquidations or mergers while neglecting original poor performance. This is consistent with conclusions from previous studies that have asserted that the majority of investors use scant professional knowledge in selecting products for purchase (Capon et al., 1996). Because investors tend to follow trends rather than make rational judgments based on previous fund performance, they can arrive at erroneous or biased investment decision behavior (Bailey et al., 2011).

References

Agrawal, A., Jaffe, J. F., & Mandelker, G. N. (1992). The Post-merger Performance of Acquiring Firms: A Re-examination of an Anomaly. *Journal of Finance*, *47*, 1605-1621. http://dx.doi.org/10.1111/j.1540-6261.1992.tb04674.x

Agresti, A. (1996). *An Introduction to Categorical Data Analysis*. New York: John Wiley & Sons.

Ahmad, Y., & Kashian, R. (2010). Modeling the Time to an Initial Public Offering: When Does the Fruit Ripen? *Journal of Economics and Finance*, *34*(4), 391-414. http://dx.doi.org/10.1007/s12197-008-9073-z

Allen, D. E., & Parwada, J. T. (2006). Investors' Response to Mutual Fund Company Mergers. *International Journal of Managerial Finance*, *2*(2), 21-35. http://dx.doi.org/10.1108/17439130610657340

Bailey, W., Kumar, A., & Ng, D. (2011). Behavioral Biases of Mutual Fund Investors. *Journal of Financial Economics*, *102*(1), 1-27. http://dx.doi.org/10.1016/j.jfineco.2011.05.002

Barber, B. M., Odean, T., & Zheng, L. (2005). Out of Sight, Out of Mind: the Effects of Expenses on Mutual Fund Flows. *Journal of Business*, *78*, 2095-2119. http://dx.doi.org/10.1086/497042

Barksdale, H. C., & Harris, C. E. (1982). Portfolio Analysis and the Product Life Cycle. *Long Range Planning*, *15*(6), 74-83. http://dx.doi.org/10.1016/0024-6301(82)90010-3

Bekaert, G., & Harvey, C. R. (2002). *Emerging Market Finance*. National Bureau of Economic Research, Cambridge, MA, USA.

Berk, J. B., & Green, R. C. (2004). Mutual Fund Flows and Performance in Rational Markets. *Journal of Political Economy*, *112*, 1269-1295. http://dx.doi.org/10.1086/424739

Bris, A., Gulen, H., Kadiyala, P., & Rau, P. R. (2007). Good Stewards, Cheap Talkers, or Family Men? The Impact of Mutual Fund Closures on Fund Managers. *Review of Financial Studies*, *20*(3), 953-982. http://dx.doi.org/10.1093/rfs/hhl017

Brown, S. J., & Goetzmann, W. N. (1995). Performance Persistence. *Journal of Finance*, *50*, 679-698. http://dx.doi.org/10.1111/j.1540-6261.1995.tb04800.x

Brown, S. J., Goetzmann, R. G., & Ross, S. A. (1992). Survivorship Bias in Performance Studies. *The Review of Financial Studies*, *5*(4), 553-580. http://dx.doi.org/10.1093/rfs/5.4.553

Bu, Q., & Lacey, N. (2009). On Understanding Mutual Fund Terminations. *Journal of Economics and Finance*, *33*(1), 80-99. http://dx.doi.org/10.1007/s12197-007-9022-2

Cakici, N., & Chatterjee, S. (2007). Hedge Fund Mergers. *Journal of Investment Management*, *5*(2), 99-111.

Cameron, A. C., & Hall, A. D. (2003). A Survival Analysis of Australian Equity Mutual Funds. *Australian Journal of Management*, *28*(2), 209-226.

Capon, N., Fitzsimmons, G. J., & Prince, R. A. (1996). An Individual Level Analysis of the Mutual Fund Investment Decision. *Journal of Financial Services Research*, *10*, 59-82. http://dx.doi.org/10.1007/BF00120146

Chen, A. H. L., Cheng, K., & Lee, Z. H. (2011). The Behavior of Taiwanese Investors in Asset Allocation. *Asia - Pacific Journal of Business Administration*, *3*(1), 62-74. http://dx.doi.org/10.1108/17574321111116405

Cooper, M. J. K., Gulen, H., & Rau, P. R. (2005). Changing Names with Style: Mutual Fund Name Changes and Their Effects on Fund Flows. *Journal of Finance*, *60*, 2825-2858. http://dx.doi.org/10.1111/j.1540-6261.2005.00818.x

Cox, D. R. (1970). *The Analysis of Binary Data*. London: Chapman and Hall.

Dritsakis, N., Grose, C., & Kalyvas, L. (2006). Performance Aspects of Greek Bond Mutual Funds. *International Review of Financial Analysis*, *15*(2), 189-199. http://dx.doi.org/10.1016/j.irfa.2005.10.001

Elton, E. J., Gruber, M. J., & Blake, C. (1996). Survivorship Bias and Mutual Fund Performance. *Review of Financial Studies*, *9*, 1097-1120. http://dx.doi.org/10.1093/rfs/9.4.1097

Evans, R. B. (2004). Does Alpha Really Matter? Evidence from Mutual Fund Incubation, Termination and Manager Change, University of Pennsylvania, Working Paper.

Gruber, M. J. (1996). Another Puzzle: The Growth in Actively Managed Mutual Funds. *The Journal of Finance*, *51*(3), 783-810. http://dx.doi.org/10.1111/j.1540-6261.1996.tb02707.x

Hausman, J., & McFadden, D. (1984). Specication Tests for the Multinomial Logit Model. *Econometrica*, *52*(5), 1219-1240. http://dx.doi.org/10.2307/1910997

Horst, J., Nijman, T., & Verbeek, M. (2001). Eliminating Look-ahead Bias in Evaluating Persistence in Mutual Fund Performance. *Journal of Empirical Finance*, *8*(4), 345-373. http://dx.doi.org/10.1016/S0927-5398(01)00032-9

Huang, J. C., Wei, K. D., & Yan, H. (2012). Investor Learning and Mutual Fund Flows. AFA 2012 Chicago Meetings Paper.

Huang, J., Wei, K. D., & Yan, H. (2007). Participation Costs and the Sensitivity of Fund Flows to Past Performance. *Journal of Finance*, *62*(3), 1273-1311. http://dx.doi.org/10.1111/j.1540-6261.2007.01236.x

Jayaraman, N., Khorana, A., & Nelling, E. (2002). An analysis of the Determinants and Shareholder Wealth Effects of Mutual Fund Mergers. *The Journal of Finance*, *57*(3), 1521-1552. http://dx.doi.org/10.1111/1540-6261.00468

Johnsen, T., & Melicher, R. (1994). Predicting Corporate Bankruptcy and Financial Distress: Information Value added by Multinomial Logit Models. *Journal of Econimics and Business*, *46*, 269-286. http://dx.doi.org/10.1016/0148-6195(94)90038-8

Kempf, A., & Ruenzi, S. (2008). Tournaments in mutual fund families. *Review of Financial Studies*, *21*, 1013-1036. http://dx.doi.org/10.1093/rfs/hhm057

Khorana, A., Tufano, P., & Wedge, L. (2007). Board Structure, Mergers and Shareholder Wealth: A Study of the

Mutual Fund Industry. *Journal of Financial Economics*, *85*(2), 571-598. http://dx.doi.org/10.1016/j.jfineco.2006.05.002

Kumar, S., & Bansal, L. K. (2008). The Impact of Mergers and Acquisitions on Corporate Performance in India. *Management Decision*, *46*(10), 1531-1543. http://dx.doi.org/10.1108/00251740810920029

Lunde, A., Timmerman, A., & Blake, D. (1999). The Hazards of Mutual Fund Underperformance: A Cox Regression Analysis. *Journal of Empirical Finance*, *6*, 121-152. http://dx.doi.org/10.1016/S0927-5398(98)00013-9

Massa, M., & Patgiri, R. (2009). Incentives and Mutual Fund Performance: Higher Performance or Just Higher Risk Taking? *The Review of Financial Studies*, *22*(5), 1777-1815. http://dx.doi.org/10.1093/rfs/hhn023

McFadden, D. (1973). Conditional Logit Analysis of Qualitative Choice Behavior. In P. Zarembka (Ed.), *Strutural Analysis of Discrete Data with Econometric Application* (pp. 105-135). Combridge: MIT Press.

Muga, L., & Santamaria, R. (2010). Market Penetration Strategies and the Fee-performance Relationship: the Case of Spanish Money Mutual Funds. *The Service Industries Journal*, *30*(9), 1529-1547. http://dx.doi.org/10.1080/02642060802626816

Namvar, E., & Phillips, B. (2013). Commonalities in Investment Strategy and The Determinants of Performance in Mutual Fund Mergers. *Journal of Banking & Finance*, *37*(2), 625-635. http://dx.doi.org/10.1016/j.jbankfin.2012.10.001

Ping, H. (2001). Two Essays on Mutual Fund Risk-Taking and Flow-Performance Relationship, Georgia State University.

Sirri, E. R., & Tufano, P. (1998). Costly Search and Mutual Fund Flows. *Journal of Finance*, *53*(5), 1589-1622. http://dx.doi.org/10.1111/0022-1082.00066

Vayanos, D. (2004). Flight to Quality, Flight to Liquidity, and the Pricing of Risk. NBER Working Paper.

Wang, N. Y., & Chen, B. H. (2009). A Study of Survivorship Bias, Fund Categories and Fund Performance Persistence. *Journal of Management, 26*(6), 673-696.

Zhao, X. (2005). Exit Decisions in the U.S. Mutual Fund Industry. *The Journal of Business*, *78*(4), 1365-1392. http://dx.doi.org/10.1086/430863

Zhou, X., & Chiang, K. C. H. (2007). Mutual Fund Postacquisition Management Retention and Its Performance Implications. *Corporate Finance Review*, *11*(6), 28-34.

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Interaction between Poverty, Growth, and Inequality during the Crisis: A Panel Data Study

Leila Chemli[1] & Mounir Smida[1]

[1] Faculty of Economic Sciences and Management, University of Sousse, Research Unit: MO2FID, Tunisia

Correspondence: Leila Chemli, Faculty of Economic Sciences and Management, University of Sousse, Research Unit: MO2FID, Tunisia. E-mail: chemli.leila@yahoo.fr

Received: February 4, 2013 Accepted: March 20, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p120 URL: http://dx.doi.org/10.5539/ijef.v5n5p120

Abstract

Difficulty of reducing poverty represents today a major challenge for all countries. Therefore the purpose of this paper is to consider the effect of economic growth and inequality on poverty during crisis periods . This study covers a MENA sample composed of eight countries (Algeria, Egypt, Iran, Jordan, Morocco, Tunisia, Syria and Yemen) from 1990 up to 2009. The econometric results show that economic growth and income inequality are proceeding in an opposite direction as for as poverty is concerned.

Keywords: economic growth, income inequality, poverty reduction, pro-poor growth, crisis

1. Introduction

The reduction of high levels of poverty represents a fundamental challenge today for both developed and developing countries. Dollar and Kraay (2000) support the necessity of the economic growth, to improve the situation of the poor people. Three different groups of researchers suggest specific visions, based mainly on the relation poverty-growth-inequality. The first vision confirms that growth is good for the poor, as shown by the (World Bank, 1990, 2000; Ravallion and Chen, 1997, 2001, 2003; Dollar and Kraay, 2002; Sala-i-Martin, 2002; Daymon, 2008; Turunç.G, 2009; Besbes and Boujelbene, 2010). The second vision says that inequality should not be omitted, because economic growth is necessary but not sufficient enough, this can be seen in the following surveys of (Deininger and Squire, 1996; Dollar and Kraay, 2001; Ravallion, 2001, 2003; Bourguignon (2004); Ravallion (2005); Besbes (2010) and Youssoufou (2010); Mchiri and Moudden, 2011). Finally the third vision shows that growth on its own is sufficient to reduce poverty, this is shown in the various studies of (Bhalla, 2002; Sala-I-Martin, 2002; Facchini, 2008; Turunç, 2009; Besbes and Boujelbene, 2010). Thus, the relation poverty-growth-inequality may be linked to financial instability which could be harmful, especially for those who suffer from poverty. Therefore, we will consider through my paper the extreme form of financial instability during time of crisis. Indeed, the last years, made us witness the birth of a new thesis called "pro-poor growth". Which fundamental idea is that economic growth is pro-poor, unless it is followed by more benefits from an economic growth process.

Therefore, the object of this paper is to analyze the effect of the economic growth and the inequality on poverty, through a MENA **(Middle East and North Africa**) sample countries, as far as crisis are concerned. So in order to achieve this target we will use a panel of data study. The outline of this paper is as follows: first, we review the theoretical and empirical literature of the relation growth-inequality- poverty. Then, we will try to present our econometric model, based on the found results.

2. Poverty Reduction, Economic Growth and Inequality in Period of Crisis: Review of the Theoretical and Empirical Literature

The study of the relation *"the triangle poverty-growth-inequality"* (Note 1), has generated many debates, as well at the theoretical level and the empirical one, for both developed and developing countries. In this paper, we are only interested in one aspect of this relation; therefore, we have not dealt with the reciprocity between economic growth, inequality and poverty. Indeed, the poverty depends essentially on the increase in the economic growth and the drop of the inequalities.

2.1 A Review of the Theoretical Literature

The interrelationship between poverty reduction, economic growth and inequality led to a debate about economic literature. Indeed, three ideas are as follow:

First, growth is good for the poor. According to the article of Dollar and Kraay (2002), entitled "Growth is good for the poor", they support that the growth is good, to improve the living standards of the poorest population (Daymon, 2008). And that the growth has no effect on inequality, therefore, they have a dominance of the acceleration of the growth and a negligence of the impact on inequality. Furthermore, this study suggests that governments may not engage in policies pro-poor growth. But, on the contrary they should simply maximize economic growth and ignore the distribution issues (Turunç, 2009; Besbes and Boujelbene, 2010). Other studies suggest the same idea as (World Bank, 1990, 2000; Ravallion and Chen, 1997, 2001, 2003; Sala-I-Martin, 2002; and Bourguignon and Morrisson, 2002).

The second presents the economic growth as a necessary step but not a sufficient condition to eradicate poverty. According to (Lustig, Arias, Rigolini, 2002): "*the economic growth is a crucial factor in the reduction of poverty, but the level of inequality affects its impact on poverty*" (Note2). Indeed, Ravallion (2005), through his article, entitled "*Inequality is bad for the poor*", affirms that inequality can be harmful to the poor and that it is a problem not to be omitted in order to fight poverty. Also, Deininger and Squire (1996); Dollar and Kraay (2001); Ravallion (2001, 2003); Bourguignon (2003); Turunç (2009); Besbes (2010) and Youssoufou (2010), share the same idea. Mchiri and Moudden (2011), affirm that "*a high inequality tends to slow down the growth in poor countries and encourage growth in the richest areas*" (Note 3). This implies that inequalities affect the situation of the poor.

The last idea, indicates that the economic growth is sufficient, to reduce poverty. According to Bhalla (2002) and Sala-I-Martin (2002), while referring to the World Bank surveys, they have concluded was too pessimistic and that one year ago, poverty was reduced in a considerable way all over the world (Turunç, 2009; Besbes and Boujelbene, 2010). Also, Facchini (2008) confirms that despite the presence of an egalitarian distribution or an unequal income, this does not have any effect on economic growth.

Moreover, this triangle may be accompanied by financial instability which may affect particularly the poor. According to Kpodar (2006), there is no explicit definition of financial instability. But, nevertheless we can witness two ways of financial instability, as it is suggested by the same economist: the first view deals with a system of financial instability crisis. Whereas the second deals with a succession of more or less regular periods of expansions and contractions of credit, or more generally of irregular levels of financial development. Besides, a crisis is often considered as an extreme situation of financial instability. In this paper, we are only interested in the last situation.

Baldacci, De Mello and Inchauste (2002) studied a sample of industrialized and developed countries during the period of 1960 up to 1998, taking into consideration 65 crises. They confirm that the main channels through which crisis affect poverty were the same for both groups of countries. They have concluded that the financial crisis was followed by strong variations of several macroeconomic variables. Indeed, an increase of the inflation was followed by an income progress held by the groups with intermediate income and a fall of the richest quintile. When the GDP per capita, increases, this explains why a monetary depreciation is sometimes expansionist, especially if the economy is in a recession situation. A crisis causing a decrease in the average national income, leads to the deterioration of income equalities. Hence, they have concluded that, the financial crisis deteriorates the situation of poor people and accentuates the inequalities of incomes.

According to Guillaumont and Kpodar (2005), in their article "*Financial Development, Financial Instability and Poverty*", there are several reasons to argue that the poor are more vulnerable to banking crisis than the rich. Indeed, the poor are most affected by the disturbances of the payment system when banks close. However, the gel of deposits is found to be particularly prejudicial to the poor, because they are unable to diversify their assets, and to invest their savings in foreign banks. Moreover, when a bank is in difficulty, the small borrowers are the first to be rationed, since their loans are less profitable to the bank. This appears to be as a direct effect of financial instability on the poor. These same authors also underline as, since the rate of investment depends on the availability of financing, then financial instability induces to the instability of this one, and consequently to the growth rate. Otherwise, this instability will lead to a volatility of the relative prices, besides the prices are not influenced by the variation of the credit in the same proportions. Noticing these two instabilities, namely the investment rate and the real exchange rate, this induces to the volatility of the growth. This appears such as an indirect effect on financial instability of the growth.

The cyclic nature of the economic growth leaves the poor more vulnerable than the rich, because of an

asymmetry between the periods of fall and rise of the global income. Indeed, the unskilled workers are often poor and are the first to be dismissed, and unemployed. Guillaumont and Kpodar (2005) present this phenomenon as "the hysteresis effect ", by which the unemployed are the last to be hired. This same effect is presented by Salama (2009), showing that in the presence of crisis, the poor are most affected, because they often have low incomes. This hysteresis effect is explained by rising inequality during the crisis.

In addition, these last years, we perceive the emergence of the thesis called "the growth pro poor ", or, "the growth favorable to the poor". This concept acquires an essential place in the history of the economic thinking, generating many discussions. According to their article entitled, "*On Various Ways of Measuring Pro-Poor Growth*", Deutsch and Silber (2011) (Note4), advance the idea of the existence of two groups of authors. On one hand, a first group which supports that the growth is pro poor, when the income of the poor increases. On the other hand, a second group which emphasizes that the economic growth is described as pro poor, only if the increase in the income of the poor is proportionally higher than the average increase of the income of the society.

2.2 A Review of the Empirical Literature

Empirically, there are many works which try to enhance the importance of the relationship between economic growth, inequality and poverty during period of crisis. Through their study entitled, "*Growth is good for the poor*", Dollar and Kraay (2000) estimate the relationship between the income of the poorest quintile of the population and gross domestic product per capita, and a number of control variables during periods of economic crisis. Their study covers a sample of 80 countries, and a period spreading out on fourth decades. Indeed, they cut their study samples into two periods: a pre period crisis and a post period crisis. According to their results, they conclude that, as the poor, those classified as non-poor are also affected by the economic crisis, and eventually, they believe the crisis is not affecting the people the same way.

In a study carried out in seven countries (Argentina, Chile, Bolivia, Costa Rica, Mexico, Panama and Dominican Republic), Hicks and Wodon (2001) have concluded that during the phases of expansion, the elasticity of the social expenditures reported to the GDP is higher than the unit, whereas on the contrary during recession phases, elasticity is lower than the unit. This means, that when the growth of the GDP per capita drops by a point, the expenditure assigned to the poor lowers by two points. They conclude that this reduction is due to the reduction of the GDP per capita by half and from the increase of the number of the poor caused by the crisis. Consequently, they affirm that the populations with low incomes are most affected. This is also confirmed, by the studies of Salama and Valier (1992, 1997), and Salama (2004, 2008).

Guillaumont and Kpodar (2005), use a model with an indicator of poverty presented by the average of the income per capita of the 20% poorest people and the share of the population earning less than one dollar per day. The variables are: the level of the GDP per capita; the level of financial development. Moreover the level of financial instability can be measured by; residues of the average absolute value which can be have obtained by the regression of the variable on its delayed value. Thus, there are many control variables: the inflation rate, the primary education, the public consumption, the trade openness, the infrastructures, the Gini index of the lands distribution and the climatic shocks. Their sample is composed of 65 developing countries, with data covering the period of 1980 to 2000. They conclude that, the positive direct effect of the financial development on the living level of the poor is not rejected. And that the financial instability largely reduces the income of the poor. They also affirm that, the financial development is more favorable for a poor person, than for one with an average income; whereas the negative effect of financial instability has more impact on the poorest, than the rest of population. They also conclude that the instability of the growth agricultural added value seems to be harmful to the income of the 20% poorest people. The infrastructure indicator represented by the strong road density is associated positively with the average income of the same 20%. And the rate of primary schooling is in negative correlation with the poverty index.

According to Turunç (2009), by combining the factor of growth and the factor of inequality, he notes that an increase in the economic growth and the share of the income held by the poor, guided under the concept of pro poor growth, will generate necessarily a poverty reduction which is higher than the income of the poor even though there is a slow increase for the rest.

Takeda (2009) uses regional data about Russia for the period 1995-2002. He considers the relationship between poverty and economic growth before and after the crisis period. The analysis reveals that the elasticity of poverty to growth drops considerably after the crisis at both national and regional level. Indeed, there is an increasing inequality between the richest and the poorest areas. Hence Takeda (2009) suggests creating pro-poor policies to minimize poverty.

3. Descriptive Analysis and Econometric Estimation: Methodology

3.1 Econometric Estimation

3.1.1 Model Specification, Sample and Data Sources

In order to analyze the relationship between economic growth, inequality and poverty reduction, during a period of crisis, we will use a MENA sample countries (Algeria, Egypt, Iran, Jordan, Morocco, Syria, Tunisia, and Yemen). The data are from the World Development Indicators (2010) and the database POVCALNET. Our analysis extends from 1990 to 2009, through the method of panel data, using the model below. Indeed, the latter refers to the model of (Takeda, 2009; Guillaumont and Kpodar, 2005; Baldacci, De Mello and Inchauste, 2002). The method of panel data allows us to use the transverse dimension of the sample and the temporal one.

3.1.2 Presentation of the Model

$$Ln(P_{it})=\beta_0+\beta_1 Ln(gdpcg_{it})+\beta_2 Ln(gini_{it})+\beta_3 crise+\beta_4 Ln(inf_{it})+\beta_5 Ln(open_{it})+\beta_6\, Ln\,(popru_{it})+\beta_7\, Ln\,(tel_{it})+\beta_8 Ln\,(pubed_{it})+\varepsilon_{it} \quad (1)$$

Where P_{it} is the matrix of the indicators of poverty presented by: the headcount poverty and the poverty gap; $gdpcg_{it}$ is the annual growth rate of the GDP per capita; $gini_{it}$ is the indicator of the inequality; the variable *crisis* takes the value 0 (absence of a crisis) and the value 1 (presence of a crisis); inf_{it} is the rate of inflation; $open_{it}$ is the rate of trade openness; $popru_{it}$ is the ratio of the rural population; tel_{it} is the indicator of infrastructure; $pubed_{it}$ represents the public expenditure on education; ε : error term; i : country and t : time. In our model, the variables of interest are constituted by: the rate of annual growth of the GDP per capita, the indicator of the inequality and the indicator of crisis.

3.1.3 Description of the Variables

-Dependent variable or endogenous

*Poverty Indicators

The headcount poverty: is the percentage of the population living below the international poverty line of one dollar a day. $Ln\ h_{it}$: denotes the logarithm of headcount poverty in the country i at the time t.

The poverty gap: is the average distance from the income of the poor people when compared to the poverty line. $Ln\ pg_{it}$: denotes the logarithm of poverty gap in the country i at the time t.

- Independent or exogenous variables

*Indicator of Economic Growth

The growth rate of GDP per capita: to measure the impact of the rate of variation of the GDP annually on poverty. $Ln\ gdpcg_{it:}$ denotes the logarithm of the growth rate of GDP per capita in the country i at the time t.

*Indicator of inequality

The Gini index: to measure inequality of income distribution. $Ln\ gini_{it:}$ denotes the logarithm of the Gini index in the country i at the time t.

*Indicator crisis: This takes the value 0 or 1. We took into account the following crisis: the Gulf War (1990-1991), the crisis of the European Monetary System (SME (1992-1993)), the Mexican economic crisis: Tequila crisis (1994), the Asian economic crisis (1997), the Russian crisis (1998), the Brazilian crisis (1998-1999), the stock market crash of 2001-2002, the Turkish crisis of (2000), the attacks of September 11 (2001), the economic crisis of Argentina (2001), the second Brazilian crisis (2002), the financial crisis: the subprime crisis (2007-2009) and the Greek crisis (2009). Here, we consider only the periods of crisis, which mean when the crisis is equal to 1.

- Variables of control

The rate of inflation: measured by the consumer price index, it captures the impact of macroeconomic stability on poverty. $Ln\ inf_{it:}$ denotes the logarithm of the rate of inflation in the country i at the time t.

The rate of trade openness: measured by the ratio of the sum of exports and imports of goods and services in the GDP. This rate reflects the impact of globalization on poor. $Ln\ open_{it:}$ denotes the logarithm of the rate of trade openness in the country i at the time t.

The rural population (% of total population). $Ln\ popru_{it:}$ denotes the logarithm of the rural population in the country i at the time t.

The number of telephone line (by 100 capita). $Ln\ tel_{it:}$ denotes the logarithm of the number of telephone lines in

the country i at the time t.

The public expenditure in education (% of the GDP): includes the public expenditure relating to the educational establishments (public and private). *Ln pubed*$_{it}$*:* denotes the logarithm of the public expenditure in education in the country i at the time t.

3.2 Results and Discussions

Figure 1 and Figure 3 illustrate perfectly, the relationship between the indicators of poverty (the headcount poverty and poverty gap) and the growth rate of the GDP per capita, whereas, Figure 2 and 4 illustrate perfectly, the relation between the indicators of poverty and the index of Gini. These graphics are executed by STATA.

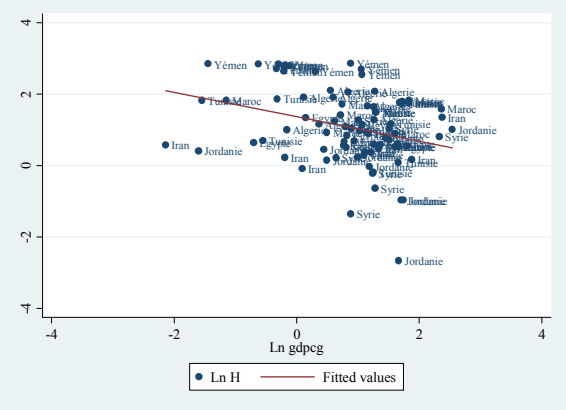

Figure 1. The headcount poverty and the growth rate of GDP

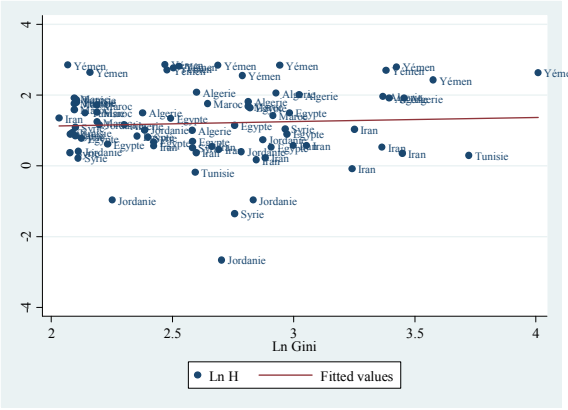

Figure 2. The headcount poverty and the index of Gini

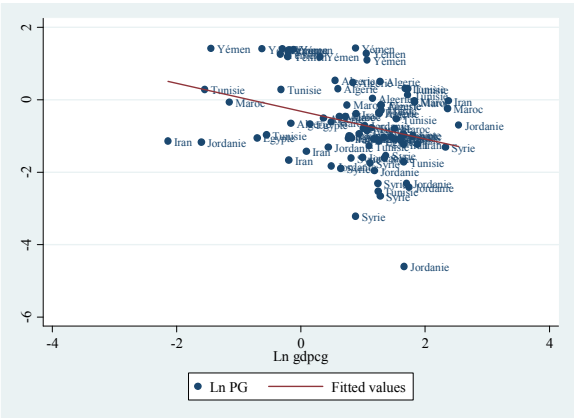

Figure 3. The poverty gap and the growth rate of GDP

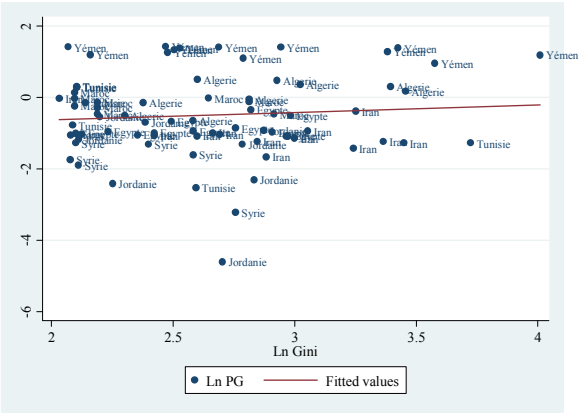

Figure 4. The poverty gap and the index of Gini

Both Figure 1 and 3 prove that the annual growth rate of the GDP per capita disadvantages the headcount poverty, as well as the poverty gap, as it is shown in the downward slope which crosses the group of points. As far as these two graphs, are concerned we can note the existence of negative effects on the growth rate of the GDP per capita on the indicators of poverty. Figure 2 and 4 illustrate perfectly, the relation between the indicators of poverty and the index of Gini. We can note that the index of Gini favors the two indicators of poverty, with a little ascending slope which crosses the group of points. A positive effect of the index of Gini on the indicators of poverty can be established.

The regression results for different indicators of poverty, for our entire sample of MENA countries over the period 1990-2009 are represented in the summary table 1, and table 2.

Table 1. The headcount poverty

Exogenous Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lngdpcg	-0,056***	-0,046***	-0,058***	-0,134***	-0,064***	-0,071***	-0,129***
	(0.088)	(0.089)	(0.091)	(0.073)	(0.076)	(0.088)	(0.068)
Lngini	0,176***	0,165***	0,178***	0,176***	0,163***	0,153***	0,204***
	(0.050)	(0.051)	(0.052)	(0.040)	(0.043)	(0.063)	(0.052)
Lninf		-0,133	_	_	_	_	-0,207**
		(0.119)					(0.092)
Lnopen			0,0013	_	_	_	0,0158*
			(0.010)				(0.008)
Lnpopru				0,128***	_	_	0,135***
				(0.025)			(0.039)
Lntel					-0,058***	_	-0,004
					(0.013)		(0.019)
Lnpubed						0,184**	0,215***
						(0.084)	(0.070)
Cst	-0.786**	-0.268**	-0.340*	-0.751***	-0.677**	-0.15**	-0.303***
	(0.464)	(0.513)	(0.755)	(0.608)	(0.312)	(0.866)	(0.540)
Obs	57	55	57	57	57	53	51
N	8	8	8	8	8	8	8

Notes: The endogenous variable is the headcount poverty. *, **, *** indicate statistical significance respectively at 10%, 5% and 1%.

Table 2. The poverty gap

Exogenous Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lngdpcg	-0,051***	-0,041***	-0,065***	-0,134***	-0,059***	-0,066***	-0,173***
	(0.099)	(0.100)	(0.101)	(0.083)	(0.090)	(0.102)	(0.075)
Lngini	0,170***	0,159***	0,180***	0,170***	0,158***	0,147***	0,239***
	(0.055)	(0.057)	(0.057)	(0.046)	(0.050)	(0.073)	(0.056)
Lninf		-0,134	_	_	_	_	-0,243***
		(0.133)					(0.100)
Lnopen			0,008	_	_	_	0,904***
			(0.012)				(0.574)
Lnpopru				0,137***	_	_	0,207***
				(0.029)			(0.043)
Lntel					-0,053***	_	0,0264
					(0.016)		(0.021)
Lnpubed						0,1909*	0,223***
						(0.097)	(0.076)
Cst	-0.394***	-0.882***	-0.901***	-0.563***	-0.2***	-0.674***	-0.814***
	(0.584)	(0.642)	(0.897)	(0.760)	(0.527)	(0.109)	(0.942)
Obs	56	54	56	56	56	52	50
N	8	8	8	8	8	8	8

Notes: the endogenous variable is the poverty gap. *, **, *** indicate statistical significance respectively at 10%, 5% and 1%.

The statistics of the Hausman test for both poverty indicators appear with a probability Prob < 5 % (Prob=0,027 and Prob=0,005 respectively for the headcount poverty and the poverty gap, by taking into account only periods of crisis. Thus we keep the fixed effect model for all the cases.

The principal objective of the study is the investigation of a number of variables of interest (the growth rate of the GDP per capita, the indicator of inequality and the indicator of crisis), when mixed with a number of variables of control, they cause an effect on poverty. This latter is explained by two indicators: the headcount poverty and the poverty gap.

The results of our estimation show that: according to all the columns of table 1, and table 2; the coefficient of the

growth rate of the GDP per capita is negative and statistically significant with the level of 1%. At this step we notice: an increase of 1% of the growth rate of the GDP per capita; towards the sample of countries of MENA; will cause a negative effect on the headcount poverty and the poverty gap (according to the column (7)), respectively of 12,9% and 17,3%. And consequently, this effect is translated by a reduction in poverty for both used indicators.

This is in conformity with the results obtained by (Delande, 2008), which noted empirically that, the economic growth allows improving the living standard of the poor and more precisely the acceleration of the poverty reduction. Indeed, this result supports the hypothesis according to which, the economic growth decreases the poverty and comes in fact aligned with the majority of the empirical studies, which confirm the negative sign of the rate growth of the GDP per capita.

Our results as mentioned in the columns (1), (2), (3), (4), (5), (6) and (7) of table 1, and table 2, leads to the coefficient of the index of Gini which is positive and statistically significant with a 1% level. Also we can detect: an increase in the coefficient of the index of Gini, towards the countries of our sample; from 1% will lead to an evolution of the headcount poverty and the poverty gap (according to the column (7)) respectively of 20, 4% and 23, 9%.

What is also established by Figure 2 and 4.

This result is in conformity with studies of (Meng, Gregory and Wang, 2005; and Bamba, 2001), which affirms the positive relation between the poverty and the level of inequality of the income; by advancing the idea that a high inequality could affect poverty negatively. And support consequently the second idea exposing the economic growth as a necessary condition but not a sufficient one.

By introducing the variable (Ln inf) which captures the impact of macroeconomic stability on poverty; there is a coefficient which is associated with a negative sign and is statistically significant to the level of 5% for the headcount poverty, and is also, statistically significant to the level of 1% for the poverty gap (column (7) for summary table 1 and 2). This can be explained by: an increase in inflation of 1% will cause deterioration in the headcount poverty and the poverty gap, respectively 20.7% and 24.3%. Moreover, the high inflation blocks the economic convergence of the countries.

In the economic literature, the inflation appears such as a factor which deteriorates the situation of the poor, since it has a negative impact on the real value of the holdings and the purchasing power.

This results with the work of economists (Levine and Renelt (1992), Fisher (1993)) which shows a negative relationship between the inflation and the poverty. However, the high inflation can deteriorate the financial intermediation, which causes the assignment of the value of monetary assets and this leads to the decisions on policies that distort the financial structure. Also, it can generate a distortion in the choice of productive investments, the disadvantage of long-term investments. Also, Dollar and Kraay (2002), affirm the same idea, showing that the rate of inflation acts negatively on the income of the 20% poorest people. Similarly, Baldacci, De Mello and Inchauste (2002) support the idea that there is a negative impact on poverty inflation rate.

By introducing the variable (Ln open), reflecting the rate of trade openness, in order to reflect the impact of the globalization on the poverty. According to the column (7), we notice that the coefficient allotted to this variable is positive and statistically significant. An increase of 1% of the rate of trade openness will result an increase in the headcount poverty and the poverty gap.

By introducing the variable (Ln popru) translating the ratio of the rural population (column (4)), we notices that we have a positive coefficient and statistically significant with the level of 1%. Indeed, the increase of 1% of the ratio of the rural population will generate an increase in the headcount poverty and the poverty gap respectively of 13, 5% and 20, 7%. In addition this result can be explained as follows:

This increase is due to the lack of the occasions of work and the lack of access to the teaching and the level of health in the rural zones.

This level our results are in conformity with those found by Lahimer (2008) which affirms that poverty is denser in the rural zones, and that in these zones the poverty proves more worrying by it's the severity and it's the gap.

By introducing the indicator of infrastructure represented by the number of the line telephone by 100 habitants (column (5) of the table 1 and 2), there is a coefficient which is associated with a negative sign and statistically significant to the level of 1%. This level we can advance:

This indicator makes it possible to act principally on the quality of life of the poor. Indeed, the infrastructures play a significant role in the process of development. It allows the contribution to connect the operators to the

markets, to reduce the costs of the factors and to improve competitiveness of the economy, and also to offer services essential to the populations (such as: the access to the roads, with water) which determine the quality of the life. In addition, the indicator of infrastructure contributes at the same time to the growth and the improvement of the standard of living of the population.

This result is advanced by Guillaumont and Kpodar (2005), showing a high road density is positively associated with the poverty indicator.

By introducing the variable (Ln puped) representative of the public expenditure on education (% of GDP), there is a positive coefficient and statistically significant at level of 1% for the headcount poverty and the poverty gap. For the expenditure on education, our estimates indicate a negative relation for the headcount poverty and the poverty gap. Indeed, an increase in a point of the percentage of the expenditure in education reduces the headcount poverty of 21, 5% and the poverty gap of 22, 3% (column (7) of the table 1 and 2).

This result is in conformity with the studies of (Baldacci, De Mello and Inchauste, 2002).

Thus, the increase in the public expenditure involves the reduction in poverty. Indeed, the MENA countries present a high proportion of the public expenditure in education relative to the total expenditures of the state, which allows the reduction of poverty because the education in these countries constitutes a growth economic potential factor. Moreover, in these countries, the governments are making large efforts to expand access to education for all children. However, the number of students which finishes the cycle of primary education teaching is in rise. Consequently, the public expenditure devoted to education is in rise, which generates a reduction in poverty in these economies.

Finally, by establishing a mixing between the various variables, we notice that the results of the total estimate of the model (column (7) of the table 1 and 2) confirm the results found above.

4. Conclusion

The poverty represents a crucial phenomenon, affecting the stability of the developing countries. And prove among the objectives of the millennium for the development. Our study shows, that in order to eradicate the phenomenon of poverty, it is necessary to examine the role of the economic growth. But, it appears as a condition necessary, but insufficient. Indeed, the presence of the inequalities affects the reduction of poverty negatively.

In this article, and in order to study the interrelationship between the economic growth, the inequality and the poverty in selected MENA countries, for the periods of crisis presented such as an indicator of financial instability, we tried, in the empirical part, with an estimate by the panel. Our period of study extends from 1990 to 2009. Indeed, for the two indicators of poverty we drew the principal conclusions:

✓ The economic growth remains necessary, but not sufficient in the reduction of the poverty.

✓ The inequality indicator allows a deteriorating situation of the poor, and we must act on this indicator, in order to reduce poverty. And an aggravation of the inequality compensates for the positive effect of the economic growth, which can appear, such as a major obstacle to growth.

✓ For our variables of controls: the trade openness, the indicator of infrastructure, influence poverty positively, whereas, demographic growth, and the expenditure in education influences negatively the various indicators of poverty. But, for the inflation and the rate of exchange their impact remains ambiguous.

Indeed, in order to fight against the poverty, the governments must concentrate with a growth poor pro, otherwise, a growth which centered on equity, the good governance, and with the improvement of the essential needs. Also, our study can be expanded to the level of the variables, with the primary education rate of schooling shown like indicator of human capital, and the ratio of the public expenditure to GDP.

References

Africa Region. (2009). Enhancing Growth and Reducing Poverty in a Volatile World. Retrieved from http://siteresources.worldbank.org/INTAFRICA/Resources/AAPProgress_Report_20100601.pdf

Assiga, E. M. (2010). Croissance économique et réduction de la pauvreté au Cameroun. Economie des entreprises publiques au Cameroun. Presse Universitaires d'Afrique, Harmattan.

Baldacci, E., De Mello, L., & Inchauste, G. (2000). Crises financières, pauvreté et répartition du revenu. Finances & Développement.

Balisacan, A., Piza, S., Mapa, D., Santos, C., & Odra, D. (2010). The Philippine Economy and Poverty During the Global Economic Crisis. UP School of Economics. *Discussion Paper,* No, 2010-08.

Berenger, V. (2008). Analyse de l'impact de la croissance sur la pauvreté et identification des stratégies de croissance bénéfique aux pauvres («pro-poor growth strategies»). Etude des cas pour six pays partenaires méditerranéens: Egypte, Israël, Liban, Maroc, Tunisie et Turquie. Rapport final du projet de recherche FEM 31-06R. Retrieved from http://www.femise.org/PDF/ci2006/FEM31-06R.pdf

Besbes, L., & Boujelbene, Y. (2010). Croissance économique, inégalité et pauvreté: Cas des pays de l'UMA. *6 ème colloque international «Stratégies de développement: Quel chemin parcouru? Quelles réponses face aux nouvelles contraintes économiques et climatiques?»*.

Bibi, S. (2005). When is Economic Growth Pro-Poor? Evidence from Tunisia. CIRPÉE Centre interuniversitaire sur le risque, les politiques économiques et l'emploi. Retrieved from https://depot.erudit.org/bitstream/002051dd/1/CIRPEE05-22.pdf

Boccanfuso, D., & Ménard, C. (2009). La croissance pro-pauvre: un aperçu exhaustif de la «boîte à outils». Cahier de recherché. *Working Paper* 09-06. Groupe de Recherche en Économie et Développement International GREDI. Retrieved from http://pages.usherbrooke.ca/gredi/wpapers/GREDI-0906.pdf

Boccanfuso, D., & Tambi, S. (2003). Croissance, Inégalité et Pauvreté dans les Années 1990 au Burkina Faso et au Sénégal. Retrieved from http://www.aed.auf.org/IMG/pdf/D._Boccanfuso.pdf

Boccanfuso, D., Bosco, J., & Ménard, C. (2009). Pro-Poor Growth Measurements in a Multidimensional Model: A Comparative Approach. Groupe de Recherche en Économie et Développement International; Cahier de recherché. *Working Paper,* 09-22. Retrieved from http://pages.usherbrooke.ca/gredi/wpapers/GREDI-0922.pdf

Bourguignon, F. (2004). The Poverty-Growth-Inequality Triangle. The World Bank. Retrieved from http://siteresources.worldbank.org/INTPGI/Resources/342674120611890151/15185_ICRIER_paper-final.pdf

Breisinger, C., Collion, M., Diao, X., & Rondot, P. (2010). Impacts of the Triple Global Crisis on Growth and Poverty in Yemen. International food policy research institute, *IFPRI Discussion Paper,* 00955. Retrieved from http://www.shebacss.com/docs/ifpridp00955.pdf

Cabral, F. (2009). La Stratégie de croissance accélérée du Sénégal est-elle pro pauvre. Cahier de recherché. *Working Paper*, 09-05, Groupe de Recherche en Économie et Développement International GREDI. Retrieved from http://pages.usherbrooke.ca/gredi/wpapers/GREDI-0905.pdf

Cardozo, A., & Grosse, M. (2009). Pro-Poor Growth Using Non-Income Indicators: An Empirical Illustration for Colombia. *Discussion Papers*, Nr. 192. Retrieved from https://www.econstor.eu/dspace/bitstream/10419/57318/1/608918733.pdf

Cling, J. P., Vreyer, P., Razafindrakoto, M., & Roubaud, F. (2003). La croissance ne suffit pas pour réduire la pauvreté: le rôle des inégalités. *Développement et insertion international*. Retrieved from http://www.persee.fr/web/revues/home/prescript/article/rfeco_07690479_2004_num_18_3_1531

Daymon, C. (2008). L'apport des données PPA 2005 à la décomposition dynamique de la pauvreté dans les pays Méditerranéens. DEFI - Université de la Méditerranée. Retrieved from http://gdri.dreem.free.fr/wp-content/c14-daymon_final.pdf

Destremau, B., & Salama, P. (2001). La pauvreté prises dans les turbulences macro-économiques en Amérique Latine. Cahier de recherché. *Working Paper*, 05-22. Retrieved from http://matisse.univ-paris1.fr/doc2/ID0118.PDF

Deutsch, J., & Silber, J. (2011). On Various Ways of Measuring Pro-Poor Growth. Discussion Paper, No. 2011-13. *Economics.* http://dx.doi.org/10.5018/economics-ejournal.ja.2011-13

Dollar, D., & Kraay, A. (2002). Growth Is Good for the Poor. *Journal of Economic Growth*. Development Research Group. The World Bank. Retrieved from http://ideas.repec.org/p/wbk/wbrwps/2587.html

Elkhider, A., Bouhadi, A., & Kchirid, M. (2009). La croissance économique est-t-elle pro pauvre au Maroc? Une tentative d'explication par l'approche monétaire et l'approche non monétaire. *Working Paper,* 481. Retrieved from http://www.erf.org.eg/CMS/uploads/pdf/1239106187_481.pdf

El-laithy, H., Lokshin, M., & Banerji, A. (2003). Poverty and Economic Growth in Egypt, 1995-2000. Policy *Research Working Paper,* 3068. The World Bank. Retrieved from http://library1.nida.ac.th/worldbankf/fulltext/wps03068.pdf

Essama-Nssah, B. (2004). A Unified Framework for Pro-Poor Growth Analysis. Poverty Reduction Group The

World Bank Washington, D.C., World Bank Policy Research *Working Paper,* 3397. Retrieved from http://elibrary.worldbank.org/content/workingpaper/10.1596/1813-9450-3397

Fanelli, J. (2008). L'instabilité financière et les enseignements à tirer des pas émergents. Centre de recherches pour le développement international (CRDI).

Ferreira, F. (2010). Distributions in motion: Economic growth, inequality, and poverty dynamics. Working Paper Series, Society for the study of economic inequality, ECINEQ *WP* 2010 – 183. Retrieved from http://www.ecineq.org/milano/WP/ECINEQ2010-183.pdf

Ferreira, F., Leite, P., & Ravallion, M. (2009). Poverty reduction without economic growth? Explaining Brazil's poverty dynamics, 1985–2004. *Journal of Development Economics*. Retrieved from http://siteresources.worldbank.org/DEC/Resources/84797-1114437274304/FLR_JDE.pdf

Grant, U. (2005). Pro-Poor Growth and the Poorest. Background Paper for the Chronic Poverty Report 2008-09, Chronic Poverty, Research center. Retrieved from http://www.chronicpoverty.org/uploads/publication_files/CPR2_Background_Papers_Grant_05_2.pdf

Guillaumont, J., & Kpodar, K. (2004). Développement financier, Instabilité financière et Réduction de la pauvreté. Document de travail de la série Etudes et Documents. E 2004. 29.

Guillaumont, J., & Kpodar, K. (2004). Développement financier, instabilité financière, croissance et pauvreté. Document de travail de la série Etudes et Documents, E 2004. 11. Retrieved from http://www.cerdi.org/uploads/ed/2004/2004.11.pdf

Guillaumont, J., & Kpodar, K. (2005). Financial Development, Financial Instability and Poverty. CSAE *WPS/2005-09*. Retrieved from http://www.csae.ox.ac.uk/workingpapers/pdfs/2005-09text.pdf

Kakwani, N., Khandker, S., & Son, H. (2004). Pro-Poor Growth: Concepts and measurement with country case studies. United Nations Development Programme International Poverty Centre, *Working Paper*, number 1. Retrieved from http://www.ipc-undp.org/pub/IPCWorkingPaper1.pdf

Khemiri, I. (2006). Pauvreté, Inégalité et Croissance Economique: Etude sur des données de Panel des pays en développement.

Lachaud, J. P. (1995). Croissance économique, pauvreté et inégalité des revenus en Afrique subsaharienne : analyse comparative. Document de travail *No. 11*. Groupe d'Economie du Développement Université Montesquieu Bordeaux IV.

Lustig, N., Arias, O., & Rigolini, J. (2002). Poverty Reduction and Economic Growth: A Two-Way Causality. Inter-American Development Bank Washington, D. C. Sustainable Development Department Technical Papers Series. Retrieved from http://www.clas.berkeley.edu/Events/fall2003/12-04-03-lustig/GrowthIneqDualCaus.pdf

Maburuki, R. (2009). L'impact de la crise financière et économique sur les économies africaines, le cas du Sénégal, La réponse du PNUD. PNUD Dakar. SENEGAL.

Marotta, D., Yemtsov, R., El-Laithy, H., Abou-Ali, H., & Al-Shawarby, S. (2011). Was Growth in Egypt Between 2005 and 2008 Pro-Poor: From Static to Dynamic Poverty Profile. The World Bank. Middle East and North Africa Region, Poverty Reduction and Economic Management.

McCawley, P. (2009). Mass Poverty in Asia: The Impact of the Global Financial Crisis. Policy Brief. Lowy Institute for International Policy.

Mchiri, H., & Moudden, F. (2011). Développement Financier, Croissance économique et Réduction des Inégalités dans les pays Emergents: Analyse empirique en données de panel. Retrieved from http://alain.alcouffe.free.fr/fullpapers/e3moudden.pdf

Mokaddem, L., Boulila, G., & Haddar, M. (2011). Croissance pro-pauvres dans des pays du Moyen-orient et de l'Afrique du Nord, 1990- 2004. *Revue d'économie du développement 2011/1, 25*.

Montalvo, J., & Ravallion, M. (2010). The pattern of growth and poverty reduction in China. *Journal of Comparative Economics, 38,* 2-16. Retrieved from http://www.econ.upf.edu/~montalvo/wp/pattern%20poverty%20china%20jce.pdf

Odhiambo, N. (2009). Finance-growth-poverty nexus in South Africa: A dynamic causality linkage. *The Journal of Socio-Economics, 38,* 320-325.

Ravallion, M., & Chen, S. (2003). Measuring pro-poor growth. *Economics Letters, 78,* 93-99. Retrieved from

http://dad.ecn.ulaval.ca/features/files/Rav_Chen_2003.pdf

Saad-Filho, A. (2010). Growth, Poverty and Inequality: From Washington Consensus to Inclusive Growth. *DESA Working Paper No.100*. ST/ESA/2010/DWP/100. United Nations Department of Economic and Social Affairs. Retrieved from http://www.un.org/esa/desa/papers/2010/wp100_2010.pdf

Salama, P. (2009). Avec cette crise, les pauvres sont-ils devenus moins vulnérables au Brésil? Retrieved from http://pierre.salama.pagespersoorange.fr/art/avec_cette_crise_les_pauvres_sont_ils_deveus_moins_vulnerables_au_bresil@fr.pdf

Takeda, Y. (2009). Economic Growth and its Effect on Poverty Reduction in Russia. Research Unit for Statistical and Empirical Analysis in Social Sciences (Hi-Stat), Institute of Economic Research Hitotsubashi University, Global COE Hi-Stat. *Discussion Paper Series*. Retrieved from http://gcoe.ier.hit-u.ac.jp/research/discussion/2008/pdf/gd09-075.pdf

Turunç, G. (2009). Croissance pauvreté et inégalités en Turquie. Communication au colloque international *«Inégalités et développement dans les pays méditerranéens»*. Université de Galataray – İstanbul – Turquie.

Vargas-Silva, C., Jha, S., & Sugiyarto, G. (2009). Remittances in Asia: Implications for the Fight against Poverty and the Pursuit of Economic Growth. *ADB Economics Working Paper Series*, No.182, Asian Development Bank. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1618025

Youssoufou, H. (2010). La dynamique de la croissance est-elle pro-pauvres au Niger? Document de travail DT/164/2010 Groupe d'Economie du Développement – GED LARE-Efi – Université Montesquieu-bordeaux IV – France.

Zhuang, J., Gunatilake, H., Niimi, Y., Khan, M., Jiang, Y., Hasan, R., . . . Huang, B. (2009). Financial Sector Development, Economic Growth, and Poverty Reduction: A Literature Review. *ADB Economics Working Paper Series,* No. 173. Asian Development Bank. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1617022

Notes

Note 1. An appellation of Bourguignon (2004).

Note 2. Lustig, N., Arias, O., & Rigolini, J. (2002). Poverty Reduction and Economic Growth: A Two-Way Causality. Inter-American Development Bank Washington, D. C. Sustainable Development Department Technical Papers Series.

Note 3. Mchiri, H., & Moudden, F. (2011). Développement Financier, Croissance économique et Réduction des Inégalités dans les pays Emergents: Analyse empirique en données de panel.

Note 4. Deutsch, J., & Silber, J. (2011). On Various Ways of Measuring Pro-Poor Growth. Discussion Paper No. 2011-13. Economics, The Open Access, Open- Assessment E-journal.

Appendix

Appendix 1. Definitions of variables

Variables	Descriptions
H	The headcount poverty
Pg	The poverty gap
Gdpcg	The annual growth rate of the GDP per capita
Gini	The Gini index
Inf	The rate of inflation
Open	The rate of trade openness
Popru	The ratio of the rural population
Tel	The number of telephone line (by 100 capita)
Pubed	The public expenditure on education (of the % GDP)

Appendix 2. Samples of Countries

Countries: Algeria, Egypt, Iran, Jordan, Morocco, Syria, Tunisia, Yemen

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Trade Creation and Trade Diversion between Tunisia and EU: Analysis by Gravity Model

Ahmed Zidi[1] & Saïd Miloud Dhifallah[2]

[1] Research Unit Enterprise, Economy and Environment, Higher Institute of Management of Gabes, Tunisia

[2] Faculty of Economics and Management of Sfax, Higher Institute of Technological Studies Tataouine of Tunisia, Tunisia

Correspondence: Saïd Miloud Dhifallah, Faculty of Economics and Management of Sfax, Higher Institute of Technological Studies Tataouine of Tunisia, Tunisia. E-mail: SaidMiloud.Dhifallah@isggb.rnu.tn

Received: February 2, 2013 Accepted: April 4, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p131 URL: http://dx.doi.org/10.5539/ijef.v5n5p131

Abstract

Since the middle of nineties, there has been a great rise of free trade agreements (FTAs) between the North and South countries. Indeed, the objective of this article is to know if FTASbetween an ndustrialized region as Europe and a small country as Tunisia are capable of increasing exchanges among them and then improving the trade of the weakest country. Our aim is to know if agreements between industrial countries and developed countries are able to increase trade between them and therefore improve the trade of the less developed country. To answer to this question we evaluate the two effects of regional integration: trade creation and diversion trade. We obtain two main results: the first result is after five years of the agreement between Tunisia and Europe, there is no trade creation. The second result shows that the preferential agreement between the two partners does not generate trade diversion of imports. However, there is a trade diversion of exports.

Keywords: creation and diversion of trade, regional agreements, gravity model, panel data, fixed effects models, random effects models

1. Introduction

The proliferation of regional agreements like North / South in which the industrialized countries and the developing countries (DCs) are equal business partners is one of the traits that most marked the international system over the past fifteen years. This development has highlighted the need to undertake a new analysis of regional integration (RI) for two reasons. First, because developing countries today are turning to these agreements to promote their development and it is therefore useful to evaluate the effectiveness of these agreements. Secondly, because regionalism is part of the global economic environment and its impact on developing countries must be better understood.

The case of the Euro-Mediterranean Agreement between the European Union (EU) and the countries of South-Eastern Mediterranean (SEM) is an example of this type of agreement. Within the framework of the Barcelona Conference in November 1995, twelve Mediterranean countries signed a free trade agreement (FTA) with Europe. Tunisia started the process in 1995 by signing an Association Agreement which has been ratified by both parties in 1998. Other countries followed suit, including Morocco in 1996, Jordan, Egypt, in 1998, Lebanon in 2000 and Algeria in 2002. Syria is, now, dealing with the EU and recently, Libya seems,also,to be fascinated by these initiatives. The Middle East and North Africa MENA region is particularly subject to multiple tensions and economic difficulties. These countries are characterized by high population growth and high unemployment that exceeds 14%, which mainly affects young people and graduates of these countries (World Bank, 2003). This region knows a high dependence on foodand some needs in economic and social infrastructure .It also suffers from a growth rate that stagnates miserably. Their trade is unbalanced and strongly oriented towards the EU while South-South trade is particularly low. These countries are also vulnerable beings evicted from the commercial momentum with their main partner, following the recent enlargement of the EU (May 2004) to new candidate countries mainly Eastern European Countries. In this particularly tense economic climate, the signatures of many MENA regional agreements with the EU can be a way to avoid the disconnection of these countries and an effective instrument to improve their foreign trade, the key to growth and employment.

On the eve of these agreements, it is useful to ask what are the economic consequences of the new Mediterranean policy of the EU within the framework established in Barcelona in 1995 on the SEM.

In this paper, we study the case of the Association Agreement Euro-Tunisian. Tunisia is the first country to sign a FTA with the EU in 1995. The study of the agreement between Tunisia and the EU is of particular interest because it is the first to be implemented in 1996 (Note 1). It is now in its twelfth year of operation. Given the relatively advanced stage of implementation of the agreement with Tunisia, it is interesting to analyze the effects already registered on the Tunisian economy and draw lessons for other Mediterranean countries that took the same initiative. The lessons relate to the effects of the FTA on trade flows in terms of creation and trade diversion.

The literature on regional integration has insisted, according to Viner's works, on creation and trade diversion. There is trade creation when a country reduces or eliminates its tariffs on imports from members of the FTA and its imports from these countries increases. This increase is considered beneficial because it is supposed to improve the welfare of the country. There is trade diversion when the establishment of a free trade zone pushes the country, which usually provides to countries around the world at low costs, to change suppliers for the benefit of less competitive member countries. This diversion will result in additional costs and may reduce the country's national income (Note 2).

The target of this research is to determine which one of these effects will prevail. To meet this goal, we have chosen an econometric specification to measure the magnitude of these two effects, the gravity model, for a number of years from 1986 to 2010 involving 41 countries. The gravity model explains imports between two countries according to their GDP, their GDP per capita, the distance between the centers of economic, historical and cultural variables and finally a set of dummy variables that measure the effects of trade liberalization.

The second section provides a review of previous studies. Then in the third section, we will outline the theoretical framework of this study. In the fourth section, we will present the empirical testing of the theoretical model. Then, in the fifth section, we interpret our results. The final section concludes.

2. Literature Review

First, a free-trade area is defined as an agreement, in which, there are no tariffs on internal trade. However, each country safeguards its external tariff. Thus, Viner J. (1950) studied the impact of FTAs on the well-being of the partner countries. Henceforth, an FTA is not always advantageous since it is a shape of arrangement of free trade and protectionism

We include this type of free trade as an example of second-best policy, since it is certainly not ideal to remove one distortion while preserving others. For this, there is a distinction between the two effects of FTA which are the trade creation and the trade diversion. Indeed, regional trade agreements (RTA) seek to reduce tariff and non-tariff barriers. In this framework, J. Viner (1950) suggests that free trade improves the well-being thanks to a better allocation of resources.

Thus: trade creation, resulting from a reduction of tariff and non-tariff, replaces a more expensive domestic production by cheaper production in partner countries. There is an improvement of the well-being which aims at facilitating prosperity, and, consequently, an increase in consumer's surplus. In contrast, there is a trade diversion, if the production of the partner country replaces less expensive imports from the rest of the world (RW). In this case, the prosperity is fragile. Thus, the regional integration promotes the prosperity only if trade creation outweighs trade diversion.

We will review previous empirical studies. The first study used here is that of Lionel and Peridy (1995) entitled "Uruguay Round and developing countries: the case of North Africa." The objective of this article is to review the impact of GATT on the export performance of North Africa (NA). In fact, they use a gravity model that incorporates the actual structure of exports from the NA such as Tunisia and Morocco and the impact of non-tariff barriers. Henceforth, they showed that the trivialization of preferences benefiting the Maghreb in the European market, will badly affect its exports. In this framework, Tunisia will be more affected than Morocco. This due to the importance of the preferential margin of Tunisia against Morocco. Similarly, most of the losses concern manufacturing and agricultural products that benefiting from lower non-tariff barriers.

Similarly, we adopt the study by the IMF to Morocco (2004) "Impact of the Barcelona Process on trade of Morocco". It shows that there is trade creation between the EU and Morocco. Thus, the Barcelona Process has created trade between the EU and Morocco, and the creation of the scope will likely medium term. Indeed, it seems that the anchoring of the Moroccan economy to the European economy space, helped increase trade between the two parties. Thus, the use of the gravity model proves that there is no diversion of trade between

Morocco and the EU. Also, this study argues that the creation of the Euro-Mediterranean Agreement does not result in an increase in intra-regional trade. Subsequently, the benefits of this integration are limited. Therefore, we have to conclude that the trade liberalization efforts proved by Morocco as part of the FTA with the EU seem relevant and could even be accelerated.

Similarly, we consider the study by Josselin and Nicot (2003) entitled "geo-economic gravity model of trade between the EU countries, the CEECs and TMC." They deal with the issue of EU enlargement to the East and more specifically the integration of the CEECs to the EU. In this framework, they studied "the transformation of the economic and geopolitical environment led the EU to redefine its relations with both the Third Mediterranean Countries (TMC) with the" excluded "from Central European Countries and Eastern Europe (CEECs). Especially the Maghreb countries and Turkey, which have economies more dependent on to Europe and their comparative advantages which are closest to the CEECs, are at risk of foreclosure. "Thus, they analyzed the evolution process of trade between the three blocs (EU, CEE and PTM). Similarly, they do a comparison of models of exchange block countries. Also, they evaluated the impact of the integration of the CEECs to the EU on the structure of trade between the EU and MNCs. In fact, this extension induces a risk of eviction in favor of the CEECs.

The study that contributed most to the construction of our empirical model is that of Akoété AGBODJI Ega (2008). He tried to evaluate the creation and trade diversion in the case of UEMOA (Economic and Monetary Union of West Africa). For this, he tried to analyze the impact of individual economic and monetary union on intra-UEMOA. In this sense, he used a dynamic gravity model. Thus, he showed that membership of the Common Monetary Area and the implementation of economic reforms has had a significant impact in terms of diversion of imports and exports. However, it has been shown that there is no trade creation within the area.

3. Theoretical Analysis

3.1 Theoretical Foundations of Gravity Models

Gravity models have been used for more than forty years in the international trade theory to analyze the effects of preferential agreements on bilateral trade flows. Gravity models have appeared in the literature with the questioning of the traditional foundations of trade. These models originally suffered from a certain lack of theoretical foundations, but authors as Helpman (1987), Anderson (1979) and Bergstrand (1985, 1989) have provided a rigorous theoretical justification and have greatly improved their quality (Baier and Bergstrand, 2001, Balgati, 2001 (Note 3).

In many theoretical derivations (Anderson 1979, Bergstrand 1985, Deardorff, 1995 and recently Baier and Bergstrand, 2001), the gravity model explains the traditional volume of trade between two countries i and j in terms of revenues in countries, their populations and transportation costs. To analyze the association agreements Euro-Tunisian these models we think are interesting for several reasons. First, because the gravity model has the distinction of integrating the weight of the geographical, historical indeed cultural proximity in bilateral trade between the two countries. Then, these models can be adapted to specific characteristics of the Euro-Tunisian trade relations, since they are closer to the theory of international trade and explain trade between industrialized countries and developing countries. Finally, by their nominative contribution, these tools can measure the consequences of a change in business strategy on trade of concerned country

This model is based on the assumption that imports of country i from country j depend on gravity variables such as (GDP, GDP per capita and DIST). The basic specification of the gravity equation includes factors of the importing country (sometimes GDP and GDP per capita), the supply factors of the exporting country (GDP and GDP per capita) and also geographical distance as a proxy for transportation costs. These equations were used to describe many different streams such as like immigration, foreign direct investment, and they are widely used in the context of international trade through their empirical performance. Thus, some economists are skeptical of their theoretical foundations.

The basic gravity equation is generally defined as follows:

$$ln\, M_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lndist_{ij} + U_{ijt} \quad (1)$$

3.2 The Choice of Explanatory Variables

✓ **Gross Domestic Product (GDP):** the more important is the GDP of partner countries is, the more important are the propensities between them. An increase in GDP of importing country causes an expansion of its richness and then a growth in its import requests. Similarly, an increase in GDP of the exporting country leads to increased wealth and competitiveness. Therefore, GDP importing and exporting countries should have a positive impact on bilateral imports.

✓ **Gross Domestic Product per capita (GDP per capita):** the addition of GDP per capita of importing and exporting countries to control the wealth effect. Thus, if a country experiences an increase in its GDP and if its population also increases, while the wealth effect will be limited by the latter. For this, the GDP per capita can have a negative impact on bilateral imports due to the poor economic conditions of partner countries.

✓ **G distance (DIST):** measures the distance between two trading partners, it's considered as a measure that greatly affects trade. It serves as a kind of "proxy" for transportation costs. Therefore, the greater the distance between two countries is, the higher are the transport costs, increasing at the same time the prices of traded goods, which reduces the competitiveness of the country with his partner. Therefore, it will have some bad consequences on its bilateral imports.

✓ **Bilateral Real Exchange Rate (RER):** this one aims to highlight the impact of the price. Thus, an increase in this variable represents a depreciation of the currency of the importing country (i) relative to the exporting country (j), and then, there is a reduction of imports of country i from country j. Therefore, the expected sign of this variable is negative.

✓ **Cultural and historical variables (contiguity (Contig), common language (Comlang) and colonization (Col) before 1945):** with the aim of facilitating trade. Therefore, the expected sign of these variables and positive.

Henceforth, to study the impact of regional cooperation between partner countries, we introduce a set of dummy variables that measure the impact of the Tunisia-EU FTA.

3.3 Model and Anticipated Results

We will use a gravity equation to analyze the impact of free trade agreement of 1995 between Tunisia and the EU on the Tunisian trade. We will base our empirical approach on the IMF report (2004) where there is analysis of the impact of the Barcelona Process on trade of Morocco. Also, we rely on the study by L. Fontagné and Péridy (1995). Where they showed that the overall negative effect of GATT 94 is justified by the reduction of the margin of preference enjoyed by the countries of the NA and the export structure in which the products are usually more preferred are represented. Finally, we will mainly base on the item Akoété (2007) for an explanation of the latter. Thus, we try to estimate an equation of the type:

$$\begin{aligned}\text{Ln } M_{ijt} = \alpha_0 + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln GDPC_{it} + \alpha_4 \ln GDPC_{jt} + \alpha_5 \ln Dist_{ij} + \alpha_6 \ln RER_{ijt} + \\ \alpha_7 Contig_{ij} + \alpha_8 Comlang_{ij} + \alpha_9 Col_{45} + \alpha_{10} M_{T\text{-}EU} + \alpha_{11} X_{T\text{-}RW} + \alpha_{12} M_{T\text{-}RW} + U_{ijt} \quad (2)\end{aligned}$$

To verify the impact of agreement on bilateral imports, we include some dummy variables to capture the effect of agreements between Tunisia and the EU from one side and between Tunisia and RW from another side.

First, a dummy variable indicating gross creation on Balassa's trade (1967) where there is an increase in bilateral imports between Tunisia and the EU countries. Then another dummy variable represents the ability to export to Tunisia in the RW. Finally, a dummy variable indicating the evolution of Tunisia's imports Tunisia preventing from RW. In summary, it is noted:

- An effect of net trade creation if $\alpha_{10} > 0$ and $\alpha_{12} = 0$;
- A diversion effect on exports if $\alpha_{10} > 0$ and $\alpha_{11} < 0$;
- A diversion effect on imports if $\alpha_{10} > 0$ and $\alpha_{12} < 0$.

We could summarize by making a table of variables and their expected signs.

Table 1. The expected sign of independent variables

Independent variables	Expected sign
GDP_i	+
GDP_j	+
GDPCi	+ or -
GDPCj	+ or -
$Dist_{ij}$	-
RER_{ij}	-
Contig	+
Comlang	+
Col_{45}	+
$M_{T\text{-}EU}$	+
$X_{T\text{-}RW}$	+ or -
$M_{T\text{-}RW}$	+ or -

Note that in order to assess the impact of the creation of the FTA between Tunisia and the EU on the structure of trade between the two parties, we must consider that the trade between partner countries and the RW has been changed due to the removal of tariff and non-tariff following the implementation of the Association Agreement.

Now that we have our model estimation, let's attain the empirical analysis in order to investigate our expectations.

4. Empirical Analysis

4.1 The Specification of the Empirical Model

The gravity equation estimated covers a period of twenty-five years (1986 to 2010) concerning 41 countries. The data are annual and the variables in the equation of gravity, in order to take an additive form, are expressed in natural logarithms. Thus, we try to estimate an equation of the type: see equation (2)

i = Tunisia (fixed)

j = 1, ..., 40

❖ Dependent Variable:

Mijt: is bilateral imports (CIF) real country i from country j for the period in million U.S. dollars at constant prices (base year 2000).

❖ Independent Variables:

- GDPit: the ability to import from country i in year t;
- GDPjt: Potential export supply of country j in year t;
- GDPCit: expresses the Gross Domestic Product per capita of the importing country for the period;
- GDPCjt: expresses the Gross Domestic Product per capita of the exporting country for the period;
- DISTij: expresses the geographical distance between the two countries i and j. We use the index called "distwces" in the CEPII database for our model.
- RERijt: expresses the bilateral real exchange rates calculated from the exchange rate of each country with the United States (local currency / U.S. dollar). To perform these calculations, we issued the no-arbitrage condition (otherwise it would have been impossible to split the different exchange rates). Thus, we recover the database IFS the nominal exchange rate of each country in relation to the dollar (NER country / $ to uncertainty for the country) and the index of consumer prices of countries (ICP country) for each year from 1986 to 2010. For countries where we do not have serial consumer prices, we consider the GDP deflator. RER bilaterally with uncertainty for country i is calculated as follows:

$$\mathrm{RER}_{\mathrm{country}i/partnerj} = \left(\frac{ICP_{partnerj}}{ICP_{\mathrm{country}i}}\right)_t \times \left(\frac{\mathrm{NER}_{\mathrm{country}i/\$}}{\mathrm{NER}_{partnerj/\$}}\right)_t$$

- Contig: is the dummy variable for contiguity value 1 if both partners have a common border and 0 otherwise.
- Comlang: is a dummy variable that takes the value 1 if the two countries share the same language and 0 otherwise.
- Col45: is a dummy variable that takes the value 1 if the partners had a link settlement before 1945, and 0 otherwise.
- For these variables, a number of dummy variables were added to capture the effect of agreements between Tunisia and the EU on the one hand and Tunisia and the rest of the world on the other.
- MT-EU: is a dummy variable taking value 1 if the importing country is Tunisia and the exporting country j is part of the EU, and 0 otherwise;
- XT-RW: is a dummy variable taking value 1 if the exporting country is Tunisia and if the importing country j is part of the RW, and 0 otherwise;
- MT-RW: is a dummy variable taking value 1 if the importing country is Tunisia and the exporting country j is part of the RW, and 0 otherwise;
- Uij: is the error term.

4.2 Choice of Estimation Method and the Various Tests

In the case of a gravity model of bilateral trade, some authors defend the idea that panel estimation is necessary,

if we do not get biased estimates. Indeed, the absence of non-availability of data over a long period, we have a limited number of observations and therefore relatively low quality of the model fit. To overcome this problem, we adopt a panel estimation allows us to study the temporal and spatial pattern of bilateral trade.

Almost all previous studies have used the method of "fixed effects" to estimate their gravity equation. In fact, when it comes to estimating a "panel" for different countries, one should tolerate separate intercepts for the different observations. This is what makes this method interesting. However, in the context of this work we should determine "econometrically" what method will be the best one for the estimation of our data. Firstly, a question arises; determine which of the two specifications (fixed or random effects) is most appropriate. One way to solve this problem is to perform the Hausman test, which determines whether the coefficients of the two estimates are statistically different. For the test results, we believe our two equations (one for fixed-effects and random effects for the other), then we perform the test.

In addition, the estimation period of the predefined template, extends from 1986 until 2010. Regressions were performed on three sub-periods. Firstly, the first sub-period is from 1986 to 1994 that is to say, before the signing of the FTA between Tunisia and the EU. Then, the second sub-period is from 1995 to 2004 that is to say the period when the agreement is implemented. Finally, the third sub-period is from 2005 to 2010 will that is to say, after the integration of the countries of Central and Eastern Europe (CEECs) to the EU. Forty countries are represented in the sample. We are interested in commercial relations between Tunisia and the EU on the one hand and Tunisia and the RW on the other. To do this, currency countries are split into two blocks:

❖ Block the European Union: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom and Poland.

❖ Block of the RW: Algeria, Morocco, Libya, Egypt, Jordan, Syria, Iran, Turkey, USA, Brazil, China, Japan and India.

4.3 Data Sources

Our empirical study consists of a panel of 41 countries for the period from 1986 to 2010. The choice of the sample of countries and the study period is justified by the fact that Tunisia has adopted a policy of openness from the beginning of the eighties in the context of structural adjustment programs, agreements (GATT and WTO recently) and regional agreements. In addition, this choice is strongly dictated by the availability of statistical information. In fact, there are different sources of data. Data on gross domestic product, gross domestic product per capita, the real bilateral exchange rate indices and consumer price series are collected from the World Bank (WDI, 2010) and supplemented by the International Monetary Fund (IFS, 2010) Database. In particular, data on imports are taken from external trade statistics of the National Institute of Statistics (1986 to 2010) and the database HATWE (2010). We used Stata 11.

The main purpose of this study is to test the impact of the FTA between Tunisia and the EU using the gravity model. For this, we attempt to evaluate the two effects associated with regional integration, trade creation effect and the effect of trade diversion.

To estimate our baseline model by the appropriate techniques, we will use the specification tests which actually correspond to the three tests of Fischer. This is to determine how our model must be specified, if the hypothesis can be accepted by panel. Thus, our analysis is based on the notion of homogeneity of the parameters of our model. Therefore these specification tests are designed to make a diagnosis of the possible need to integrate heterogeneous dimension and how this heterogeneity must be specified. If heterogeneity is detected only in constants, you must verify that the individual effects model is estimated using techniques within (fixed effects) or by the procedure of MCG (random effects). Finally, to determine which model should be learned we will use the standard specification test of Hausman (1978).

Before turning to the econometric estimates, we will try to test the stability of the coefficients using the Chow test. Similarly, we will try to detect if there is heterogeneity problem, which will determine the specification tests.

4.4 Tests on Panel Data

4.4.1 Chow Test

The Chow test is used to test the stability of regression coefficients in three different sub-periods. Thus, one can easily perform this test, following step by step procedure:

Table 2. Step 1: Estimation of the model for the whole period (going from 1986 until 2010)

Dependent Variable: $\ln M_{ij}$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.902750	9.239365	-0.205939	0.8369
ln GDP_i	1.180119	4.272392	0.276220	0.7825
ln GDP_j	0.966807	0.042783	22.59802	0.0000
ln $GDPC_i$	0.032785	0.304068	0.107821	0.9142
ln $GDPC_j$	-0.795706	0.062267	-12.77889	0.0000
ln $Dist_{ij}$	1.14E-10	2.40E-11	4.735829	0.0000
ln RER_{ij}	-0.000538	0.000392	-1.372564	0.1703
$M_{T\text{-}EU}$	-0.503048	9.231877	-0.054490	0.9566
$X_{T\text{-}RW}$	-1.717946	9.232290	-0.186080	0.8524
$M_{T\text{-}RW}$	-1.717946	9.232290	-0.186080	0.8524
$Contig_{ij}$	1.169452	0.100031	11.69085	0.0000
$Comlang_{ij}$	0.746355	0.088576	8.426198	0.0000
Col_{45ij}	1.031267	0.124003	8.316450	0.0000
R-squared	0.759229			
Adjusted R-squared	0.754827			
F-statistic	172.4625			
Prob (F-statistic)	0.000000			
Sum squared resid	235.2994			

Note: Was SSR = 235.30.

Table 3. Step 2: Estimation of the model for the first sub-period, before the signing of the agreement (1986 to 1994)

Dependent Variable: lnMij				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.812714	0.773509	-2.343496	0.0199
ln GDP_i	0.984367	0.865942	16.46732	0.0000
ln GDP_j	0.974594	0.064120	15.19952	0.0000
ln $GDPC_i$	-0.961497	0.104913	-9.164688	0.0000
ln $GDPC_j$	-0.942387	0.123892	-9.342156	0.0000
ln $Dist_{ij}$	-1.563707	0.201798	-7.748878	0.0000
ln RER_{ij}	0.011684	0.057698	0.202506	0.8397
$M_{T\text{-}EU}$	5.046558	0.199593	25.28423	0.0000
$X_{T\text{-}RW}$	3.678943	0.189325	15.90432	0.0000
$M_{T\text{-}RW}$	4.690439	0.272828	17.19190	0.0000
$Contig_{ij}$	0.030932	0.193199	0.160104	0.8729
$Comlang_{ij}$	0.166693	0.168962	0.986573	0.3248
Col_{45ij}	0.744907	0.187139	3.980514	0.0001
R-squared	0.802524			
Adjusted R-squared	0.794624			
F-statistic	101.5974			
Prob (F-statistic)	0.000000			
Sum squared resid	67.27096			

Note: Was SSR1 = 67.27.

Table 4. Step 3: Estimation of the model for the second sub-period, after the entry into force of the agreement (1995 to 2004)

Dependent Variable: $\ln M_{ij}$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.698687	0.756365	-0.923744	0.3564
ln GDP_i	0.865597	0.054481	15.88802	0.0000
ln GDP_j	0.794383	0.048943	14.32567	0.0000
ln $GDPC_i$	-0.658309	0.091413	-7.201480	0.0000
ln $GDPC_j$	-0.547892	0.087654	-6.987652	0.0000
ln $Dist_{ij}$	-2.010389	0.173498	-11.58740	0.0000
ln RER_{ij}	0.076368	0.042944	1.778321	0.0764
$M_{T\text{-}EU}$	5.449329	0.161275	33.78914	0.0000
$X_{T\text{-}RW}$	4.890654	0.217643	23.90321	0.0000
$M_{T\text{-}RW}$	5.405040	0.222417	24.30140	0.0000
$Contig_{ij}$	0.032877	0.158696	0.207169	0.8360
$Comlang_{ij}$	-0.379665	0.142015	-2.673408	0.0080
Col_{45ij}	0.725909	0.153448	4.730651	0.0000
R-squared	0.848549			
Adjusted R-squared	0.843121			
F-statistic	156.3186			
Prob(F-statistic)	0.000000			
Sum squared resid	55.46063			

Note: Was SSR2 = 55.46.

Table 5. Step 4: Estimation of the model for the third sub-period (going from 2005 until 2010)

Dependent Variable: $\ln M_{ij}$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.141881	43.80424	0.071725	0.9429
ln GDP_i	5.365594	29.50128	0.181877	0.8559
ln GDP_j	0.992142	0.088823	11.16982	0.0000
ln $GDPC_i$	-0.008401	0.477358	-0.017600	0.9860
ln $GDPC_j$	-0.741985	0.117431	-6.318475	0.0000
ln $Dist_{ij}$	1.23E-11	2.79E-11	0.439505	0.6609
ln RER_{ij}	-0.000476	0.000394	-1.209104	0.2284
$M_{T\text{-}EU}$	-9.246258	43.72926	-0.211443	0.8328
$X_{T\text{-}RW}$	-10.55287	43.72744	-0.241333	0.8096
$M_{T\text{-}RW}$	-10.55287	43.72744	-0.241333	0.8096
$Contig_{ij}$	1.375446	0.207892	6.616158	0.0000
$Comlang_{ij}$	0.730777	0.179609	4.068711	0.0001
Col_{45ij}	1.581808	0.288815	5.476895	0.0000
R-squared	0.780815			
Adjusted R-squared	0.762894			
F-statistic	43.57041			
Prob(F-statistic)	0.000000			
Sum squared resid	52.87175			

Note: Was SSR3 = 52.87.

We calculate the test statistic that follows a Fisher distribution: F (k, n-3k) = 17.94.

Thus, we note that the value obtained from the Fisher statistic is greater than the critical value (F (13.695) ≈ 1.70 for α = 5%). We therefore reject the hypothesis of constant coefficients. There is structural change between the three sub-periods. For this, one has the interest to study the impact of the FTA between Tunisia and the EU on the Tunisian economy. We now turn to the specification tests that will detect if there is heterogeneity or not.

4.4.2 Specification Tests or Tests of Homogeneity

In fact, when we use the technique of panel data, the first step is to check is whether the specification

homogeneous or heterogeneous. Thus, we will test the equality of the coefficients of the model studied in the individual dimension. In economic terms, the objective is to check if the theoretical model adopted is exactly the same for all countries, or on the contrary there are specificities for each country.

Thus, it is possible to introduce the notion of fixed effects whose main interest is to understand, through decomposition constant, unobservable heterogeneity in the behavior of countries in the panel. Therefore, our fixed-effects model can be written as follows:

$$\ln M_{ijt} = \alpha_0 + \beta_{ij} + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln GDPC_{it} + \alpha_4 \ln GDPC_{jt} + \alpha_5 \ln RER_{ijt} + U_{ijt} \quad (3)$$

Where β_{ij} traces bilateral fixed effects.

In fact, the constant term α_0 depending on the model includes, in general, the influence of a set of variables not specified in the explanatory model. As this set, whose influence is synthesized by the constant term is assumed common for country i, j for all partners, all periods t and all pairs of countries. We can assume the contrary, this set of variables is not formalized, is different depending on the country (i), partners (j) and the observation period (t), or pairs of countries (ij). The fixed effects models therefore propose, on the one hand, treating individual heterogeneities, such as a constant parameter β_i, β_j, β_t and β_{ij} and secondly, to allocate, in the end, an econometric relationship separate specification for each type i, j, t, or ij, which we focus here.

Thus, in a gravity-type model with simple fixed effects [Matyas (1997 and 1998), Harris and Matyas (1998), Egger and Pfaffermayr (2003b)] we can propose a decomposition of the constant which takes into account the specific behavior of country partners and those periods. A gravity-type model with fixed effects combined offers, meanwhile, rather a decomposition of the constant function, the specific behavior of the country (i) in time, the partners (j) in time and the one that interests us most, bilateral (country effects / partners noted (β_{ij})) [Cheng and Wall (2004), Baltagi (2001), Egger and Pfaffermayer (2003b), Glick and Rose (2002), Egger and Pfaffermayr (2003a)].

In fact, bilateral fixed effects β_{ij} remain relevant because they allow introducing in the analysis of all time-invariant phenomena that affect the country pairs [Egger and Pfaffermayr (2004) and Maurel (2004)]. In this sense, this model has several configurations that are possible.

- The constants β_{ij} and coefficients are identical. In this context, our model can be described by a panel homogeneous and therefore OLS can be used to estimate our model.
- β_{ij} constants and coefficients are different across countries. For this, we have different models to estimate and then we reject the panel structure.
- β_{ij} constants are identical, against the coefficients are different in different countries. In this case, we have N equations to estimate.
- Coefficients are identical, whereas the constants β_{ij} are different countries. In this case, we obtain a model with individual effects.

Thus, we adopt an homogeneity procedure which going to ensure what type of panel we have to follow in our model.

Table 6. Specification tests or homogeneity

	Heterogeneity constants	Homogeneity of coefficients
First sub-period	F(28,225)= 139.67	F(7,225)= 5,43
(1986-1994)	Prb>F= 0. 0000	Prb>F= 0.9602
Second sub-period	F(28,254)= 288.08	F(7,254)= 2,36
(1995-2004)	Prb>F= 0. 0000	Prb>F= 0.1969
Third sub-period	F(40,198)= 1.51	F(7,198)= 0.17
(2005-2010)	Prb>F= 0.0357	Prb>F= 0.9538

From this table, we can see that there is a consistency coefficient for the three sub-periods, since the gain is greater than 10%. For cons, the constants β_{ij} are heterogeneous as for the three sub-periods the gain is less than 10%. So our reference model is specified as a panel with individual effects.

4.4.3 Typology of Models Suited to the Study of Bilateral Trade

First, we begin by specifying the models adopted for each type of effects (fixed or random effects). In addition, the introduction of fixed effects in the analysis has a dual interest since - apart from without traditional

determinants of trade - it takes into account the dynamic behavior of various countries and their bilateral relations heterogeneities. This allows to identify whether partners, particularly other presents specific (strategic or not) and if they evolve in time and in space. The goal is of course whether or not they have a favorable influence trade.

As our problem is to highlight the influence of variable standards of trade, the regional agreements and, finally, that the heterogeneity of bilateral behavior we have chosen to test a fixed effects model as described in equation (4).

If this model has the advantage of allowing the introduction of fixed effects, it prohibits as we mentioned above taking into account all time-invariant variables such as distance and cultural variables, historical and language such as (Contig, Comlang and Col45).

However, regarding the choice of model, it is actually hardly possible to stop the alternative model (4) (FE). It is essential to check if the component is not β_{ij} random type and if the FE model should not be replaced by a random-effects model (5) which we denote RE where the hazard is compound type. This is using the Hausman tests (which is actually a $\chi 2$ test (dlFE)) for determining the choice between FE model and RE model.

Thus, the RE model is written as follows:

$$\text{Ln } M_{ijt} = \alpha_0 + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln GDPC_{it} + \alpha_4 \ln GDPC_{jt} + \alpha_5 \ln Dist_{ij} + \alpha_6 \ln RER_{ijt} + \alpha_7 Contig_{ij} + \alpha_8 Comlang_{ij} + \alpha_9 Col_{45ij} + \omega_{ijt} \quad (4)$$

Where;

$w_{ijt} = U_{ijt} + \beta_{ij}$ is hazard

RE in this model, it should be noted that all time-invariant variables can be reintroduced. Once the choice of model is made, it may be carried out to estimate the effects of regional agreements between Tunisia and the EU. To determine the model best suited to our problem we use estimation techniques within and GLS.

Table 7. Comparison of FE and RE models

	Periods					
	1986-1994		1995-2004		2005-2010	
Exogenous variables	Within	GLS	Within	GLS	Within	GLS
Constant	-6.561 (-3.40)*	-1.619 (-0.49)	-3.44 (-2.99)*	3.378 (1.10)	-20.304 (-0.66)	24.150 (1.62)***
$\ln GDP_i$	1.234 (4.32)*	0.975 (4.26)***	1.89 (2.15)*	0.921 (3.21)*	0.432 (0.18)	0.765 (1.45)***
$\ln GDP_j$	1.051 (3.22)*	0.893 (3.98)*	2.18 (2.40)*	0.828 (2.49)*	0.413 (0.15)	1.632 (2.19)*
$\ln GDPC_i$	0.312 0.46	-0.612 -0.25	-2.321 (-3.65)*	-0.21 (-2.54)*	-0.532 (-0.15)	-0.421 (-1.52)***
$\ln GDPC_j$	0.213 0.35	-0.538 -0.13	-2.099 (-2.14)*	-0.638 (-1.73)**	-0.307 (-0.10)	-1.862 (-1.92)**
$\ln RER_{ij}$	0.113 (3.55)*	0.109 (3.59)*	0.030 1.36	0.035 (1.63)***	-0.062 (-1.10)	-0.051 (-0.89)
$\ln Dist_{ij}$		-1.013 (-1.30)***		-1.638 (-1.75)**		-3.709 (-1.71)**
$Contig_{ij}$		0.492 (2.31)*		0.836 (1.95)**		5.529 (1.91)**
$Comlang_{ij}$		1.398 (2.29)*		0.699 (1.19)		4.633 (3.04)*
Col_{45ij}		0. 888 (1.95)**		0.875 (2.01)*		0.566 (2.01)*
R^2	0.13	0.25	0. 06	0. 22	0. 18	0. 37
N[a]	261	261	290	290	246	246
N[b]	29	29	29	29	41	41

Notes: The values in the parentheses represent the t-statistics; (***) significance at 1% level, (**) significance at 5% level and (*) significance at 10% level. [a] Number of observations, [b] Number of bilateral effects.

Thus, we can see that the estimation for the three sub-periods, whatever by Within or GLS, gives the same outcomes and significant results .

So the estimation technique used, the variables GDP, RER (for the first two sub-periods), common border (Contig), common language (Comlang) and colonization before 1945 (Col45) exercise overall for the three sub-periods, a force of attraction between partners is tending to enlarge the integration to them. However, the expected sign of the variable is negative RER which is not the case for our estimate. In fact, the GDP of partners countries is for the first two sub-periods, the variables common border, common language and settlement before 1945 for the three sub-periods were the strongest factors which best explain the level of Tunisian imports from its partners.

Instead, the variables GDP per capita (except with the estimation technique Within the first sub-period), RER (for the third sub-period) and distance play in the sense of a repulsive force. Thus, the variable GDP per capita of partners countries is (with GLS estimation technique) for the first sub-period, the same for the two other sub-periods (with the two estimation techniques) and the variable distance three sub-periods (with GLS estimation technique) hold high elasticities and thus higher explanatory power.

Table 8. Test for the presence of individual effects

	First sub-period	Second sub-period	Third sub-period
Fischer test	F(28, 225) = 139.67	F (28, 254) = 288.08	F (40, 198) = 1.51
	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0357

Although the Prob> F is less than the confidence threshold (here 5%) for the three sub-periods, then there is presence of individual effects.

Henceforth, in the presence of individual effects model, the question that immediately arises is how these individual effects must be specified: should we adopt the hypothesis of fixed effects or effects contrary to the hypothesis random? For this, we use the test Arbitration of Hausman (1978). Indeed, this specification test is a general test that can be applied to many problems of specification in econometrics.

So, this test seeks to explore the possibility of a correlation or a default specification. Assuming we have two types of estimators for the parameters of our model. The first estimator is supposed to be unbiased estimator minimum variance under the null hypothesis of correct specification of the model (no correlation). In contrast, under the alternative hypothesis of misspecification, this estimator is supposed to be biased. Both assumptions Hausman can be specified as follows:

$$\begin{cases} H_0^1 : \mathrm{E}(\beta \mathrm{ij} / Xij) = 0 \\ H_a^1 : \mathrm{E}(\beta \mathrm{ij} / Xij) \neq 0 \end{cases}$$

With Xij : the matrix of explanatory variables.

Hausman (1978) advocates the specification test based on the following statistic:

$$H = \left(\beta_k^F - \beta_k^A\right)' \left(Var\left(\beta_k^F - \beta_k^A\right)\right)^{-1} \left(\beta_k^F - \beta_k^A\right) \qquad \forall \text{ k} = 1,2,3,\ 4,\ 5,6,7$$

Under the null hypothesis of correct specification, this statistic is asymptotically distributed according to a chi-square with k degrees of freedom. Thus, under the null hypothesis that the theoretical model can be specified with individual random effects and should retain GCM estimator (BLUE estimator). By cons, under the alternative hypothesis, the model must be specified with fixed individual effects and must retain or LSDV estimator within (the unbiased estimator). The table below summarizes the Hausman test (1978) to our model.

Table 9. Hausman test

	First sub-period	Second sub-period	Third sub-period
Stat-Hausman	$\chi^2(7)$= 3.06 (0.5483)	$\chi^2(7)$= 2.69 (0.6102)	$\chi^2(7)$= 1.79 (0.7745)

From this table, we can conclude that our model is specified by a panel with individual random effects since the Hausman statistic is less than the critical value of chi-square with seven degrees of freedom ($\chi^2(7)$ = 7.14 for = 5 %) for the three sub-periods. In this case, we use the method of Generalized Least Squares (GLS) to estimate our model.

4.4.4 The Unit Root Tests on Panel Data

The non-stationarity is detected from basket unit root tests. In fact, the analysis of non-stationary panel data only developed very recently, since the pioneering work of Levin, Lin and Chu (2002). Indeed, the econometrics of non-stationary panel data by Baltagi and Kao (2000) aims to combine the “best of both worlds”: the treatment of non-stationary series with the time series methods and increased number of data and the power of tests with the use of the individual dimension. Moreover, another benefit from the addition of the individual dimension to the temporal dimension due to the fact that the asymptotic distributions of unit root tests on panel data are asymptotically normal as they are from non-standard ‘a single time dimension.

However, for our model, the size of observations is less than 20 years (see table below) and then absence of unit roots. Thus, our model is stationary.

Table 10. Size of observations

	Nombre d'années
First sub-period (1986-1994)	9
Second sub-period (1995-2004)	10
Third sub-period (2005-2010)	6

The size of the observations for each sub-period is very low. For this, the stationarity of the variables of our model is irreversible and we do not check this stationarity for the application of unit root tests whether heterogeneous or homogeneous ,t-Statistics give below the critical value of the law standard normal distribution at 5% risk threshold equal to -1.64.

4.4.5 Heteroscedasticity Test

Heteroscedasticity describes data that does not have a constant variance. The heteroscedasticity does not bias the estimated coefficients, but the usual inference is no longer valid because the deviations found are not good. Heteroscedasticity is a situation encountered frequently in panel data. It is therefore important to detect and correct.

Detection of heteroscedasticity

Several tests exist to detect resembling heteroscedasticity. Two of these tests, which are; the Breusch-Pagan test and the White. In our approach, we use the White test. Indeed, the general idea of this test is that it takes the explanatory variables to the power of 2, and the interactions between the explanatory variables in the regression of the squared residuals.

Table 11. Detection of heteroscedasticity

	White	Chi-square	Probability
First sub-period	1.32978	7.5987	0.84957
Second sub-period	1.06879	7.95874	0.85367
Third sub-period	0.94875	7.29781	0.87491

From this table, we can see that the waste variances are homogeneous as White statistics (for the three sub-periods) are less than the critical values of chi-square. Hence, homoscedasticity is a dominant character for the three sub-periods.

4.4.6 Autocorrelation Test

Similarly, for the correlation, the new aspect which we must pay attention to the possibility of correlated errors between individuals. We must also ensure that errors are not autocorrelated and, for each individual.

Table 12. Autocorrelation test

	F-Statistiques	Probabilités
First sub-period	4.68971	0.795847
Second sub-period	3.59871	0.849512
Third sub-period	2.69871	0.946812

We can see from the autocorrelation test that the residue of each sub-period is not auto correlated over time. To do this, we accept the hypothesis of absence of autocorrelation of the residuals problem and we retain the estimation results within and GLS.

In conclusion, there are no problems of heteroscedasticity and autocorrelation.

As it appears that the RE model is under test, the more relevant it can be chosen to study the interaction between partners and the effects of diversion / creation of traffic.

Like the work of Aitken (1973), Gros and Gonciarz (1996), Bayoumi and Eichengreen (1997), Ghosh and Yamarik (2003), Soloaga and Winters (2001) and Carrere (2006), we introduced into the model RE dummies in order to tap the effect of agreements, between Tunisia and EU on the one hand and Tunisia and the rest of the world on the other hand:

The GLS estimation technique for the three sub-periods is confirmed by the statistics of Hausman (1978) since

the Hausman statistics are lower than the critical value of chi-two to seven degrees of freedom. This estimate is filtered by the problem of heterogeneity of variances of coefficients and error term. Also, it was no residual autocorrelation and correlations between the explanatory variables. We interpret the equation (5) of trade between countries and for three sub-periods by the Generalized Least Squares technique (GLS) as constants or specific characters are variations over time.

5. Interpretation of Results

Now we look at the impact of the Association Agreement Tunisia-EU Tunisian economy through.

Table 13. Institutional and natural exchanges between Tunisia and its partners

	Periods		
	1986-1994 (1)	1995-2004 (2)	2005-2010 (3)
	R^2= 0. 81	R^2= 0. 87	R^2= 0.37
	N= 261	N= 290	N= 246
	Number of pairs = 29	Number of pairs = 29	Number of pairs = 41
exogenous variables	α (t)	α (t)	α (t)
C	-2.398 (-1.25)***	-1.198 -0.75	38.131 (1.56)***
Variations in the time variable			
$\ln GDP_i$	0.982 (7.32)*	0.941 (7.12)*	0.654 1.01
$\ln GDP_j$	0.971 (6.55)*	0.900 (6.20)*	1.205 1.02
$\ln GDPC_i$	-0.921 (-4.21)*	-0.823 (-4.76)*	-0.534 -1.03
$\ln GDPC_i$	-0.802 (-3.21)*	-0.703 (-3.67)*	-1.434 -1.05
$\ln RER_{ij}$	0.054 (1.81)**	0.078 (1.81)***	0.032 0.67
Time-invariant variables			
$\ln DIST_{ij}$	-1.463 (-2.89)*	-1.919 (-4.19)*	-6.463 (-1.57)*
$Contig_{ij}$	0.052 (2.11)*	0.097 (2.23)*	9.194 (1.95)**
$Comlang_{ij}$	0.259 (2.62)*	0.297 (1.81)**	4.238 (1.98)**
$Col45_{ij}$	0.781 (1.65)***	0.723 (1.71)***	0.586 (2.11)*
Variables RA			
$M_{T\text{-}EU}$	4.931 (9.81)*	5.443 (12.13)*	-0.527 -0.15
$X_{T\text{-}RW}$	-6.057 -0.40	-11.831 (-1.08)*	-0.095 -0.03
$M_{T\text{-}RW}$	4.587 (6.74)*	5.313 (8.84)*	2.448 0.49

Notes: The values between parentheses represent statistics student, (*) significance at 1% level, (**) significance at 5% level and (***) significance at 10% level.

Based on the results in Table 13 it shows us that although the coefficient of determination R^2 "between" is significant that the extent it is equal to 81% for the first sub-period (1986-1994), then is increased is 87% for the second sub-period (1995-2004), which would mean a gain in accuracy. Finally, it has decreased to 37% for the third sub-period (2005-2010). Thus, we can conclude that all the variables considered significantly explain the dependent variable: Tunisian imports from its partners.

As the signs of the coefficients, the results of the tests in this model clearly confirm a priori the sign mentioned by the theoretical model. However, we found that the GDPC variable is negative. It is certainly due to bad circumstances which, for a number of consecutive years, may affect the economies of partner countries.

In the last estimate, we can distinguish natural determinants of trade (GDP, GDP per capita, DIST, RER, common border, common language and settlement before 1945) the institutional determinants ($M_{T\text{-}EU}$, $X_{T\text{-}RW}$ and $M_{T\text{-}RW}$). However, for natural determinants of trade can be seen although the GDP of partners countries the bilateral real exchange rates and the historical and cultural variables (contiguity, common language and settlement before 1945) explain the positive exchanges (for the three sub- periods). However, the GDP per capita of partners countries and distances, which reflect transport costs, explain negative exchanges (for the three sub-periods).

It is, moreover, the country GDP of partner countries, the GDP per capita countries of partner countries the bilateral real exchange rates (for the first two sub-periods), geographic distance and cultural and historical variables (for the three sub-periods) that have the greatest explanatory power.

Thus, we introduce three dummy variables and it aimed to assess the effects of trade creation ($M_{T\text{-}EU}$) and misappropriation of trade in terms of export ($X_{T\text{-}RW}$) and diversions import ($M_{T\text{-}RW}$). Henceforth, according to the

table 13, we see that the two dummies $M_{T\text{-}EU}$ and $M_{T\text{-}RW}$ have higher elasticities and therefore have a greater explanatory power even before the force of the Association Agreement between Tunisia and the EU.

If we analyze the effects of regional Association Agreement of 1995 between Tunisia and the EU we find that the coefficient of the variable ($M_{T\text{-}EU}$), which measures the effects of the FTA, becomes higher after the time of signing of the association. It goes from (4.931) for the first sub-period (1986-1994) to (5.443) for the second sub-period (1995-2004) and then decreasing and becomes negative (-0.527) for the third sub-period (2005-2010). More precisely, Tunisia and the EU are trading more than 138 times (exp (4.931)) over the natural predicted level by the model and that was before the period of association agreements. After the period of agreements application (1995-2004) the commercial trades between Tunisia and the EU are about 231 times (exp (5.443)) more than predicted norms the gravity variables. This means that there has been an intensification of trade after the integration period. Arguably overall association agreements euro-Tunisiangenerated a trade creation effect between the first two sub-periods. However, we note that the third sub-period there was a decrease of variable ($M_{T\text{-}EU}$) and thereafter there is no intensification of trade between Tunisia and the EU, then no creation of trade between the two sides because of the enlargement of the EU to Eastern Europe. As trade diversion for exports towards the rest of the world, we see that there is a decrease in the coefficient of the variable ($X_{T\text{-}RW}$) there is at the same time increasing the coefficient of variable ($M_{T\text{-}RW}$) (for the first two sub-periods) and then there is a diversion of trade for exports. However, for the variable ($M_{T\text{-}RW}$) there is an increase of the coefficient changes from (4.587) for the first sub-period (5.313) for the second sub-period is decreased then becomes (2.448) for the third sub-period. Thus, we conclude that fear is no misappropriation of trade import requirements. We can explain this result by the fact that most Tunisian trade is already with the EU and therefore a trade diversion effect will not be large (Note 4). The second reason is that the parallel reduction of tariffs on products of list1 (capital goods) from Europe, the Tunisian government has declined equivalent tariffs List 1 from the rest the world. List 2 (intermediate goods and raw materials) has not had the same treatment but are not very substitutable goods to local produce so the risk of diversion there is also low. For cons, the third sub-period there was a decrease in the variable ($M_{T\text{-}RW}$) means that there is trade diversion to the detriment of RW and this is due to the enlargement of the EU.

Nevertheless,According to table 13 we can constant, that the coefficient α_{10} is positive for the two first sub-periods. At the same time, the coefficient α_{12} is positive for all three sub-periods. Subsequently, there is trade creation in the sense of J. Viner (1950) as the increase in trade between Tunisia and the EU takes place mainly at the expense of domestic producers. Similarly, we note that the coefficient of the variable α_{11} ($X_{T\text{-}RW}$) is negative for all three sub-periods and therefore there is trade diversion in exports (by Endoth, 1999 and Soloaga and Winters, 1999).

However, if we examine the evolution of the variable measuring the effects of trade creation after the integration period, we note that the effect of trade creation remains weak and uncertain. Recall that Tunisian exports to the EU are around 80% of Tunisian exports and the fact that manufactured exports already enjoy free access to the European market can not expect any new side effects exports. Therefore if there is an effect of creation can not come from the import side.

An important conclusion that can be drawn from the analysis is that there was no significant change in coefficients and therefore no trade creation during the first five years of the FTA although the list 1 (capital goods) and List 2 (intermediate goods and raw materials) is fully liberalized. The last year of tariff products list 2 took place in 2000. The rather modest growth factors occurs only three years, from 2000, we suggest that the trade creation occurred after the reduction of tariffs for goods from the list 3 (consumer not competing with local products (Note 5)) and List 4 (consumer goods with few substitutes compared to local products).

One reason for the weakness of the trade creation effect is mainly due to the fact that trade liberalization has long been limited to capital goods and intermediates that do not have a high substitutability in relation to national production.

Another important reason is the existence of other barriers other than tariffs on imports continues to operate. For example, it has eliminated tariffs on imported capital goods but was replaced by an increase in VAT. Also the establishment of a system of taxation implemented until the end of 2001, which is to set the value of imports not according to statements by the importer but the Minister of Industry has resulted in effective rates much higher (Lahouel M. and A. Marouani, 2003). Finally, despite significant political opening, Tunisia is still experiencing significant levels of protection, tariff structure very complex and complicated customs procedures and complex. The number of tariff rates charged by the Tunisian government is very high (52 rates) with values that can sometimes reach 215% (IMF, 2003).

As the tariff schedule set by the EU and Tunisian authorities had the effect of increasing the degree of effective protection in the implementation of free trade agreements. Estimates made by the Institute of Quantitative Economics (1999) show for the Tunisian economy an increase in the effective rate of protection, which rose from 56% in 1995 to 88% in 1999 possibly in protected areas such as agriculture and manufacturing sectors (metal products) where Tunisia is not necessarily an advantage. This has pushed companies to invest in sectors where Tunisia has no comparative advantages. This policy seems to be responsible for a misallocation of resources and not redirecting investment to exporting activities. In addition to the country's economic structural problems, dismantling timetable seems generated significant costs.

6. Conclusion

Application of gravity models was carried out in the framework of the FTA between Tunisia and the EU. Thus, according to many empirical studies, the coefficients of the gravity variables have the expected signs and are generally significant: GDP variables have a positive sign, the GDP per capita variables are assigned a negative sign (although as we have mentioned above, not always), confirming the hypothesis of Linneman (1996) that the degree of openness of an economy and negatively correlated with the variable population. The sign of the coefficient of the distance is negative.

Following the results, it seems that the gravity model explains bilateral trade well. But you cannot assign the level of intra-regional trade only by geographical proximity, GDP, POP and because it finds unambiguously that membership in preferential agreements is a predisposing factor intensity of bilateral trade.

If we analyze the effects of regional Association Agreement of 1995 between Tunisia and the EU we note that there is a greater exchange after the integration period. In fact, we can say that overall association agreements Euro-Tunisian generated trade creation effect. As trade diversion vis-à-vis the rest of the world, we see that there is no significant diversion of trade to the detriment of the EU countries. This means that the agreement did not generate a negative effect in the sense of import diversion. However, there is a diversion of export.

Thus, the Tunisian experience could be interesting for other Mediterranean countries, because the tariff dismantling schedules that have been negotiated are very similar to that of Tunisia. These countries can expect an effect of trade creation but several years after the implementation of the agreement and a significant increase in the protection of their domestic manufacturing industries for several years after the entry into force of the agreements. To avoid these costs it may be useful to reconsider the timing of trade liberalization set in the context of free trade agreements. Also a further reduction in tariff rates, very complex in the SEM, and customs and administrative procedures is strongly recommended. These measures should reduce distortions and trade costs and at the same time facilitate the recovery of the activity of the domestic supply. Thus it is not certain that the Euro-Mediterranean policy as it has been defined by the EU is the best way to accelerate economic integration in the Mediterranean basin. Our results show, however, that while trade creation is modest, the SEM are moving more and more towards the integration in their natural exchange zone, the EU.

References

Agbodji, A. E. (2008). The Impact of Subregional Integration on Bilateral Trade: The Case of UEMOA. *Faculté des Sciences Economiques et de Gestion University of Lomé, Togo*. 1-34. Retrieved from http://www.aercafrica.org/documents/rp186.pdf

Aitken, N. D. (1973). The effect EEC and EFTA on European Trade: A Temporal Cross-Section Analysis. *American Economic Review, 63,* 881-892. Retrieved from http://www.jstor.org/stable/1813911?origin=JSTOR-pdf

Anderson, J. E. (1979). A theoretical foundation for the gravity equation. *American Economic Review, 69,* 106-113. Retrieved from http://www.jstor.org/stable/1802501?origin=JSTOR-pdf

Balassa, B. (1967). Trade Creation and Trade Diversion in the European Common Market. *Economic Journal, 27*(8), 1-17. http://dx.doi.org/10. 2307/2229344

Baltagi, B. H. (2001). *Econometric Analysis of Panel Data*. Chichester: Wiley.

Baltagi, B. H., & Kao, C. (2000). No stationary Panels, Cointegration in Panels and Dynamic Panels. A Survey. In B. Baltagi (Ed.). *Advances in Econometrics, 15*(3), 7-51. http://dx.doi.org/10.1016/S0731-9053(00)15002-9

Bergstrand, J. H. (1985). The gravity equation in international trade-some microeconomic foundations and empirical evidence. *Review of Economics and Statistics, 67,* 474-481. http://www.jstor.org/stable/1925976

Bergstrand, J. H. (1989). The Generalized Gravity Equation, Monopolistic Competition, and the

factor-Proportions Theory in International Trade. *Review of Economics and Statistics, 71*(1), 143-153. Retrieved from http://www.jstor.org/stable/1928061?origin=JSTOR-pdf

Bergstrand, J. H., & Baier, L. S. (2003). Endogenous Free Trade Agreements and the Gravity Equation. *Department of Finance and Business Economics,* April. Retrieved from http://www3.nd.edu/~jbergstr/Working_Papers/EndogenousFTAs.pdf

Carrère, C. (2006). Revisiting the effects of regional trade agreements on trade flows with proper specification of the gravity model. *European Economic Review, 50,* 223-247. http://dx.doi.org/10.1016/j.euroecorev.2004.06.001

Cheng, H., & Wall, H. J. (2005). Controlling for Heterogeneity in Gravity Models of Trade and Integration. *The Federal Reserve Bank of St. Louis, Review, 87*(1), 49-63. Retrieved from http://research.stlouisfed.org/wp/1999/1999-010.pdf

Egger, P., & Pfaffermayr, M. (2003a). The Impact of bilateral treaties on foreign direct investment. *Journal of Comparative Economics, 32*(4), 788-804. http://dx.doi.org/10.1093/acprof:oso/9780195388534.003.0008

Egger, P., & Pfaffermayr, M. (2003b). The Proper panel econometric specification of the gravity equation: A three-way model with bilateral interaction effects. *Empirical Economics, 28*(3), 571-580. Retrieved from http://link.springer.com/article/10.1007/s001810200146

Egger, P., & Pfaffermayr, M. (2004). Distance, trade and FDI: a Hausman–Taylor SUR approach. *Journal of Applied Econometrics, 19*(2), 227-246. http://dx.doi.org/10.1002/jae.721

Endoth, M. (1999). Trade creation and trade diversion in the EEC, the LAFTA and the CMEA: 1960-1994. *Applied Economics, 31,* 207-216. http://dx.doi.org/10.1080/000368499324435

Ghosh, S., & Yamarik, S. (2003). Are regional trading Arrangements trade creating? An application of extreme bounds analysis. *Journal of International Economics*, *63*, 369-395. http://dx.doi.org/10.1016/S0022-1996(03)00058-8

Glick, R., & Rose, A. K. (2002). Does a currency union affect trade? The time-series evidence. *European Economic Review, 46,* 1125-1151. http://dx.doi.org/10.1016/S0014-2921(01)00202-1

Gros, D., & Gonciarz, A. (1996). A Note on the Trade Potential of Central and Eastern Europe. *European Journal of Political Economy, 12*(4), 709-721. http://dx.doi.org/10.1016/S0176-2680 (96)00024-9

Harris, M. N., & Mătyăs, L. (1998). The Econometrics of Gravity Models. *Melbourne Institute Working Paper*, n°5/98, Melbourne.

Hausman, J. A. (1978). Specification Tests in Econometrics. *Econometrica, 46*(6), 1251-1271. Retrieved from http://www.jstor.org/stable/1913827?origin=JSTOR-pdf

Helpman, E. (1987). Imperfect competition and international trade: Evidence from fourteen industrial countries. *Journal of the Japanese and International Economics, 1*(1), 62-81. http://dx.doi.org/10.1016/0889-1583(87)90027-X

IMF. (2004). Impact of the Barcelona Process on trade of Morocco. *IMF report number 04/164*.

Josselin, D., & Nicot, B. (2003). A geo-economic gravity model of trade between the EU countries, the CEECs and PTM. *European Journal of Geography,* 237. Retrieved from http://www.cybergeo.revue.org/4219

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometric, 108*(21), 1-24. Retrieved from http://www.uio.no/studier/emner/sv/oekonomi/ECON5120/h07/undervisningsmateriale/JOECT_UnitRootPanel.pdf

Linnemann, H. (1966). *An Econometric Study of International Trade Flow*s. Amsterdam: North-Holland.

Lionel, F., & Péridy, N. (1995). Uruguay Round and developing countries: the case of North Africa. *Economic Review, 46,* 703-715.

Mătyăs, L. (1997). Proper Econometric Specification of the Gravity Model. *The World Economy, 20*(3), 363-368. http://dx.doi.org/ 10.1111/1467-9701.00074

Mătyăs, L. (1998). The Gravity Model: Some Econometric Considerations. *The World Economy, 21*(3), 397-403. http://dx.doi.org/ 10.1111/1467-9701.00136

Maurel, M. (2004). Current Account Constraint as a Barrier to International Trade: Evidence from the European

Enlargement Process. *Economic Systems, 28*(3), 301-317. http://dx.doi.org/10.1016/j.ecosys.2004.03.007

Soloaga, I., & Winters, L. A. (2001). Regionalism in the Nineties: What Effect on Trade? *North American Journal of Economics and Finance, 12*(1), 1-29. http://dx.doi.org/10.1016/S1062-9408(01)00042-0

Viner, J. (1950). *The Customs Union Issue*. New York: Stevens & Sons Ltd.

Notes

Note 1. Association agreements between the EU and Morocco were ratified in 2000, Jordan and Algeria in 2002 and Lebanon in 2003.

Note 2. The trade diversion phenomena are even more accentuated in the context of Euro-Mediterranean agreements because they are shaped "center periphery", in which the EU is the main beneficiary of partnerships separately negotiated and it maintain barriers between different countries of the southern Mediterranean. Recent IMF studies have shown that such agreements redirect flows to the EU.

Note 3. Balgati's work, provides a solid theoretical support for the study of gravitational models with fixed effects.

Note 4. The risk of trade diversion is more in the case of Egypt, Jordan, as imports from the EU is less than 50%.

Note 5. According to a study by Dr. A. Lahouel and Marouani 2003, the ratio of total imports of consumer goods in GNP increased from 13.8% in 2000 to 16.1 in 2001. But almost 75% of this increase is attributable to the offshore sector and the remaining 25% are more specific market. It therefore appears that there was indeed a creation effect for this class of products, but most of this creation is in fact the rapid expansion of offshore activities which re-export their goods rather than strong growth in the local market.

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

The Effect of Banking Relationship on Firm Performance in Vietnam

Vu Huu Thanh[1] & Nguyen Minh Ha[1]

[1] Graduate School, Ho Chi Minh City Open University, Vietnam

Correspondence: Nguyen Minh Ha, Graduate School, Ho Chi Minh City Open University, 97 Vo Van Tan Street, District 3, Ho Chi Minh City, Vietnam. Tel: 84-8-3930-0947. E-mail: ha.nm@ou.edu.vn or ngmiha@yahoo.com

Received: March 10, 2013 Accepted: March 29, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p148 URL: http://dx.doi.org/10.5539/ijef.v5n5p148

Abstract

The objective of this paper is to examine how banking relationship influences on performance of public listed firms in Vietnam. With a sample of 465 companies listed in Vietnam observed in period 2007 – 2010 and using regression method, the research finds that firm performance decreases as the number of bank relationships increases. If a firm establishes strongly short-term credit financing relationship with banks, the firm's performance reduces. On the contrary, if a firm has strongly long-term credit financing relationship with banks, its performance increases. The effectiveness of using total assets is worse as a firm has strongly overall credit financing relationship with banks. Additionally, the study also indicates that asset tangibility structure has negative relationship with firm's ROE, while assets have negative association with ROA. Turnover has positive association with firm performance. Finally, firms with higher state shares have less effective than ones with lower state shares.

Keywords: banking relationship, credit, firm performance, financing

1. Introduction

The previous studies on firm performance show that factors such as debt, growth, size and structure of assets of a firm, and the accessibility to bank loans, have certain influence on the firm performance. On the other hand, the firms' performance is affected by the close relationship between banks and firms. Firm's banking relationship is important role for firm's performance such as to improve business reputation, to increase accessibility to loans, to reduce the negative effect of asymmetric information, and to decrease the interest costs.

In Vietnam, there are a small number of firms listed on the stock market. The listing helps them have other funding channel. However, funding from banks still plays particularly important role in the maintenance and growth of firms. Building up strong banking relationships helps firms take certain advantages. At the present, Vietnam's economy has been a transition economy. Since the mid-1980s, through reform period ("Đổi Mới" period), Vietnam has made a shift from a highly-centralized planned economy to a socialist-oriented market economy. The government still controls many areas of the economy. In this transition process, the financial market of Vietnam is imperfect and the shadow of state monopoly, of cause, still presents in fields. Due to above characteristics, opportunities of private firm in accessing bank funding become harder than firms having large state – owned equity. In recent years, the State Bank has taken control of credit growth to curb inflation, this leads to difficulty for firms in accessing loans from banks. In such conditions, any firm being able to access easily bank loans will take more advantages or have growth opportunities than others, especially those originate in state firms or have large ratio of state – owned equity. A question can be posed in this condition: Do firms having better banking relationship actually operate more effectively than others? This is also one of the interesting reasons for the research paper and this question will be answer in this study.

There are a lot of empirical studies of banking relationships on firm performance in developed countries. However, this, to our knowledge, is not any research of this topic in Vietnam (a new developing country). Hence, the purpose of this paper is to analyze the firm's banking relationship affect firm performance in Vietnam and to suggest policy implications related to the firm's banking relationship. The method applied is regression with panel data. The data is the firm-level panel data in Vietnam covering the period from 2007–2010, consisting of 465 companies listed.

The rest of this paper is organized as follows: The next section gives a brief literature review. Section 3 present the methodology and research model, and Section 4 analyze empirical results. Finally, Section 5 concludes the

paper and gives recommendations.

2. Literature Review of Banking Relationship and Firm Performance

The banking relationship includes two kinds: deposit relation and lending relation. However, this research concentrates on the lending relationships. Banking relationships are expressed through the number of banking relationships, duration of banking relationship, the amount of credit (Peltoniemi, 2004), interest (Bolton and Freixas, 2000), and banking services (Degryse and Cayseele, 2000).

From firm's perspective, establishing good relationships with banks will help firms to enhance business reputation, to reduce the leakage of information to competitors (Campbell, 1979), to decrease the negative impact of asymmetric information (Diamond, 1984 and 1991; Fama 1985; Rajan, 1992, Holmstrom and Tirole, 1997, and Bolton and Freixas, 2000), to reduce agency conflicts related to financial intermediation (Deloof and Vermoesen, 2010), to increase accessibility to loans, and to reduce the interest cost (Houston and James, 1996; Pertersen and Rajan, 1995). This leads to less dependence of firms on the liquidity of cash flow within the firms. Hence, firms can easily invest in fixed assets with lower cost of capital, and reserves cash will be further optimized to increase profitability (Fazzari et al., 1988; Hoshi et al., 1990; and Ramirez, 1995). Shen et al. (2004) argue that when a firm has a strong banking relationship, firm's investment is less sensitive to cash flow. Diamond (1984) finds that a close relationship allows the bank to undertake an active monitoring role which can alleviate problems related to free-riding and information asymmetry. In addition, when firms establish close banking relationship through repeated lending from a bank, they will increase their prestige on the various funding channels. Diamond (1991) also indicates that firms choose bank funding first in order to establish sufficient credibility and then access the capital markets. Kutsuna et al. (2003), researching impact of banking relationships to access the capital markets of Japanese firms, find that when firms build good relationships with commercial banks, they increase accessibility to equity capital markets. Furthermore, building up close relationships with banks helps firms overcome financial or business distress (Hoshi et al., 1990). Finally, many empirical researches have evidences of effects of banking relationship on firm performance.

However, firms not only get the benefits from establishing close relationships with banks, but also face certain risks. Dass and Massa (2006) point out that through the bank lending activity, banks act as "insiders". They play a supervisory role and do not encourage managers to accept investments in high risk projects. This cause firms not to achieve profit breakthrough, and then their stock prices will become more stable. Thus, the stock liquidity will be reduced.

In the process of building sustainable relationships, banks hold a lot of information (especially the sensitive and important information) related to the firms performance, the banks will disclose information to competitors intentionally or unintentionally. This problem will become more serious (Berger and Udell, 1998). The more long term relationships firms build, the more monopoly information banks increasingly require. This may allow banks to ask firms about higher interest rate and more collateral in the future (Suwannaporn, 2003). Greenbaum et al., (1989), Sharpe (1990), Thadden (1995) and Rajan (1992) agree with this view and argue that when banks are capable of observing confidential information from the borrower, it can cause a lock-in problem. It means that firms can not release the information to other financial institutions to set up credit relationship with them, and then they have to face to the hold-up problem. This creates a switching cost, or losses valuable investment opportunities.

Small firms usually tend to switch banks, especially when they have growth opportunities (Farinha and Santos, 2001). In order not to lose power of governing firms, banks tend to restrain their expected growth (Gambini and Zazzazo, 2009). In another aspect, when firms have long-term banking relationship, they will easily be funded to overcome distress. Banks may decide to extend further loan in order to recover its previous loan (Boot, 2000). Then, the soft-budget constraint problem occurs when firms rely on others and lack of effort to prevent the negative effects since they expected that banks will help them eventually.

The impact of banking relationships on business performance under some angles as follows:

Banking relationship increases the value of shareholder's equity: James (1987) argues that when firms announce publicly on the new loan contracts or the extension of banks credit, their stock price will increase. This finding reinforces Fama's research (1985) when he says the bank's loans provide firms a degree of certainty about future cash flow. James and Weir (1990), and Slovin and Young (1990) conclude that if firms have bank lending relationship, initial public offerings (IPOs) will be less underpriced than IPOs for others. Billett et al. (1995) explore the relationship between lender quality and loan announcement – day return. They find that if firm borrows from the higher quality lender, loans are associated with positive and statistically significant price reaction. Conversely, loans announcement from the lower quality lender has negative impact on price. These

show that the value of shareholder's equity will increase when firms establish good banking relationships.

Banking relationships impact on firm investment: Studies of Fazzari et al. (1988), Hoshi et al. (1990), Ramirez (1995), and Shen et al. (2004) point out that creating a good relationship with bank will improve the financial structure of the business. However, the more close relationships with banks firms have, the more they get dominated by banks through their supervisory activities. Banks are less likely to encourage firms to make decisions to invest in risk areas, therefore it is difficult for firms to expand scale. This becomes true if firm size is small (Dass and Massa, 2006) or firm depends on credit of a main bank (Gambini and Zazzazo, 2009).

Banking relationships influence business performance and growth: Banking relationship has different impacts on firm performance and growth. Rajan (1992) finds out that firms can settle hold – up problem by setting up multiple bank relationships. Hiraki et al. (2003) reinforce this view that if firms belong to a main bank relationship, their profit will decrease; on the contrary, multiple main bank relationships will reduce the hold – up cost and lead to higher profitability. However, multiple bank relationships can be costly (duplicated monitoring, free rider problems, or restructuring of debt claim) and bring about decrease in profitability. Castelli et al. (2006) demonstrates that firms' profitability (ROE and ROA) decreases as the number of bank relationships increases. Fok (2004), using sample of Taiwanese firms around the 1997 Asian financial crisis, points out a negative relation between firm performance and the number of domestic-bank relationships, but a positive relation between firm performance and the number of foreign-bank relationships. Yosha (1995) and Degryse and Ongena (2001) argue that if firms disclose proprietary information to creditors, firms establishing bilateral bank relationship will gain higher sales profitability than those establishing multilateral bank relationship.

Studies in effects of duration bank relationship on firms' performance and growth are given various results. Gambini and Zazzazo (2010) investigates Italian manufacturing firms in the period 1998 – 2003 and shows that small firms maintaining stable credit relationship with a main bank during the three-year survey (long-lasting bank ties) grow less than bank-independent small firms; however, long-lasting bank ties of medium firms have a positive relation with growth. Castelli et al. (2006) find that sales over assets has quadratic function relation with duration bank relationship, the more longer duration firms get, the more firm sales over assets decreases.

The study of Hiraki et al. (2003) is the one of the rare studies on bank loans quantity. They show negative relation between total main bank loans to total liabilities and ROA, and conclude that the hold – up costs of main bank relationships damage the profitability of the firm.

3. Methodology and Research Model

3.1 Methodology

Research data in the paper are presented in panel data. By using panel data regression, we decide between fixed or random effects through running a Hausman test where the null hypothesis is that the preferred model is random effects versus the alternative the fixed effects (Baltagi, 2005; and Park, 2009).

3.2 Research Model

The performance of firms may be affected by two main factors: (i) banking relationship, and (ii) firm characteristics. Banking relationship can include some variables like number of bank relationships, credit financing relationships or loan bank relationships, duration of bank relationships, bilateral and multilateral bank relationships. Besides, firm performance also is affected by firm characteristics like age, size, growth or tangible asset structure.

In this study, banking relationship factors include: (i) Number of bank relationships and (ii) Credit financing relationships. If firms are provided a large amount of credit, the firms have strong credit relationships. This study uses factor of "credit financing relationships" calculated as follows: First, the ratio of short-term or/and long-term bank loans to total liabilities of a firm are calculated; and then, the average ratio of short-term or/and long-term bank loans to total liabilities of all firms in sample research are estimated. Thus, there are three variables: short-term credit financing relationships, long-term credit financing relationships, and overall credit financing relationships. If each ratio of a firm is greater than average ratio corresponding, it means that this firm has a significant involvement of bank loans (short-term, long-term or overall) than others, and this variable takes value 1. By contrast, this takes value 0. Thus, these variables are dummy ones classifying the strength or weakness of relationship through amount of credit provided.

Firm characteristics used in this research contain variables as follows: age, size, tangible asset structure and type of ownership. The dependent variables demonstrating firm performance are return on assets (ROA) and return on equities (ROE).

There are two general models to examine two cases as follows:

Case 1: Analyzing the impact of the number of bank relationships, short-term credit financing relationship and long-term credit financing relationships on the firms' performance. The model is given by:

Profit = f(number of bank relationships, short-term credit financing relationship, long-term credit financing relationships, age, size, tangible asset structure and type of ownership).

Case 2: To understand the impact of the number of bank relationships and overall credit financing relationships (both short and long term) on the firms' performance. The model is as follows:

Profit = f(number of bank relationships, overall credit financing relationships, age, size, tangible asset structure and type of ownership).

3.3 Measuring Variables

Dependent variables: Firm performance is measured by its profit, including the two sub-variables: ROA and ROE. ROE is equal to return after tax on equities, and ROA is equal to return before tax on assets.

Independent variables: Banking relationship variables are main independent variables. They contain four variables: number of bank relationships, short-term credit financing relationship, long-term credit financing relationships and overall credit financing relationships.

(i) Number of bank relationships (Banknumber and [Banknumber]^2): This variable has quadratic function relation with dependent variable (Castelli et al., 2006). This means that when firms increase number of bank relationships, they will increase the power of negotiation, reduce hold-up cost, easily get more loans for investment, and improve the liquidity of cash flow, resulting firms' performance increase (measured by *Banknumber* variable). However, if firms setting up so many number of bank relationships, they will bear the raise of transaction costs and representative costs. These cost outweigh from positive effects above, so they make reduction of profits (measured by *[Banknumber]*^{2} variable). *Banknumber* variable is defined as total of number banks lending firms loans in fiscal year. *[Banknumber]*^{2} is equal to *Banknumber* squared.

(ii) Short-term credit financing relationships (ShortRelation): This is a dummy variable and is determined that if the ratio of short-term bank loans to total liabilities of a firm is greater than the average ratio of short-term bank loans to total liabilities of all firms, it takes value 1. Otherwise, it gets value 0. This variable is equal to one, meaning that the firm has a significant using of bank loans than others. Although firms create the strong relationship with banks, they take advantage of this relationship to handle short-term business problem through short-term overfunding. This demonstrates that when firms are under-pressure by liquidity of cash flow, or concentrate on overgrowth in short – term, they have to accept the increase in financing cost. It is expected that *ShortRelation* variable associates negatively to firm performance.

(iii) Long-term credit financing relationships (LongRelation): This is a dummy variable and is determined as follows: if the ratio of long-term bank loans to total liabilities of a firm is greater than the average ratio of long-term bank loans to total liabilities of all firms, it takes value 1 and otherwise, it take zero. When the variable is equal to one, it means that the firm has stronger long-term credit financing relationships than others. The long-term loans will promote the sustainable long-term investment activities of firms, and create their effective performance. *LongRelation* impact is expected to be positive on firm performance.

(iv) Overall credit financing relationships (CreditRelation): It is a dummy variable and is defined that if the ratio of total bank loans to total liabilities of a firm is greater than the average ratio of total bank loans to total liabilities of all firms, it will be equal to one and otherwise is zero. Establishing strong overall credit of banking relationship helps firms improve their liquidity of cash flow and financing easily their business or investment. Therefore, there may be existence of positive influence between *CreditRelation* and firm performance.

Besides banking relationship variables, there are firm characteristics variables, including:

(i) Firm size: This variable is measured by the logarithm of total assets (*LnAsset*) and logarithm of turnover (*LnTurnover*). It is expected that firm's size associates positively to firm's performance because following reseons: First, small firms are less likely to be close to the minimum efficient scale needed to operate efficiently in a market (Audretsch and Mahmood, 1994; and Geroski and Mata, 2005). Second, small firms apply different technologies in accordance with their size. Due to small scale, they use less capital intensive approaches, so variable costs achieve a higher ratio within the total costs of the firm. In a case of lowering prices, small firms find it difficult to bear these costs for a long time; thus, they are less efficiency (Matta and Portugal, 1994 and Petrunia, 2002). Furthermore, small firms' market power is weak, and their operations are in niche markets, which are uncertain. They are more vulnerable to temporary demand shocks and the uncertainties of the market

than large firms (Dhawan, 2001). Moreover, small firms are typically less diversified than larger firms, which may deteriorate their survival prospects by increasing risk and failing to keep alive options in a fiercely competitive market (Geroski and Mata, 2005).

(ii) Firm age: It is measured by the logarithm of the number of years since the inception of the firm to the observation date, including variables: *LnAge* and $[LnAge]^2$. Stinchcombe (1965) shows that older firms can gain experience-based economies. It expects that there is a positive relationship between *LnAge* and firm's performance, but a negative relationship between $[LnAge]^2$ and firm performance.

(iii) Asset Tangibility structure: It is measured by the ratio of fixed assets to total assets. Firms retaining large investments in tangible assets will have smaller costs of financial distress than firms relying on intangible assets (Akintoye, 2008). Thus, asset tangibility is expected to associates positively to firm performance.

(iv) State Ownership: This variable represents the state ownership. State ownership is a specific characteristic of companies listed on Vietnam's stock market. State ownership characteristic includes two variables: *State1* and *State2*. *State1* is equal to 1 if the state owns more than 35% firm's equity, and otherwise it is zero. *State2* takes value 1 if the state owns from 5% to 35% firm's equity, otherwise it takes value zero. If the state's equity represents only 0% to 5%, the state is only a small shareholder (Vietnamese Securities Law, 2010), and it has less power of voting/vetoing. If the state owns from 5% to 35% firm's equity, the state is a major shareholder, but it is not strong enough to veto on any business issues of firm (Vietnam law on enterprise, 2005). If the state holds shares of 35% or more, the state is a major shareholder and has enough power of vetoing on any business issues of firm (Vietnam law on enterprise, 2005). In state firms, the capital is from the government (the state), and a firm's managers are not its owners, so the responsibility of efficiency in state firms is generally lower than it is in other types of firms. Besides, state firm's organization is bulky and higher costs, and these firms have less profit. From above reasons, firms with higher state shares are influenced more by operation styles of state firms, and so they are less efficiency. Thus, state ownership variables (*State1* and *State2*) may impact negatively on firms' performance.

3.4 Study Data

The study data includes 465 out of 671 non- financial firms listed on the HOSE (Ho Chi Minh Stock Exchange) and HASE (Ha Noi Stock Exchange) of Vietnam from 2007 to 2010. Sample rate reached 69.3% of population (465/671) – relatively large sample ratio. This study excludes financial institutions such as investment funds, insurance firms, and securities firms from the sample because their asset and capital structure have different characteristics to non- financial firms.

Up to April, 2011, the total of number of banks working with the analyzed companies is 61, in which 5 banks of State Development and Policies, 37 banks of Joint – Stock Commercial, 6 banks of Joint – Venture, and 13 banks of 100% foreign capital and foreign bank branches.

4. Empirical Results

4.1 Statistical Description

Table 1 shows the statistical description of variables in the sample. The average number of banks companies have lending relation is 2.65 and the maximum number of banks companies have lending relation is 8. The ratio of short-term bank loans to total liabilities of firm that is greater than the average ratio of short-term bank loans to total liabilities is 57%. Similarly, the ratio of long-term bank loans to total liabilities of firm that is greater than the average ratio of long-term bank loans to total liabilities is 41%. The average asset tangibility structure is 0,21. The number of firms holding state shares of 35% or more is 18%, the number of firms having state shares of from 5% to below 35% is 38%, and the number of firms owing state shares below 5% is 44%. The ratios of ROA and ROE are 9% and 17%, respectively.

4.2 Empirical Result Analysis

There are two popular models used to estimate panel data: fixed effects model (FE) and random effects model (RE). To decide between fixed or random effects, a Hausman test is run. The Hausman specification test compares fixed effect and random effect models. With null hypothesis, a random effect model is preferred, and vice versa. Hausman test results of two regression cases are summarized in Table 2.

According to analysis results in table 2, the coefficient Prob (chi2) are less than 0.05. It means that Hausman test is significant at 5% level (rejecting the hypothesis H_0). Thus, it is better to use fixed effects model to estimate two regression cases. Table 3 provides the results of the regression of the two performance measures (ROA and ROE) in four specificaitons.

Table 1. The statistical description of variables

Variables	Obs	Mean	Min	Max	Std. Deviation
Banknumber	1860	2.65	0	8.00	1.53
$Banknumber^2$	1860	9.36	0	64	10.37
Short Loan Credit	1860	99.45	0	3,513	246.22
Long Loan Credit	1860	102.74	0	8,108	494.16
Total Loan Credit	1860	202.19	0	10,772	630.38
Short Relation (dummy)	1860	0.57	0	1	0.49
LongRelation (dummy)	1860	0.41	0	1	0.49
CreditRelation (dummy)	1860	0.30	0	1	0.46
Tang	1860	.21	.00	.98	.20
LnTurnOver	1859	26.33	20.13	30.34	1.41
LnAge	1860	2.59	.00	4.42	.79
$LnAge^2$	1853	5.18	0	8.84	1.59
LnAsset	1860	26.50	21.07	31.09	1.34
State 1	1860	.18	0	1	.38
State 2	1860	.38	0	1	.49
State 3	1860	.44	0	1	.496
ROA	1860	.09	-.33	2.77	.13
ROE	1860	.17	-1.34	.75	.14

Observing estimation results of four specifications (I, II, III and IV) in table 3, the all significance value of the F statistics of these models are less than 0.05, which means that at least one coefficient at each specification is different from 0. These results indicate that the overall models are statistically significant. Additionally, all significance value of the Wald statistics of four specifications are less than 0.05, so we reject the null hypothesis of homoskedasticity (the null is heteroskedasticiy) at four specifications. The two R Squares, the coefficient of determination, at specification I and III show that more than half the variation in ROE and ROA is explained by the model. However, R Squares in specification II and IV show that nearly half the variation in ROE and ROA is explained by the model.

The effects of the independent variables on firm performance described in table 3 are as follows:

The impact of the number of bank relationships (Banknumber) on firm performance: This variable is statistically significant in all four specifications and has negative relation to ROA and ROE. Castelli et al. (2006) find the negative influence between number of bank relationships and firm performance. While Garriga (2006) points out the opposite. The estimation result of this research is similar to Castelli's result. Although increase in number of bank relationships helps firms increasing in number of credit supply resources and solving the hold-up problem, firms may face to the rise of transaction costs, representative cost and free-riding problem. Moreover, firms in Vietnam have to accept high interest rate in this period (normally, if firms increase number of bank relationships, they will increase the power of negotiation. Thus, they may get lower interest rate). In the period 2008 – 2010, Vietnam economy faced galloping inflation, so the government had to use monetary policy tightening in attempt to curb inflation. This leaded to the increase in interest rate. The rate sometimes reached 24% per year.

Like a coin with two sides, increasing the number of banks in banking relationship help firms easily find more source of funding, but this makes firm easily use credit provided to business activities not appraised carefully. In fact, if the firm gets credit financing from a previous bank, the next banks will become more easily to provide credit to the firm because they often rely on the evaluation of the previous bank. Consequently, the business may operate ineffectively. Hence, the negative effects of increasing the number of banks (transaction costs, free-riding problem, high borrowing cost...) outweigh the positive effects. This explains the existence of negative relation between number of bank relationships and firm performance.

Table 2. Hausman test results of two regression cases

No.	Cases	Dependence	Chi2	Prob(chi2)	Model choice
1.	Case 1	ROE	35.48	0.0012	Fix Effect
		ROA	43.34	0.0001	Fix Effect
2.	Case 2	ROE	23.20	0.0394	Fix Effect
		ROA	70.44	0.0000	Fix Effect

Table 3. The results of the regression

	Case 1		Case 2	
	ROE	ROA	ROE	ROA
	I	*II*	*III*	*IV*
R^2	0.65	0.43	0.56	0.47
Prob(Hausman Test)	0.0012	0.0001	0.0394	0.0000
Prob(F-Test)	0.0000	0.0000	0.0000	0.0000
Prob(Wald – Test)	0.0000	0.0000	0.0000	0.0000
Banknumber	-0.055***	-0.023***	-0.066***	-0.027***
[Banknumber]2	-0.0002	-0.0001	0.0003	-0.0001
ShortRelation	-0.036***	-0.016***		
LongRelation	0.020*	-0.001		
CreditRelation			0.003	-0.014***
Tang	-0.046**	-0.021	-0.045*	-0.018
LnTurnOver	0.009*	0.015**	0.01*	0.015**
LnAge	0.620	0.444	0.553	-0.42
LnAge2	-0.321	-0.219	-0.292	-0.209
LnAsset	0.009	-0.020***	0.011*	-0.018***
Year2007	0.009	-0.004	0.008	-0.003
Year2008	0.008	-0.0002	0.010*	0.001
Year2009	0.006	-0.0001	0.010**	0.011
State1	-0.027*	-0.018*	-0.030*	-0.018*
State2	-0.022*	-0.006	-0.027*	-0.007
Cons	-0.85	0.29**	-0.109	0.25**

Notes: (***) Significant at 1% level, (**) Significant at 5% level, (*) Significant at 10% level.

The impact of short-term credit financing relationship on firm's performance: This variable is statistically significant in the specification I and II. Theoretically, when firms establish strong short-term credit financing relationships, they have opportunity to achieve more effectively short-term business activities; thereby this affects firm performance on overall. In fact, there are no previous experimental studies on effects of short-term credit financing relationships to firm performance. Hiraki et al. (2003), use the ratio total main bank loans to total liabilities to estimate their models, find this variable has negative relationship to firms' performance. This study in Vietnam uses short-term credit financing relationships to estimate the banking relationships in models. This empirical result shows that there is a negative impact of short-term credit financing relationship on firm performance. It is likely that firms having strong short-term credit financing relationships are less effective than the others. This is likely explained that Vietnam firms focusing on overgrowth (or short-term growing too fast) are not effective in the period 2007 – 2010 when the global financial crisis and domestic economic distress are happening. The effort of speeding up activities in the short-term is ineffective when market purchasing power declines seriously. Therefore, firms fall into distress condition and face short-term cash flow pressures. Additionally, having strong short-term credit financing relationship (it may be a sign of falling into distress) helps firms solve hold-up problem in short-term, but firms have to accept higher borrowing cost in trade-off. Finally but not last the last, in fact, some firms usually use short-term loans to cover to long-term businesses. Above reasons explains why the short-term credit financing relationship associates negatively to firm performance.

The impact of long – term credit financing relationship on firm performance: This variable is used in specification I and II to explore the effect of long-term credit financing relationship to firm performance. This research finds out that firms having strong long-term credit financing relationships are more effective than other firms. It's likely that concentrating on long-term growth through long-term investment helps firm create sustainable performance. This result also shows that the speed of increase in return after tax is more rapid than the speed of increase in equity to firm having strong long-term credit financing relationship. This implies that firms having the strong relationship use financial leverage better than other firms.

There is no statistically significant relationship between this variable and ROA. It means that there is no difference in ROA between firms having strong long-term credit financing relationships and the others. It may conclude that firms establishing strong long-term credit financing relationships use financial leverage (in long – term loans) better, but their effectiveness of using total assets is not significantly better. These lead to the

difference in ROE but the indifference in ROA between two groups of firms.

The impact of overall credit financing relationship on firm performance: This variable is used in specification III and IV to examine the influence of overall credit relationship to firm performance. Theoretically, if firms achieve strong overall credit financing relationship, firms will have more opportunities to get profit. This study do not find out the statistically significant difference in ROE between firms having strong overall credit financing relationships and the remaining firms (specification III). However, this variable is statistically significant in specification IV, showing difference in ROA between the two groups of firms. It's likely that an increase in assets through credit financing reduces effectiveness of using total assets in general.

The impact of tangible asset on firm performance: Son (2003), examines the effect of capital structure on firm performance in Vietnam, does not find out any statistically significant relationship between two variables. However, this research shows the negative relation between this variable and firm performance. This result is consistent with study of Garriga (2006) that an increase in tangible assets reduces firm performance.

The impact of turnover on firm performance: While Zeitun and Titan (2007) do not figure out any relationship between two variables, this study indicates a statistically significant positive relationship between turnover and firm performance. This is consistent with previous studies that an increase in turnover helps firms increase their profit, but this increase is negligible.

The impact of state ownership (State1) on the firm performance: This variable has statistically significant in all four specifications and has negative relationship to ROA and ROE. State ownership in enterprises is one of characteristics of Vietnamese economy. Son (2008) points out that if the State owns over 50% of capital in the firm, firm's performance will become worse. This study figures out that if the state just owns more than 35% of capital of any firm, the firm will be less effective than the rest. Firms having over 35% State ownership take advantage of accessing to loans with cheaper financial cost than others. However, they may not turn this advantage into reality. It is likely that if firms have more state ownership rate, firms' governance structure becomes heavier. They increase free-riding and their governance system is less flexibility. These outweigh the advantages that the firms take from the state ownership.

The impact of state ownership (State2) on the firm performance: While *State1* variable affects both ROE and ROA in four specifications, *State2* variable only impacts negatively on ROE (specification I and II). It is likely that although firms having over 35% State ownership own large-scale assets and easily access to loans, the use of total assets and equities are both ineffective while firms having 5%-35% State ownership use equities ineffectively.

The impact of asset on the firm performance: It is measured by total asset (tangibles and intangibles) to measure the impact of total assets on the firm performance. This study finds out statistically significant relationship between these two variables (excepting specification I) while Son (2008) finds no association. The result in table 2 shows that total assets have positive relationship to ROE while they have negative impact to ROA.

Beside the statistically significant variables explained above, the remaining variable, age, is not statistically significant (excepting specification III).

5. Conclusions and Recommendations

5.1 Conclusion

This study uses a sample of 465 companies listed in Ho Chi Minh and Ha Noi Stock Exchange in Vietnam, including 1,860 observations in period 2007 – 2010 in order to examine the effects of banking relationship on firm performance. The results are summarized as follows:

(i) The more number of bank relationships firms increase, the more firm performance decrease. (ii) Credit financing relationship is one of factors representing banking relationship. This factor includes in three variable such as short-term credit financing relationship, long-term credit financing relationships and overall credit financing relationships. This research points out that if firms establish strong short-term credit financing relationship, their performance will reduce. Inversely, if firms build strong long-term credit financing relationship, they will increase the performance. These imply that focusing on short-term growth is not appropriate for firms while focusing on long-term growth helps firm get better performance. In terms of overall credit financing relationships, firms having the strong relationship use assets ineffectively which lead to the negative association between this variable and ROA. (iii) The increase in total assets during this period through borrowing from banks reduces the effective use of assets but improves financial leverage and these lead to increase in effectiveness of using equity. (iv) Effort on increasing turnover helps firms improve profits. (v) The use of tangible assets through debt financing from financial institutions is ineffective leading to reduction of

firms' performance. (vi) Currently, Vietnam economy is operating in a so-called "transition stage", and the State still plays a dominant role in the market. One of its manifestations is that the ratio of state ownership in the listed firms is still high. So, firms having over 35% State ownership are less effective than the others.

5.2 Recommendations

Based on the results above, we suggest some recommendations as follows:

(i) Firms should focus on quality of banking relationship rather than trying to establish more number of relationships. Establishing more number of bank relationships in distress period helps firms increasing in number of credit supply resources and solving the hold-up problem, but firms face to the rise of transaction costs, representative cost and free-riding problem. This trade off is negative.

(ii) Firms should improve the efficiency of using bank credit in short-term business activities, and avoid the trap of growing too fast (the growth trap). Once firms overcome the pressure of short-term performance through improving managerial activities, firms will have essential condition concentrating on improving long-term business activities radically. This helps firm grow sustainably and get higher performance.

(iii) Banks should consider "lemon problem" from firms which tend to increase more number of bank relationships. This increase is likely that firms are looking for more sources of credit financing to solve short-term problem in the distress period instead of solving radically business activities. The correct analysis of firms' loan purpose helps banks avoid the "lemons problem" and helps firms not fall into free-riding problem. Banks should also eliminate the routine of easily financing credit to firms which are financed credit from previous banks.

(iv) The State may carefully consider reducing the domination to the economy by reducing ownership rate out of firms which it owns more than 35% equity, or requiring the State-owned enterprises to reduce State ownership rate out of the firms listed.

References

Akintoye, I. R. (2008). Effect of capital structure on firms' performance: the Nigerian experience. *European Journal of Economics, Finance and Administrative Sciences, 10*, 233- 243.

Audretsch, D. B., & Mahmood, T. (1994). The Rate of Hazard Confronting New Firms and Plants in US Manufacturing. *Review of Industrial Organization, 9*(1), 41-56. http://dx.doi.org/10.1007/BF01024218

Baltagi, B. H. (2005). *Econometric Analysis of Panel Data* (3rd ed.). John Wiley & Sons.

Berger, A. N., & Udell, G. F. (1998). The Economics of small business finance: the roles of private equity and debt market in the financial growth cycle. *Journal of Banking and Finance, 22*, 613-673. http://dx.doi.org/10.1016/S0378-4266(98)00038-7

Billett, M. T., Flannery, M. J., & Garfinkel, J. A. (1995). The effect of lender identity on a borrowing firm's equity return. *Journal of finance, 50*, 699-718. http://dx.doi.org/10.1111/j.1540-6261.1995.tb04801.x

Bolton, P., & Freixas, X. (2000). Equity, Bonds, and Bank Debt: Capital Structure and Financial Market Equilibrium under Asymmetric Information. *Journal of Political Economy, 108*, 324-351. http://dx.doi.org/10.1086/262121

Boot, A. W. A. (2000). Relationship Banking: What Do We Know? *Journal of Financial Intermediation, 9*, 7-25. http://dx.doi.org/10.1006/jfin.2000.0282

Campbell, T. S. (1979). Optimal invesment financing decisions and the value of confidenciality. *Journal of Financial and Quantative Analysis, 14*, 232-257.

Castelli, A., Dwyer, G. P. Jr., & Hasan, I. (2006). Bank relationships and small firms' financial performance. Federal Reserve Bank of Atlanta. *Working paper* 2006-5.

Dass, N., & Massa, M. (2006). The Dark Side of Bank-Firm Relationships: The (Market) Liquidity Impact of Bank Lending. Georgia Institute of Technology. *Working paper*.

Degryse, H., & Cayseele, P. V. (2000). Relationship Lending within a Bank-Based System: Evidence from European Small Business Data. *Journal of Financial Intermediation, 9*, 90-109. http://dx.doi.org/10.1006/jfin.1999.0278

Degryse, H., & Ongena, S. (2001). Bank relationships and firm profitability. *Financial Management Spring*, 9-34. http://dx.doi.org/10.2307/3666389

Deloof, M., & Vermoesen, V. (2010). The value of bank relationships: Evidence from Belgium at the start of the

Great Depression. *Working paper*. University of Antwerp and Louvain School of Management.

Dhawan, R. (2001). Firm Size and Productivity Differential: Theory and Evidence from a Panel of US Firms. *Journal of Economic Behavior & Organization*, *44*, 269-293. http://dx.doi.org/10.1016/S0167-2681(00)00139-6

Diamond, D. (1984). Financial Intermediation and Delegated Monitoring. *Review of Economic Studies, 51*, 393-414. http://dx.doi.org/10.2307/2297430

Diamond, D. (1991). Monitoring and reputation: the choice between bank loans and privately placed debt. *Journal of Political Economy, 99*, 689-721. http://dx.doi.org/10.1086/261775

Fama, E. (1985). What's Different about Banks? *Journal of Monetary Economics, 15*, 29-39. http://dx.doi.org/10.1016/0304-3932(85)90051-0

Farinha, A. L., & Santos, A. C. J. (2001). Switching from single to multiple bank lending relationships: Determinants and implications. *Journal of Financial Intermediation, 11*(2), 124-151. http://dx.doi.org/10.1006/jfin.2001.0328

Fazzari, S. M., Hubbard, R. G., & Peterson, B. C. (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity*, 141-206. http://dx.doi.org/10.2307/2534426

Fok, C. W., Chang, Y. C., & Lee, W. T. (2004). Bank relationships and their effects on firms performance around the asian financial crises: evidence from Taiwan. *Financial Management,* Summer, 89-112.

Gambini, A., & Zazzazo, A. (2009). Who captures who? Long-Lasting bank relationships and growth of firms. Università Politecnica delle Marche - Faculty of Economics. *Working paper*.

Garriga, M. J. (2006). The effect of Relationship Lending on Firm Performance. Department of Business Economics, Universitat Autonoma de Barcelona. *Working paper*.

Geroski, P. A., & Mata, J. (2005). Founding Conditions and the Survival of New Firms. Retrieved from http://www.mpiew-jena.mpg.de/english/news/workshops/egpworkshop/Geroski_etal.pdf

Greenbaum, S. I., Kanatas, G., & Venezia, I. (1989). Equilibrium loan pricing under the bankclient relationship. *Journal of Banking Finance, 13*, 221-235. http://dx.doi.org/10.1016/0378-4266(89)90061-7

Hiraki, T., Ito, A., & Kuroki, K. (2003). *Single versus Multiple Main Bank Relationships: Evidence from Japan*. Social Science Research Network.

Holmstrom, B., & Tirole, J. (1997). Financial Intermediation, Loanable Funds and the Real Sector. *Quarterly Journal of Economics, 112*, 663-691. http://dx.doi.org/10.1162/003355397555316

Hoshi, T., Kashyap, A., & Scharfstein, D. (1991). Corporate structure, liquidity and investment: Evidence from Japanese industrial groups. *Quarterly Journal of Economics, 106*, 33-60. http://dx.doi.org/10.2307/2937905

Houston, J., & James, C. M. (1996). Bank information monopolies and the mix of private and public debt choices. *Journal of Finance, 51*, 1863-1889. http://dx.doi.org/10.1111/j.1540-6261.1996.tb05229.x

James, C. (1987). Some Evidence on the Uniqueness of Bank Loans. *Journal of Financial Economics, 19*, 217-235. http://dx.doi.org/10.1016/0304-405X(87)90003-1

James, C., & Weir, P. (1990). Borrowing relationships, intermediation and the cost of issuing public securities. *Journal of Financial Economics, 28*, 149-171. http://dx.doi.org/10.1016/0304-405X(90)90051-Z

Kutsuna, K., Smith, K. J., & Smith, L. R. (2003). Banking Relationships and Access to Equity Capital Markets: Evidence from Japan's Main Bank System. Claremont Colleges. *Working paper*.

Mata, J., & Portugal, P. (1994). Life duration of new firms. *The Journal of Industrial Economics*, *42*(3), 227-245. http://dx.doi.org/10.2307/2950567

Park, H. M. (2009). Linear Regression Models for Panel Data Using SAS, Stata, LIMDEP, and SPSS. *Working paper*. Indiana University.

Peltoniemi, J. (2004). *The Value of Relationship Banking: Empirical evidence on small business financing in Finnish credit markets*. Faculty of Economics and Business Administration, Department of Accounting and Finance, University of Oulu.

Petersen, M., & Rajan, R. (1995). The Effect of Credit Market Competition on Lending Relationships. *Quarterly Journal of Economics, 110*, 406-443. http://dx.doi.org/10.2307/2118445

Petrunia, R. (2002). Start-up Conditions and the Post-Entry Experience of New Firms. Retrieved from

http://www.sauder.ubc.ca/research/research_centres/era/arena1/papers/paper%202.pdf

Rajan, R. G. (1992). Insiders and outsiders: the choice between informed and arm's length debt. *Journal of Finance, 47*, 1367-1400. http://dx.doi.org/10.1111/j.1540-6261.1992.tb04662.x

Ramirez, C. (1995). Did J.P. Morgan's men add liquidity? Corporate investment, cash flow, and financial structure at the turn of the twentieth century. *Journal of Finance, 50*, 661-678. http://dx.doi.org/10.1111/j.1540-6261.1995.tb04799.x

Sharpe, S. A. (1990). Asymmetric information, bank lending and implicit contracts: a stylized model of customer relationships. *Journal of Finance, 45*, 1069-1087.

Shen, C. H., & Wang, C. A. (2004). Does bank relationship matter for a firm's investment and financial contraints? The case of Taiwan. *Pacific Basin Financial Journal, 13*, 163-184. http://dx.doi.org/10.1016/j.pacfin.2004.07.004

Slovin, M. B., & Young, J. E. (1990). Bank lending and initial public offerings. *Journal of banking and finace, 14*, 729-740. http://dx.doi.org/10.1016/0378-4266(90)90073-B

Sơn, T. H. (2008). *Cơ cấu vốn và hiệu quả hoạt động doanh nghiệp của các công ty niêm yết trên SGDCK TPHCM*. Tạp chí Phát triển Kinh tế - Đại học Kinh tế Tp. HCM, 12.

Stinchcombe, A. L. (1965). *Social structure and organizations* (J.G ed.). Handbook of Organizations, Chicago, Rand McNally.

Suwanaporn, C. (2003). *Determinants of Bank Lending in Thailand: An Empirical Examination for the Years 1992 to 1996*. Peter Lang Publishing.

von Thadden, E. L. (1995). Long term contracts, short term investment, and monitoring. *Review of Economic Studies, 62*, 557-575. http://dx.doi.org/10.2307/2298077

Weinstein, D., & Yafeh, Y. (1998). On the Costs of a Bank-Centered Financial System: Evidence from the Changing Main Bank Relations in Japan. *Journal of Finance, 53*, 635-672. http://dx.doi.org/10.1111/0022-1082.254893

Yosha, O. (1995). Information disclosure costs and the choice of financing source. *Journal of financial intermediation, 4*, 3-20. http://dx.doi.org/10.1006/jfin.1995.1001

Zeitun, M., & Tian, G. G. (2007). Capital Structure and Corporate performance: Eviden from Jordan. *Australasian Accounting Bisness and Finace Journal, I*(4).

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Testing for Global Volatility Spillover, Financial Contagion and Structural Break in Fifteen Economies from Two Regions: A Diagonal VECH Matrix and EGARCH (1,1) Approach

Raisul Islam[1], M Talhatul Islam[1] & Abdul Hannan Chowdhury[1]

[1] School of Business, North South University, Dhaka, Bangladesh

Correspondence: Raisul Islam, Lecturer, School of Business, North South University, Bashundhara, Dhaka-1229, Bangladesh. Tel: 88-181-665-3221. E-mail: r.islam@northsouth.edu

Received: March 4, 2013 Accepted: April 3, 2013 Online Published: April 18, 2013

doi:10.5539/ijef.v5n5p159 URL: http://dx.doi.org/10.5539/ijef.v5n5p159

Abstract

This paper studies the transmission of volatility and financial contagion among 15 countries from two regions. The extensiveness and the scope of the current paper outlines the shifting of market attributes globally, in the pre and post financial crisis period. The most significant markets in the two regions (Asia/Pacific and Europe) are studied for own-volatility spillover up to five lags and cross volatility spillover in a multivariate GARCH diagonal VECH model framework. The switch of the regional market structure is captured with "structural break" phenomenon applying partial asymmetric EGARCH that overcomes non-negativity constraints of volatility clustering. The methods combined, compare and contrast the short term variability and long term regime shifts in the two most dynamic regions of the financial world in the post global financial crisis period.

Keywords: financial contagion, volatility spillover, structural break, diagonal VECH, EGARCH

1. Introduction

In last few decades, countries of all scale experienced rapid economic growth that led to enhanced capital market activities. The degree of real linkage increased significantly and brought about the need to abolish barriers, increasing the flow of capital throughout the economies, which can be attained by complete financial liberalization; and an undeniable element of financial liberalization is financial linkage across economies. Financial linkage is crucial in a sense, with majority of economies shifting to floating exchange rate regime; better macroeconomic stabilization requires a proper degree of financial linkage (Maneschilod, 2006). While this is desirable to attain financial linkage, experts suggest stock market integration is profound in industrialized economies with high degree of financial linkage (Gultekin et al., 1989; Mittoo, 1992; Taylor and Tonks, 1989). Such financial markets integration contradicts the contemporary theories of portfolio diversification, which suggest the lack of co-movement of equity markets motivate investors to invest in foreign equity markets to diversify risk. In absence of correlated markets, the actions of market makers and investors under the circumstances of idiosyncratic shocks or stochastic volatility, outlines the behavior of emerging and emerged markets.

The US market experienced an unstoppable flow of capital due to asset scarcity in the global market, which resulted in asset bubbles. The global financial crisis commenced as in the first phase mortgage backed securities in the US market experienced a simultaneous burst in bubble. In the aftermath of mortgage market crash many of the other alternative saving vehicles followed and the exacerbation of crisis resulted in the shortage of assets in the world economy. The massive upheaval in the US asset market eventually triggered scarcity in alternative vehicles through contingent and non-contingent channels, and recreated bubble in commodities such as oil markets. The increasing oil prices turned financial assets seeking petrodollar to the US market, and thus influenced stabilization, reducing destabilization caused by capital outflows. In the second phase, when the global growth fell steep, the deceleration of growth, in course of time reversed the tighten of commodity prices. Such resulted in reversion of bubble construction and destroyed bubble formation in commodities that commenced in the summer of 2008. The vicious cycle therefore, adjusted the economic bubble, leaving behind many partially and non-contingent economies in rubbles (Caballero et al. 2013).

Many studies examined the characteristics of recent episodes of local stock market "shocks" in non-contingent

markets such as Mexico(1982), Russia (1998), Brazil (1999), Thailand (1997), resulting from initiation of the process of abolishing the capital control by the host countries. The propagation of shock into uncorrelated markets spiked the interest of experts to apply new methods in non-contingent markets to examine the spread and aftermath of shocks. While emerging markets, with less financial linkages, surprised the experts with indication to shocks propelling from "ground zero" economy and spreading into economies, correlated to a lesser extent, the risks of financial linkage is enhanced. Arshanapalli and Doukas (1993) outlined that the 1987 stock market crash, fortified the stock market integration among the emerged economies. In addition, during Exchange Rate Mechanism Crisis of 1992-93, East Asian Crisis of 1997 and Russian Crisis of 1998 bears evidence of financial markets increased integration post-financial crisis (Chan Lau et al 2004). From the analysis of 1990s tech bubble by Chan Lau and Ivaschenko (2001), it is suggested that in bull markets, price synchronism intensifies. Bassler and Yang (2003) suggested in response, that such integration decreases the benefit of diversification, as the integrated markets offer little benefits if the market movements are parallel. Though during such propagation of shocks, mutual funds are preferred investment vehicle (Bhattacharyya and Nanda,1999), the role of mutual funds are largely scrutinized by Brown, Goetzmann and Park (1998); Eichengreen and Mathieson (1998); Kaminsky, Lyons and Schmuklar (2000,2001); Disyatat and Gelos (2001); Kim and Wei (2002). Previous studies focused on the stock market co-movement in the framework of local market turbulences and global crisis up to 2002, while the recent financial crisis of 2007 have altered the market relationships and behavior of number of markets to a great extent.

Collins and Biekpe (2003) defined the risk of "contagion" as the wider integration of equity markets, which may cause reversals in the international capital movement due to an enhanced level of foreign influence. The US mortgage market crash, resulting from integrated securitization is undoubtedly the recent most significant example of financial contagion in the literature of financial linkage. "Contagion" has been used largely in medicine, sociology and philosophy, bearing the meaning " transmission by direct or indirect contact; the spread of a behavior pattern, attitude, or emotion from person to person or group to group through suggestion, propaganda, rumor or imitation; the tendency to spread, as of doctrine, influence or emotional". The impact of financial contagion intrigued researchers during the Asian crisis. The shocks may propagate through crisis non-contingent and crisis contingent channels. "Monsoonal effect" of financial contagion is as described by Masson (1999) the contamination of stock market contagion among countries with similar macroeconomic policies. Crisis non-contingent channel contagion may spread trade links and financial links as well. Following a stock collapse in "ground zero" economy, investors tend to sell off assets to rebalance portfolio, and shocks propel through markets, resulting from market behavior rather than local turmoil; where the portfolio rebalancing is amplified by information asymmetry (Calvo, 1999). Crisis contingent channel propagation of contagion is best categorized by "shift contagion" and "pure contagion." "Shift contagion illustrates the propagation of shock beyond normal level"; during a crisis, while "pure contagion" is the transmission of contagion purely due to unexplained fundamentals generally identified post crisis period (Percolli and Sbracia, 2003; Dungey and Tambakis, 2005; Flavin and Panopoulou, 2010). Majority of the transition and non-transition economies are inflicted as volatility spillovers take place, causing reversals in the market confidence (Charumilind et al. 2006). In addition to financial linkage, real linkage plays an important role in integrating stock markets in different contingents. Real linkage or integration of economic fundamentals may give birth to idiosyncratic shocks, which alter market behavior more extensively after a crisis, contrasting to behavior prior to the crisis. In an example of the propagation of shocks caused by real linkage, let us assume there is private information to a market maker in the host country of an idiosyncratic shock. Now, to conceal the fact that the market maker takes his next move from the private information from dealer, or to protect a market from speculative attack, the market maker sells an asset of the host country, and a foreign asset, in order to rebalance portfolio. Speculators may also believe that the market makers actions are shaped by systematic information. A pool of such behavior propelled by asymmetric information causes contamination or can better be explained with volatility spillover into uncorrelated markets. Spillover of volatility intensifies in the presence of a crisis, which is better explained by capturing structural break in the system, and such behavior has been discussed profoundly in a number of empirical literatures. To be able to examine this phenomenon in the financially globalized markets, it is also important to illustrate the historic attributes of different markets around the world.

In the study conducted by Khallouli and Sendretto (2012), the accession of US market into some Middle Eastern and North African Muslim countries have been checked, which can be considered as one of the recent works in this class. The study on MENA countries reveal that US subprime crisis raises the probability of many markets in the region to shift from high-mean, low-variance to low-mean, high variance region. The study applied markov-switching model to trace the fixed transition probability of time varying relationship of risk and return. The experts suggested from the finding that the segmented MENA equity markets were less immune to the risk

of contagion and questioned the efficiency of international portfolio diversification in this part of the world. A study by Maneschiold (2006), checked long run, steady-state integration among Baltic stock markets and International Stock markets, using bidirectional causality, suggested the existence of low correlation with international turmoil. It was argued that these markets are less dependent on investment horizon and a greater benefit can be achieved in portfolio diversification; in spite of the markets having trace of local contagion compared to global volatility contagion. Similar study conducted by Gunduz and Hatemi-J (2005), applying similar causality among Hungary, Poland, Czech Republic examined with significant uni-directional and bi-directional causality, but such are less significant between Russia and Turkey. However, as Russia and Turkey in such case are immune to contagion effect, the researchers directed their focus on the weak-form of information efficiency between these two large-scale traders. While Southeast Asian economy has been envy to many economies, a relatively old study by Chancharoenchai and Dibooglu (2006) examined six Southeast Asian markets seeking volatility spillover effect and found strong evidence of relationship in 1997 Asian crisis framework. The significance of interaction reveals the degree of openness in these markets, while markets were left vulnerable to foreign shocks transmitted through real linkage.

There has been plethora of studies conducted in contradiction to popular belief relating to volatility contagion. The existing theories are categorized broadly into real linkage models and financial linkage models. *Real linkage* emphasizes on the propagation of shock through trade linkage and shocks are mostly idiosyncratic in nature (Helpman and Razin, 1978; Cole and Obstfeld, 1991; Backus, Kehoe and Kydland, 1992; Baxter and Crucini, 1993; Case and Pavlova, 2004). Most of these studies attempted to rationalize spillover effects in the presence of low correlations of fundamentals. However, empirical evidence are relatively unsupportive but abundant in this regard (Kaminsky and Reinhart, 2000; Mody and Teylor, 2002). Not only these studies failed to explain the causes for crisis to spread in East Asia, Latin America and Eastern Europe but also the reasons for financial crisis not to contaminate the neighboring countries despite of the existence of significant real linkages. The second branch of studies shifted the concentration to *financial linkage* in contagion. The dispute around the first *correlated information* channel introduced by King and Wadhwani (1990) which elaborates discussion on contamination of asymmetric information is spiked by *portfolio rebalancing* discussed largely in the studies of Fleming, Kirby and Ostdiek (1998). The later demonstrates the reactions of risk averse investors to private information, which may mislead the updating process of information. While it is believed that information is shared symmetrically among the markets, most volatile markets are characterized by information heterogeneity. In trace of eminent idiosyncratic shocks, strategic traders are endowed more with diverse information that leads to the transmission of contagion of volatility. Therefore, the impact of regime shifting is important to study in the field contagion and spillover study.

An important study conducted by Yuan (2005) outlined interesting attributes of financial contagion. Through the construction of rational expectations equilibrium (REE), Yuan suggested contagion and financial crisis opt to appear following a small shock, resulting in a large movement of assets, mostly towards negative direction. In markets of acute information asymmetry, if the condition of borrowing constraints exist, financial crisis is more likely. It can therefore, be suggested that contagion is mostly asymmetrical and asset prices in contagion prone economies are more skewed (Connolly and Wang, 2003). In contradiction to previous studies, Yuan (2005) proved through REE, that crisis is consequence not of common shocks but of investors borrowing constraints. Such constraints help crisis to propagate in economies through same group of investors during financial upheavals.

The current study examines global financial contagion and volatility transmission, with focus to the post financial crisis 2007 period. As observed from the previous section, most of the papers examined the spillover effect and contagion effect on sample markets ranging from specific markets to specific regions. While some of the previously conducted papers checked for market linkage applying cointegration and focused on stationary condition of stock index, this paper focuses on “leverage effect” and “volatility clustering” property of short term non-linear market data and tests the attributes of conditional variability of global financial market. The financial crisis of 2007 is responsible for altering financial markets across countries, and thus, this paper studies the transmission of volatility and financial contagion among 15 countries from two regions, with and without linkage to the US market (US accession). The extensiveness and the scope of the current paper outlines the shifting of market attributes globally, in the pre and post financial crisis period. The most significant markets in the two regions (Asia/Pacific and Europe) are studied for own-volatility spillover up to five lags and cross volatility spillover in a multivariate GARCH diagonal VECH model framework. The switch of the regional market structure is captured with “structural break” phenomenon applying partial asymmetric EGARCH that overcomes non-negativity constraints of volatility clustering. The methods combined, compare and contrast the

short term variability and long term regime shifts in the two most dynamic regions of the financial world is the post global financial crisis period.

2. Empirical Framework

To investigate the behavior of excess return volatility and volatility spillovers we consider the weekly stock prices of eight major Asia-Pacific Markets (India, Japan, China, South Korea, Taiwan, Malaysia, Singapore and Australia) for the Asia-pacific region and for the European region we consider seven major markets (Austria, France, Germany, Greece, Netherlands, Italy and United Kingdom) of Europe. The sample economies are selected on the basis of the probability of the markets being less homogeneous to each other. It must be noted that, in Asia/Pacific and in Europe some major economies are skipped because it seems, in the post-financial crisis period some of the contemporary major economies are reciprocal in nature, as the association increases among the market anomalies. Such a major economy in the European region would be Spain. Regardless of Spain being the fourth biggest economy in Europe, the financial crisis and the subsequent Eurozone crisis sends Spanish market tumbling as it does for Greece and for Italy (Castle and Jolly, 2012). To avoid such reciprocation, we consider the sample economies that should be more heterogeneous to each other. It is better to consider smaller economies, as they are believed to be more heterogeneous. The sample therefore emphasizes on structural dissimilarities of the markets as that would be more interesting to check for association among markets more divergent.

Weekly data offer some advantages over the use of daily data. Firstly, it evades the interferences linked with the use of corresponding data as the trading day of one country may overlap with a public holiday in another country. Secondly, it also circumvents the time zone differences. We collect the data over the period 8/11/1997 to 4/02/2013 and include 797 observations. For examining the impact of global financial shock, we consider US stock market index as the "ground zero" host market and used it as an exogenous shock. Weekly returns of the stock indices has been converted into logarithmic term where the series of observed returns converted into squared weekly returns which in fact gives the volatility estimate for each point in time (t). The range of the approximation has been calculated by taking the log of the ratio of the highest observed price to the lowest observed price for each weekly return at time (*t)*,

$$\sigma_t^2 = \log\left(\frac{High_t}{Low_t}\right)$$

In this paper, we form the joint process of prevailing stock market return indices for both Asia-Pacific and European region using the Multivariate GARCH-Diagonal VECH model. The conditional variance-covariance equations for the unbounded VECH model contain 21 parameters. The VECH model's conditional variance-covariance matrix has been bound to the form developed by, Bollerslev, Engle and Wooldridge (1988), where, *A* and *B* are assumed to be diagonal. The VECH model characterized by,

$$h_{i\,j,t} = \omega_{i\,j} + \alpha_{i\,j} u_{i,t-1} u_{\,j,t-1} + \beta_{i\,j} h_{i\,j,t-1} \quad \text{for } i\ ,\ j\ =\ 1,\ 2 \tag{1}$$

In equation (1), ω_{ij}, α_{ij} and $\beta_{ij,}$ are the parameters. The diagonal VECH multivariate GARCH model could also be articulated as an unbound order multivariate ARCH model, where the covariance is represented as a geometrically dilapidated weighted average of precedent cross products of unanticipated returns, with recent observations carrying higher weights.

The conditional variance-covariance matrix (H_t) has eight (i.e. for Asia-Pacific region), seven (i.e. for Europe region) dimensions with the diagonal, and non-diagonal components stand for the variance and the covariance stipulations, correspondingly. H_t can be expressed in the matrix form,

$$H_t = \begin{pmatrix} h_{11t} & h_{12t} & \cdots & \cdots & h_{18t} \\ h_{21t} & . & \cdots & \cdots & h_{28t} \\ \vdots & . & . & . & \vdots \\ \vdots & . & . & . & \vdots \\ h_{81t} & h_{82t} & \cdots & \cdots & h_{88t} \end{pmatrix} \tag{2}$$

In this matrix h_{ijt} is a conditional variance at the point of time *t* for the stock return of country *i* and refers to the conditional covariance linking the stock returns of country *i* and country *j* ($i \neq j$) at time *t*.

We used the diagonal VECH model (Bollerslev et al., 1988) to enhance the understanding of the conditional variance and covariance matrix since this model is more flexible when we use more than two variables (Scherrer and Ribarits, 2007). The diagonal VECH demonstration works, based on the theory that the conditional variance depends on squared lagged residuals and the conditional covariance depends on the cross-lagged residuals and lagged covariance of other series (Harris and Sollis, 2003). The diagonal VECH model can also characterized by,

$$VECH\ (H_t) = C + AVECH\ (\varepsilon_{t-1}\varepsilon'_{t-1}) + BVECH\ (H_{t-1}).\ e_t|\psi_{t-1} \sim N\ (0,\ H_t) \quad (3)$$

Where, A and B are 1/2 N (N +1) × 1/2 N (N +1) parameter matrices and C is a 1/2 N (N +1) ×1 vector of constants. The diagonal elements of matrix A (a_{11}, a_{22}, ⋯ ⋯ a_{88}) deals with the influence from previous squared innovations on the present explosive nature, which can also be expressed as own volatility shocks. On the other hand, non-diagonal essentials verify the cross product consequences of the lagged innovations on the cross-volatility shocks. In the same way, the diagonal elements of matrix B (b_{11}, b_{22}, ⋯ ⋯ b_{88}) provide the impacts from past squared volatilities on the current volatility which can be expressed as own volatility spillovers and non-diagonal elements determine the cross product effects of the lagged cross-volatilities on the cross-volatility spillovers.

Because of the non-negativity clause of the traditional GARCH (1,1) model, we follow the partial asymmetric GARCH model called EGARCH created by Nelson(1991) to detect the volatility clustering and leverage effect impact within these elected stock markets. The model measurements is given below,

$$\mathrm{Ln}\sigma^2_{j,t} = \omega_j + \beta_j\ \ln(\sigma^2_{j,t-1}) + \gamma\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}} + \alpha\left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^2_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] \quad (4)$$

$\sigma^2_{j,t}$ is one step forward estimate of variance also known as conditional variance, and $\omega,\beta,\gamma,\alpha$ are the parameters to be projected. The benefit of using EGARCH (1,1) model is that even if the parameters are negative, σ^2_t will always be positive. In equation (4) parameter α correspond to the symmetric effect of the model, β represents volatility persistence and γ denotes the leverage effects (Alexander, 2009).

3. Empirical Results

Table 1, presents the descriptive statistics for all the stock market indices along with the global market proxy US. The mean returns for all the stock indices are positive, array from a minimum 0.0005 (both China and Italy) to a maximum 0.1699 (Austria). According to the sample standard deviations, Australian stock return is the least volatile series with a standard deviation of 0.0077, while the stock return of South Korea could be considered as the most volatile series with a standard deviation of 0.0155. The first column of the table 1 represents the cross-correlation between Asia-pacific and Europe region with US stock indices. The correlation coefficients of Asia-Pacific region and US market seem excessively low compared to the Europe region. In Asia-Pacific, the highest correlation is with Australia (0.7716) and the lowest is with Malaysia (0.0915) indicating the level of interdependence between US market and Asian market is comparatively low. On the other hand, For Europe region, highest correlation of US market is with Austria (0.7979) and the lowest is with Greece (0.3660). For other markets of this region, correlation is more than .60 for all cases.

Table 1. Descriptive statistics for all stock indices

	Correlation	Mean	Median	Std. Dev.	Skewness	Kurtosis	J-B
TAIWAN	0.1965	0.0196	0.0171	0.0109	1.6727	7.33	993.45***
SINGAPORE	0.4160	0.0172	0.0141	0.0124	2.9342	16.58	7262.98***
SOUTH KOREA	0.2957	0.0239	0.0197	0.0155	1.9512	8.61	1549.77***
MALAYSIA	0.0915	0.0150	0.0108	0.0146	3.9360	26.26	20003.05***
JAPAN	0.4029	0.0182	0.0162	0.0105	3.6839	29.05	24312.53***
INDIA	0.4485	0.0214	0.0184	0.0125	2.1611	10.58	2526.52***
CHINA	0.2331	0.0129	0.0107	0.0084	1.6221	6.49	752.55***
AUSTRALIA	0.7716	0.0118	0.0098	0.0077	2.8177	15.85	6533.11***
UNITED KINGDOM	0.7644	0.0162	0.0137	0.0102	2.6376	16.17	6681.03***
NETHERLANDS	0.6065	0.0137	0.0112	0.0099	2.1806	10.34	2419.33***
ITALY	0.6325	0.0130	0.0104	0.0094	1.9492	8.61	1548.71***
GRECE	0.3660	0.0162	0.0132	0.0118	2.1387	10.06	2261.15***
GERMANY	0.6368	0.0209	0.0174	0.0132	2.2485	10.66	2621.40***
FRANCE	0.7196	0.0196	0.0168	0.0118	2.0798	10.23	2308.21***
AUSTRIA	0.7979	0.0184	0.0149	0.0137	3.8538	29.19	24749.86***
USA	-	0.0135	0.0106	0.0105	3.7017	26.50	20131.5***

Note: *** indicating 1% level of significance.

Based on the estimated skewness statistics, all indices skewed to right. As expected with any high frequency financial return series, the assessment of kurtosis is more than three for all the countries. Which represent a classic leptokurtic distribution, whereby the series are spikier around the mean with a thicker tails compared to

the normal distribution. In addition, outcome of the J-B test shows that the null hypothesis of normal distribution at 1% level of significance is rejected for all stock markets indices.

In order to evaluate the fitness of the model, Autoregressive Conditionally Heteroskedasticity – ARCH (1,1) tests were conducted on the standardized and squared residuals and the end results were satisfactory. The outcomes satisfy the stipulation of non-linearity. The outcome of the ARCH test (up to 5 lags) implies significance in the non-linearity of the observations.

Table 2. ARCH (1,1) results for Asia-Pacific region

	India	Japan	China	Malaysia	Taiwan	South Korea	Singapore	Australia
F-statistic	15.40***	7.67***	3.07***	12.71***	3.14***	19.80***	21.82***	6.71***
Obs*R^2 (χ^2)	70.68***	36.84***	15.19***	59.26***	15.52***	88.60***	96.54***	32.42***
u_{t-1}	0.257***	0.057*	0.107***	0.153***	0.132***	0.200***	0.210***	0.143
u_{t-2}	0.024	0.063*	0.031	0.041	-0.019	0.175***	0.079**	0.049
u_{t-3}	0.092**	0.190***	0.040	0.145***	0.021	0.079**	0.076**	0.081**
u_{t-4}	0.016	-0.005	0.022	0.094***	0.029	-0.009	0.190***	-0.002
u_{t-5}	0.009	-0.015	0.040	-0.013	0.020	0.004	-0.083**	0.057*

Notes: *** 1%, ** 5%,* 10% level of significance.

Table 3. ARCH (1,1) results for Europe region

	Austria	France	Germany	Greece	Italy	Netherlands	United Kingdom
F-statistic	2.032*	2.555**	2-953**	6.575***	10.688***	7.782***	3.651***
Obs*R^2 (χ^2)	10.111*	12.667**	14.607**	31.798***	50.418***	37.35***	17.979***
u_{t-1}	0.030	0.075**	0.038	0.161***	0.156***	0.166***	0.031
u_{t-2}	-0.007	0.003	0.054	0.054	0.070**	-0.001	0.008
u_{t-3}	0.081**	0.034	0.078**	0.020	0.136***	0.123***	0.103***
u_{t-4}	0.017	0.070**	0.070**	0.009	0.023	-0.016	0.093***
u_{t-5}	0.067**	0.044	0.007	0.064**	-0.011	0.049	0.012

Notes: *** 1%, ** 5%,* 10% level of significance.

The results reported in table 4 (Asia-Pacific) and 6 (Europe) represents values of the own mean spillovers (μ_{ii} for all i= 1,..,8 and i= 1,..,7) are significant at the 1% per cent level of significance, providing evidence of an influence on current returns of each stock market arising from their first lag returns (r_{iit-1}). For Asia-Pacific region the own-mean spillovers fluctuate from a smallest amount of 0.0046 (Australia) to the highest of 0.0094 (Taiwan). Positive cross-mean spillovers consequence is present from in between countries of experiment. Within the Asia-Pacific region, there is no negative cross mean spillovers and the impact of cross mean spillover is significant in both directions.

Table 4. Parameter estimation for the mean equation from diagonal VECH (1,1) equation for Asia-Pacific

Parameter		μ_{0i}	μ_{i1}	μ_{i2}	μ_{i3}	μ_{i4}	μ_{i5}	μ_{i6}	μ_{i7}	μ_{i8}
Australia	**Coef.**	0.0093***	0.0046	0.0094	0.0066	0.0075	0.0106	0.0088	0.008	0.0093
	S.E.	0.00018	0.00039	0.00049	0.0005	0.00052	0.00039	0.00049	0.00044	0.00055
China	**Coef.**	0.0106***	0.0101	0.0083	0.0104	0.0109	0.0122	0.0116	0.0108	0.0116
	S.E.	0.00046	0.00053	0.00051	0.00059	0.00059	0.00043	0.00055	0.0005	0.00062
India	**Coef.**	0.0177***	0.0139	0.0179	0.0084	0.0149	0.019	0.0144	0.0148	0.0154
	S.E.	0.00036	0.00073	0.00079	0.0007	0.00084	0.00062	0.00076	0.0007	0.00088
Japan	**Coef.**	0.0162***	0.0105	0.0159	0.0105	0.0093	0.0154	0.0108	0.0109	0.0125
	S.E.	0.00061	0.00059	0.00067	0.00066	0.00065	0.00051	0.00061	0.00055	0.00073
Malaysia	**Coef.**	0.01056***	0.01105	0.01426	0.00966	0.01019	0.00669	0.00645	0.00638	0.00996
	S.E.	0.00046	0.00092	0.00095	0.001	0.00102	0.00062	0.00088	0.0008	0.00105
South Korea	**Coef.**	0.0161***	0.0169	0.0226	0.0135	0.0149	0.017	0.0084	0.0134	0.0147
	S.E.	0.00034	0.00094	0.001	0.001	0.00103	0.00071	0.00077	0.00082	0.00107
Singapore	**Coef.**	0.0124***	0.0087	0.0139	0.0083	0.0081	0.0124	0.0082	0.0069	0.0105
	S.E.	0.00026	0.00071	0.00079	0.00079	0.0008	0.00059	0.00072	0.00061	0.00087
Taiwan	**Coef.**	0.0163***	0.0155	0.0183	0.015	0.0134	0.0169	0.0131	0.0143	0.0094
	S.E.	0.00048	0.00067	0.0007	0.00074	0.0007	0.00053	0.00065	0.00061	0.00068

Notes: (1) i = 1 for Australia, i = 2 for China, i = 3 for India, i = 4 for Japan, i = 5 for Malaysia, i = 6 for South Korea, i = 7 for Singapore, i = 8 for Taiwan. (2)*** 1%, ** 5%,* 10% level of significance. (3) From $\mu_{i1} - \mu_{i8}$ all coefficients are statistically significant at 1% level of significance.

Table 5. Parameter estimation for the variance equation from diagonal VECH (1,1) equation for Asia-Pacific

Parameter		C_{i1}	C_{i2}	C_{i3}	C_{i4}	C_{i5}	C_{i6}	C_{i7}	C_{i8}
Australia	**Coef.**	0.0000013	-0.0000027	0.0000051	0.0000018	0.0000050	0.0000041	0.0000016	.0000010
	S.E.	0.0000043	0.0000032	0.0000048	0.0000369	0.0000046	0.0000176	0.0000108	.0000124
China	**Coef.**		0.0000134*	-0.0000006	-0.0000013	-0.0000017	0.0000027	0.0000005	-.0000012
	S.E.		0.0000074	0.0000035	0.0000173	0.0000033	0.0000092	0.0000058	.0000044
India	**Coef.**			0.0000299***	0.0000032	0.0000073*	0.0000057	0.0000046	.0000074
	S.E.			0.0000101	0.0000724	0.0000041	0.0000253	0.0000177	.0000318
Japan	**Coef.**				0.0000201***	0.0000044	0.0000015	0.0000031	.0000037
	S.E.				0.0000063	0.0000415	0.0000198	0.0000126	.0000154
Malaysia	**Coef.**					0.0000168**	0.0000013	0.0000015	.0000046
	S.E.					0.0000069	0.0000120	0.0000079	.0000160
South Korea	**Coef.**						0.0000050	0.0000019	.0000059
	S.E.						0.0000107	0.0000060	.0000102
Singapore	**Coef.**							0.0000017	.0000026
	S.E.							0.0000032	.0000029
Taiwan	**Coef.**								.0000119
	S.E.								.0000084
Parameter		a_{i1}	a_{i2}	a_{i3}	a_{i4}	a_{i5}	a_{i6}	a_{i7}	a_{i8}
Australia	**Coef.**	0.2976***	0.2409	0.3213***	0.1917	0.2807**	0.2608	0.1924	0.2215*
	S.E.	0.0976	0.4237	0.0641	0.6842	0.1115	0.1617	0.1321	0.1297
China	**Coef.**		0.2598*	0.2110	0.1569	0.2358**	0.2004*	0.1131*	0.1912
	S.E.		0.1426	0.2394	1.6828	0.0998	0.1076	0.0588	0.2552
India	**Coef.**			0.3536***	0.1735	0.3296***	0.2869***	0.1990***	0.2496
	S.E.			0.1162	1.4154	0.0794	0.0465	0.0620	0.1899
Japan	**Coef.**				0.1558	0.1828	0.1849	0.1299	0.1594
	S.E.				1.0473	0.7973	0.8293	0.5775	0.6528
Malaysia	**Coef.**					0.3801***	0.2697***	0.1956***	0.2453
	S.E.					0.1167	0.0656	0.0549	0.1984
South Korea	**Coef.**						0.2808**	0.1708	0.1885**
	S.E.						0.1432	0.1647	0.0784
Singapore	**Coef.**							0.1267	0.1756
	S.E.							0.1911	0.2015
Taiwan	**Coef.**								0.2311**
	S.E.								0.102
Parameter		b_{i1}	b_{i2}	b_{i3}	b_{i4}	b_{i5}	b_{i6}	b_{i7}	b_{i8}
Australia	**Coef.**	0.2416*	0.3166	0.2920***	0.2986	0.3008	0.3586	0.4280	0.3224
	S.E.	0.1250	0.8587	0.1115	3.5283	0.4813	0.2389	0.2786	0.3262
China	**Coef.**		0.5067***	0.4635	0.4777	0.4982***	0.5096	0.6276	0.4791
	S.E.		0.1112	0.3589	3.6405	0.1804	0.5222	0.7320	0.2689
India	**Coef.**			0.4045***	0.4205	0.4780***	0.4574***	0.5689***	0.4227
	S.E.			0.0795	4.0029	0.0547	0.0883	0.0848	0.3970
Japan	**Coef.**				0.5774	0.5282	0.5918	0.6656	0.5767
	S.E.				2.1075	2.2423	0.9818	0.9899	1.9361
Malaysia	**Coef.**					0.5576***	0.5755***	0.6656***	0.5313
	S.E.					0.0713	0.0987	0.0652	0.3284
South Korea	**Coef.**						0.7018***	0.7309***	0.5580***
	S.E.						0.0572	0.0966	0.1340
Singapore	**Coef.**							0.8296***	0.6314***
	S.E.							0.1480	0.1067
Taiwan	**Coef.**								0.5612***
	S.E.								0.2062

Notes: (1) i = 1 for Australia, i = 2 for China, i = 3 for India, i = 4 for Japan, i = 5 for Malaysia, i = 6 for South Korea, i = 7 for Singapore, i = 8 for Taiwan. (2)*** 1%, ** 5%,* 10% level of significance.

Table 6. Parameter estimation for the mean equation from diagonal VECH (1,1) equation for Europe

Parameter		μ_{0i}	μ_{i1}	μ_{i2}	μ_{i3}	μ_{i4}	μ_{i5}	μ_{i6}	μ_{i7}
Austria	**Coef.**	0.01574***	0.005682	0.007477	0.009867	0.012607	0.010021	0.010777	0.007378
	S.E.	0.001372	0.000589	0.000833	0.000836	0.000786	0.000745	0.000763	0.000788
France	**Coef.**	0.01756***	0.01186	0.00644	0.007581	0.015339	0.010771	0.009941	0.007274
	S.E.	0.00104	0.000608	0.000602	0.000593	0.000683	0.000597	0.000575	0.000587
Germany	**Coef.**	0.01886***	0.013078	0.006001	0.006488	0.016289	0.01158	0.009912	0.007279
	S.E.	0.001268	0.000705	0.000675	0.000636	0.000771	0.000689	0.000644	0.000671
Greece	**Coef.**	0.01461***	0.010543	0.0106	0.011927	0.009175	0.010796	0.01203	0.010456
	S.E.	0.001062	0.000654	0.000781	0.000761	0.00064	0.000674	0.000693	0.000748
Italy	**Coef.**	0.01134***	0.007309	0.004467	0.005453	0.00879	0.005723	0.006765	0.005276
	S.E.	0.00082	0.000498	0.000545	0.000537	0.000535	0.000472	0.000502	0.000536
Netherlands	**Coef.**	0.01156***	0.006223	0.000119	0.001651	0.008643	0.003905	0.005585	0.001713
	S.E.	0.001552	0.000483	0.000386	0.000415	0.000551	0.000416	0.000483	0.000423
United Kingdom	**Coef.**	0.01455***	0.008994	0.004956	0.006181	0.01221	0.008806	0.008185	0.005277
	S.E.	0.000779	0.000516	0.000531	0.000531	0.00059	0.000527	0.000512	0.000503

Notes: (1) i = 1 for Austria, i = 2 for France, i = 3 for Germany, i = 4 for Greece, i = 5 for Italy, i = 6 for Netherlands, i = 7 for United Kingdom. (2)*** 1%, ** 5%,* 10% level of significance. (3) From $\mu_{i1} - \mu_{i7}$ all coefficients are statistically significant at 1% level of significance.

In case of European region (table 6), the own-mean spillovers are also significant at 1% level of significance. The own-mean spillovers vary from a largest 0.015741 (Austria) to a smallest 0.003905 (Netherlands). All cross mean spillovers are positive and significant indicating that the impact of cross mean spillovers exists in both directions.

In table 5, the own-volatility distress for all eight markets (a_{11}, a_{22} . . . a_{88}) are significant except for Japan and Singapore and fluctuates from 0.231093 (Taiwan) to 0.380093 (Malaysia), demonstrating the existence of ARCH effects. This indicates that the precedent shocks occurring from the Malaysian market will have the strongest impact on its own future market volatility compared to the shocks stemming from the other markets. Based on the magnitudes of the estimated cross-volatility coefficients, $a_{ij}(i \neq j)$, innovation in all of the eight stock indices maneuver the instability of other indices, but the own-volatility shocks, a_{ij} ($i = j$), are normally bigger than the cross-volatility shocks. This recommends that past volatility shocks in individual markets have a larger effect on their own future unpredictability than past volatility shocks occurring from other indices. Therefore, it become visible that the lagged country-specific shocks (ARCH influence) do add to the stock market volatility of any given country in a recursive way.

Unlike the Asia-Pacific region, European region (Table 7) shows a different result for own volatility shocks (a_{11}, a_{22} . . . a_{77}). There is significant result for only three stock indices (France, Italy and United Kingdom) and varies from 0.422786 (United Kingdom) to 0.343712 (France). These results of European region indicate that these countries (except France, Italy, and United Kingdom) have strong exogenous impact on their future market volatility rather than the shocks generating from their own market.

In European region, the degree of cross-volatility shock is strongest between France and United Kingdom (0.401234) and the weakest is between Germany and Italy (0.338840). For Asia-Pacific region the strongest cross-volatility shock exist in between India and Malaysia (0.3296) and the weakest is in between China and Singapore (0.1131).

The projected coefficient for the variance-covariance matrix (equation 3) is also presented in Table 5(Asia-Pacific) and Table 7 (Europe). With $b_{ij}(i \neq j)$ one-lag conditional variance for both Asia-Pacific and Europe region are positive but most of them are not significant. Compared to Europe, the Asia-Pacific region has higher significant values, which indicates the presence of high volatility persistence. In Asia-Pacific region the largest value for the own volatility impact belongs to Singapore (0.8296) and the lowest belongs to Australia (0.2416). These results imply that these markets have the strongest impact on their future volatility from their own past volatility. On the other hand, Europe region does not have any significant values for one-lag conditional variance, indicating very low volatility persistence.

Table 7. Parameter estimation for the variance equation from diagonal VECH (1,1) equation for Europe

Parameter		C_{i1}	C_{i2}	C_{i3}	C_{i4}	C_{i5}	C_{i6}	C_{i7}
Austria	**Coef.**	0.0000568	0.00000633	0.000002	0.0000106	0.00000815	0.00000622	0.00000726
	S.E.	0.000235	0.000139	0.000213	0.000134	0.000126	0.000133	0.00012
France	**Coef.**		0.00000836	0.0000027	0.00000247	0.00000648	0.00000127	0.00000625
	S.E.		0.0000388	0.00012	0.0000959	0.0000772	0.0000632	0.0000454
Germany	**Coef.**			0.00000406	0.000000191	0.0000022	-6.71E-08	0.00000307
	S.E.			0.000219	0.00015	0.00017	0.0000667	0.000101
Greece	**Coef.**				0.0000371	0.0000041	0.00000123	0.00000486
	S.E.				0.000107	0.000109	0.0000912	0.0000864
Italy	**Coef.**					0.0000185	0.00000178	0.00000505
	S.E.					0.0001	0.0000448	0.000061
Netherlands	**Coef.**						0.0000132	0.0000016
	S.E.						0.000111	0.0000654
United Kingdom	**Coef.**							0.0000121
	S.E.							0.0000472
Parameter		a_{i1}	a_{i2}	a_{i3}	a_{i4}	a_{i5}	a_{i6}	a_{i7}
Austria	**Coef.**	0.417582	0.398416	0.373629	0.264258	0.3788	0.385364	0.419757
	S.E.	0.721572	0.294703	0.571996	0.230525	0.432623	0.612468	0.363071
France	**Coef.**		0.379674*	0.356085	0.250186	0.359832***	0.369283*	0.401234**
	S.E.		0.232068	0.17545	0.354527	0.084145	0.192779	0.190825
Germany	**Coef.**			0.334284	0.23474	0.338840*	0.346066	0.376149
	S.E.			0.273942	0.543303	0.204165	0.489955	0.262895
Greece	**Coef.**				0.171082	0.236524	0.239498	0.264826
	S.E.				0.229973	0.344684	0.190586	0.267515
Italy	**Coef.**					0.343712***	0.351193	0.381679***
	S.E.					0.11372	0.282878	0.129485
Netherlands	**Coef.**						0.360248	0.389767
	S.E.						0.595646	0.328643
United Kingdom	**Coef.**							0.422786**
	S.E.							0.179631
Parameter		b_{i1}	b_{i2}	b_{i3}	b_{i4}	b_{i5}	b_{i6}	b_{i7}
Austria	**Coef.**	0.004474	0.019296	0.020545	0.019925	0.015055	0.019062	0.013783
	S.E.	0.299964	0.34672	0.417481	0.497609	0.398662	0.438666	0.435084
France	**Coef.**		0.428564	0.469508	0.464067	0.336243**	0.349575	0.294463
	S.E.		0.284036	0.300014	0.48806	0.167526	0.452881	0.391218
Germany	**Coef.**			0.531372	0.517937	0.38563	0.391604	0.330329
	S.E.			0.423703	0.411551	0.26081	0.568057	0.331902
Greece	**Coef.**				0.510469	0.373566**	0.385254	0.320035
	S.E.				0.39017	0.183605	0.260124	0.642087
Italy	**Coef.**					0.280512	0.278038	0.238073
	S.E.					0.225179	0.342261	0.269303
Netherlands	**Coef.**						0.293081	0.2405
	S.E.						0.635203	0.430398
United Kingdom	**Coef.**							0.206262
	S.E.							0.486231

Notes: (1) i = 1 for Austria, i = 2 for France, i = 3 for Germany, i = 4 for Greece, i = 5 for Italy, i = 6 for Netherlands, i = 7 for United Kingdom. (2)*** 1%, ** 5%,* 10% level of significance.

The level of variability of the stock indices before and after/within the financial crisis of 2007 capturing structural break property of switch model is presented in table 8 (for Asia-Pacific region) and table 9 (for Europe region). The student-t EGARCH (1,1) model was used to estimate the parameters. The first part of both tables present the variability of the overall sampling period and the remaining parts show the pre (i.e. 30th June, 1997 to 25th December, 2006) and post/within (i.e., 1st January, 2007 to 4th February, 2013) financial crisis variability.

The parameter of EGARCH (1,1), *'α'* stands for the symmetric effect of the model. In Asia-Pacific region (table

8) α was largest during the financial crisis period but in Europe region (table 9) it was smallest. This is indicating that, during the financial crisis period volatility was much more sensitive in Asia-Pacific market compared to Europe. It proves Europe has more integrated market structure within the region, whereas Asia-Pacific markets do not have well integrated stock market system.

The leverage effect (γ) was positive for all Asia-Pacific markets (except India and Malaysia) during the financial crisis period and also larger than zero, which indicates that, the positive information are more destabilizing than the negative information. In case of India and Malaysia both have negative leverage effect, indicating positive shocks generate less volatility than the negative information or shocks for these two markets. In European region (table 9), all the leverage effect variables are positive during the crisis period and more than zero. For all the markets of this region, negative information propagates greater shock compared to the positive information.

The last parameter β represents the perseverance in conditional volatility irrespective of any incident in the market. For both the region in every scenario β is less than one and positive, implies that the volatility among these stock markets do not take longer to diminish following a catastrophic period.

Table 8. Parameter estimation of EGARCH (1,1) for regime switching (Asia-Pacific)

	India	Japan	China	Malaysia	Taiwan	South Korea	Singapore	Australia
1997-2013(Full Sample Period)								
ω	-7.028625***	-7.467567***	-5.839***	-0.374***	-6.940***	-3.221***	-1.324***	-8.126***
α	0.577485	-0.286307	0.671	1.890**	0.654	0.135	1.169	1.233**
γ	0.418527	0.889897	0.004	-1.629	0.492	0.886	-1.108	-0.676
β	0.242478	0.164072	0.403***	0.983***	0.231	0.075***	0.914***	0.228
1997-2006(Before Financial Crisis)								
ω	-7.341830***	-7.730703***	-2.645***	-0.475**	-6.838***	-5.151***	-0.533***	-8.056***
α	0.571981	0.289	0.998	0.270	0.231	0.434	1.164	2.194*
γ	0.371058	0.311	-0.369	0.076	0.584	0.654	-0.892	-1.6026
β	0.178330	0.100	0.769***	0.986***	0.215	0.454***	0.979***	0.2261
2007-2013(During/Post Financial Crisis)								
ω	-6.033160***	-3.649	-8.101***	-3.056***	-6.930***	-7.963***	-6.577***	-8.522***
α	1.350240	-0.628	0.291	3.734*	0.426	0.259	-0.325	0.1315
γ	-0.393247	0.898	0.420	-3.352	0.175	0.357	1.013	0.4077
β	0.411205*	0.620**	0.126	0.716***	0.283	0.183	0.371*	0.1733

Notes: *** 1%, ** 5%,* 10% level of significance.

Table 9. Parameter estimation of EGARCH (1,1) for regime switching (Europe)

	Austria	France	Germany	Greece	Italy	Netherlands	United Kingdom
1997-2013(Full Sample Period)							
ω	-7.987***	-6.947***	-6.966***	-1.309***	-5.859***	-6.457***	-7.992***
α	0.482	0.631	0.590	1.779	1.374	1.157	0.476
γ	0.259	0.186	0.372	-1.240	-0.557	-0.540	0.325
β	0.187	0.285*	0.279**	0.901***	0.465***	0.388***	0.183
1997-2006(Before Financial Crisis)							
ω	-5.975***	-7.415***	-5.799***	0.001	-5.680***	-7.923***	-7.609***
α	1.484	0.691	0.789	-0.306***	1.495	0.615	0.665
γ	-0.676	0.163	0.216	0.301***	-0.5360	-0.021	0.269
β	0.402*	0.216	0.426**	0.996***	0.507***	0.258**	0.214
2007-2013 (During/Post Financial Crisis)							
ω	-7.546***	-7.957**	-7.918***	-7.668***	-8.692***	-7.952***	-8.276***
α	0.218	0.202	0.222	-0.046	0.156	0.047	0.209
γ	0.379	0.342	0.372	0.602	0.365	0.264	0.359
β	0.188	0.152	0.176	0.142	0.126	0.176	0.172

Notes: *** 1%, ** 5%,* 10% level of significance.

4. Conclusion

The non-linearity of the logged market price is best suited to measure short term volatility transmission and the

heteroscedastic nature of market price is a major motivation for portfolio balancing. The markets from both the regions show significant non-linearity to test for conditionality of the observations. The diagonal VECH parameterization primarily tests for own mean and own volatility spillover to test for the impact of historic volatility of host market or significance of "volatility spillover" effect. The third parameter tests for the cross volatility spillover indicating "contagion" of long term and short term shock among the markets. The finding is remarkable for both of the Asia/Pacific and European region. For the 8 major economies of the Asia/Pacific region own volatility spillover is more significant, and "volatility spillover" effect of the domestic market is more profound compared to "contagion" effect. The regime switch measures suggest, in compliance to "leverage effect" phenomenon, there is indication of turbulent markets post global financial crisis, but the shocks converge to mean and to do not persist, that is found with EGARCH parameterization. It explains that this region is integrated through more real linkage than financial linkage, and so is less vulnerable to a persistent global shock. In contrast to this, the European market exhibits more significant cross-volatility spillover and it is suggested that "financial contagion" is more significant the "volatility spillover" It must be noted financial contagion phenomenon can be explained with volatility transmission as well. The VECH matrix suggest, the 7 most significant sample markets from European region have sheer integration, and market anomalies spread instantaneously in the rest of the markets. The pure economic integration results in extreme financial linkage and leaves the markets to be highly vulnerable to persistent shocks similar to global financial crisis 2007. The regime switch phenomenon measures, shocks propagated within European markets may become acute but bears a similarity to the Asia/Pacific markets, that shocks will have mean reversion and will not persist for a considerably long period.

References

Alexander, C. (2009). *Practical Financia Econometrics.* John Wiely and Sons Ltd.

Arshanapalli, B., & Doukas, J. (1993). International Stock Market Linkages: Evidence from the Pre- and Post-October 1987 Period. *Journal of Banking and Finance, 17*(1), 193-208. http://dx.doi.org/10.1016/0378-4266(93)90088-U

Backus, D. K., Kehoe, P. J., & Kydland, F. E. (1992). International Real Business Cycles. *Journal of Political Economy, 100*(4), 745-775. http://dx.doi.org/10.1086/261838

Baxter, M., & Crucini, M. C. (1993). Explaining Saving-Investment Correlations. *American Economic Review, 83*, 416-436.

Bhattacharyya, S., & Nanda, V. N. (1999). Marking to Market and the Closed-End Fund Discount. *Working Paper,* Ross School of Business, University of Michigan.

Bollerslev, T. E. (1988). A Capital asset prising model with time-varying covariances. *Journal of Political Economy, 96*(1), 116-131. http://dx.doi.org/10.1086/261527

Brown, S., Goetzmann, W. G., & Park, J. P. (1998). Hedge Funds and the Asian Currency Crisis of 1997. *Working Paper 6427, NBER*.

Caballero, R. J., Farhi, E., & Gourinchas, P. O. (2008). Financial Crash, Commodity Prices, and Global Imbalances. *Brookeing papers on economic activity, 2008*(Fall), 1-55.

Calls, S., & Jolly, D. (2012, September 26). Euro zone crisis sends stock markets tumbling Wednesday in Greece and Spain. Retrieved from http://www.sott.net

Calvo, G. A. (1999). Contagion in Emerging Markets: When Wall Street is a Carrier. Mimeograph.

Cass, D., & Pavlova, A. (2004). On Trees and Logs. *Journal of Economic Theory, 116*, 41-83. http://dx.doi.org/10.1016/j.jet.2003.05.001

Chancharoenchai, K. D. (2006). Volatility Spillovers and Contagion during the Asian Crisis: Evidence from Six Southeast Asian Stock Markets. *Emerging Markets Finance and Trade, 42*(2), 4-17. http://dx.doi.org/10.2753/REE1540-496X420201

Chan-Lau, J. A. (2001). Asian Flu or Wall Street Virus? Price and Volatility Spillovers in the Tech and Non-Tech Sectors. *Journal of Multinational Financial Management, 13*, 302-322.

Chan-Lau, J. A. (2004). Extreme Contagion in Equity Markets. *IMF Staff Papers, 51*(2), 386-408.

Charumilind, C. R. (2006). Connected Lending:Thailand Before the Financial Crisis. *Journal Of Business, 79*(1), 181-218. http://dx.doi.org/10.1086/497410

Cole, H., & M, O. (1991). Commodity Trade and International Risk Sharing. *Journal of Monetary Economics,*

28, 3-24. http://dx.doi.org/10.1016/0304-3932(91)90023-H

Disyatat, P., & Gelos, G. (2001). The Asset Allocation of Emerging Market Mutual Funds. *IMF Working Paper, 1*(111).

Eichengreen, B., & Mathieson, D. (1998). Hedge Funds and Financial Market Dynamics. *IMF Occasional Papers, 166*.

Fleming, J., Kirby, C., & Ostdiek, B. (1998). Information and Volatility Linkages in the Stock, Bond and Money Markets. *Journal of Financial Economics, 49*, 111-137. http://dx.doi.org/10.1016/S0304-405X(98)00019-1

Gultekin, M., Gultekin, N., & Penati, A. (1989). Capital Controls and International Capital Market Segmentation: The Evidence from the Japanese and American Stock Markets. *Journal of Finance, 44*(4), 849-869. http://dx.doi.org/10.1111/j.1540-6261.1989.tb02627.x

Gunduz, L., & Hatemi, A. J. (2005). Stock Price and Volume Relation in Emerging Markets. *Emerging Markets Finance & Trade, 41*(1), 29-44.

Helpman, E., & Razin, A. (1978). *A Theory of International Trade Under Uncertainty*. New York: Academic Press.

Kaminsky, G., & Reinhart, C. (2000). On Crises, Contagion and Confusion. *Journal of International Economics, 51*, 145-168. http://dx.doi.org/10.1016/S0022-1996(99)00040-9

Kaminsky, G., & Reinhart, C. (2000). The Center and the Periphery: Tales of Financial Turmoil. *Working Paper,* George Washington University .

Kaminsky, G., Lyons, R., & Schmuklar, S. (2000). Managers, Investors and Crises: Mutual Fund Strategies in Emerging Markets. *Working Paper* 7855, NBER .

Kaminsky, G., Lyons, R., & Schmuklar, S. (2001). Mutual Fund Investment in Emerging Markets: An Overview. *Working Paper*, George Washington University .

Khallouli, W., & Sendretto. (2012). Testing for "Contagion" of the Subprime Crisis on the Middle East and North African Stock Markets: A Markov Switching EGARCH Approach. *Journal of Economic Integration, 27*(1), 134-166. http://dx.doi.org/10.11130/jei.2012.27.1.134

Kim, W., & Wei, S. (2002). Foreign Portfolio Investors Before and During a Crisis. *Journal of International Economics, 56*, 77-96. http://dx.doi.org/10.1016/S0022-1996(01)00109-X

King, M., & Wadhwani, S. (1990). Transmission of Volatility Between Stock Markets. *Review of Financial Studies, 3*, 5-33. http://dx.doi.org/10.1093/rfs/3.1.5

Maneschiold, P. O. (2006). Integration Between the Baltic and International Stock Markets. *Emerging Markets Finance and Trade, 42*(6), 25-45. http://dx.doi.org/10.2753/REE1540-496X420602

Masson, P. (1999). Contagion: macroeconomic models with multiple equilibria. *Journal of International Money and Finance, 18*(4), 587-602. http://dx.doi.org/10.1016/S0261-5606(99)00016-9

Mittoo, U. (1992). Additional Evidence on Integration in the Canadian Stock Market. *Journal of Finance, 47*(5), 2035-2054. http://dx.doi.org/10.1111/j.1540-6261.1992.tb04696.x

Mody, A., & Teylor, M. (2002). Common Vulnerabilities. *IMF Working Paper*.

Pericoli, M. S. (2003). A primer on financial contagion. *Journal of Economic Surveys, 17*(4), 571-608. http://dx.doi.org/10.1111/1467-6419.00205

Taylor, M., & Tonks, I. (1989). The Internationalization of Stock Markets and the Abolition of U.K. Exchange Control. *Review of Economics and Statistics, 71*(2), 332-336. http://dx.doi.org/10.2307/1926980

Yuan, K. (2005). Asymmetric Price Movements and Borrowing Constraints: A Rational ExpectationsEquilibrium Model of Crises, Contagion, and Confusion. *The Journal of Finance, 60*(1), 379-411. http://dx.doi.org/10.1111/j.1540-6261.2005.00733.x

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Transmission of the Global Financial Crisis to the East Asian Equity Markets

Tran Phuong Thao[1,2], Kevin Daly[1] & Craig Ellis[1]

[1] School of Business, University of Western Sydney, Sydney, Australia

[2] Department of Banking, University of Economics Ho Chi Minh City, Vietnam

Correspondence: Kevin Daly, School of Business, University of Western Sydney, Sydney, Australia. E-mail: K.Daly@uws.edu.au

Received: December 5, 2012 Accepted: April 3, 2013 Online Published: April 24, 2013

doi:10.5539/ijef.v5n5p171 URL: http://dx.doi.org/10.5539/ijef.v5n5p171

Abstract

This paper investigates the transmission mechanism of the Global Financial Crisis originated in the United States to the East Asian equity markets, including the developed markets (Hong Kong, Japan and Singapore), emerging markets (Malaysia, Thailand and Taiwan) and frontier market (Vietnam). To test for the transmission, we employ the constant conditional correlation (CCC) and the dynamic conditional correlation (DCC) based on the MGARCH model to estimate the time-varying correlations between the United States and East Asian equity markets. Our empirical findings suggest that the Global Financial Crisis transmitted to these markets vary over time, particularly to Hong Kong and Singapore during the pre-crisis period, and to Japan and Vietnam during the crisis period. In addition, the results show that almost all the East Asian markets reveal higher correlations to other markets in the region than the United States even during the crisis period. Finally, the crisis is attributed to enhancing the correlations between the frontier market towards regional and global markets.

Keywords: global financial crisis, East Asian equity markets, contagion effect, conditional correlation

1. Introduction

The Global Financial Crisis (GFC) has been considered as the most severe crisis in history since the 1930s Great Depression. It was attributed to a series of severe market events such as speculative bubble in the U.S. housing market in 2006, the sub-prime mortgage crisis in the United States in early 2007 and the liquidity crunch in global credit markets in mid-2007. The crisis intensified in the second half of 2008 after the U.S. State Bank and Government refused to rescue Lehman Brother's and confirmed the collapse of the American International Group. These events partly caused panic for both investors and financial institutions in the world, leading to a sharp decline in global equity markets which lasted until the first quarter of 2009 (Bartram & Bodnar, 2009; Dooley & Hutchison, 2009). For a full comprehensive review of the history of the GFC refer to the study by Arestis; Sobreira and Oreiro (2011).

The above studies focused on the impacts of the GFC for advanced and emerging markets, rather than small young emerging markets. Research documenting the impacts of the GFC at the country, regional and global markets has been performed by Dooley & Hutchison (2009), Markwat, Kole, & van Dijk (2009), Bartram and Bodnar (2009), Claessens, Claessens et al., (2010) and Allen & Carletti (2010)). In addition, several studies indicate that the GFC was more serious than previous crises. For example Gklezakou and Mylonakis (2010), show that while previous crises disturbed the financial systems of directly affected economies, the GFC penetrated practically every aspect of global economic activities. Recently, Guo, Chen and Huang (2011) examined the impacts of the GFC on various markets such as stock, real estate, energy markets and credit default swap markets they find that credit default swaps are non-existent in other crises.

Despite increasing concerns over the direct impacts of the GFC, the issue of how the GFC was transmitted to the global markets has not been widely developed in the literature. Several previous studies, such as Claessens et al. (2010) and Mishkin (2011) examine the transmission of the GFC to the global markets by visually describing the interactions of market movements during the crisis. Other studies explore the transmission mechanism empirically (see, for example Gupta and Donleavy (2009), Naoui; Liouane and Brahim (2010), Marcal et al.(2011) and Kenourgios; Samitas and Paltalidis (2011)); however, almost these studies focus on the impacts of

the GFC for developed and emerging markets which maintain strong links to the United States. As such, the primary objective of this paper is to empirically explore transmission mechanism of the GFC to equity markets of the East Asian region.

In this paper, we investigate the transmission mechanism of the shock caused by the GFC to equity markets in the East Asian region, including the developed markets (Hong Kong, Japan, Singapore), emerging markets (Malaysia, Thailand, Taiwan) and the frontier market of Vietnam (Note 1). There are two main reasons for selecting these markets. Firstly, the East Asian region has experienced the highest average growth rate in terms of real GDP in the last two decades and has been responsible for the majority of growth recorded globally. Secondly, the region was severely affected by previous 1997 Asian Financial Crisis, in this respect we compare how the region responded to the GFC compared to the 1997 crisis. The data used in the paper is sourced from the DataStream for the period from 1/7/2007 to 31/12/2010. The rest of the paper is structured as follows. Section 2 presents the literature review on crises and transmission mechanisms of crises. Section 3 introduces data and research methods used in the paper. Section 4 discusses empirical findings. Section 5 concludes the paper.

2. Literature Review

Over recent decades, global markets have experienced a series of crises that originated in a specific market and rapidly transmitted to other markets. Such transmission of financial turmoil across markets is often refereed as a 'contagion effect' (Dornbusch, Park, & Claessens, 2000; Forbes & Rigobon, 2002; Guo, et al., 2011; Khalid & Kawai, 2003). A study by Claessens and Forbes (2001) indicates that the concept was firstly introduced in chemistry with reference to the spread of medical diseases; however, in the late 1990s, the concept was widely used in the economics to describe a transmission of a shock across markets. There are several definitions of contagion in the existing literature. For instance, while Forbes and Rigobon (2002) define contagion as a significant increase in the correlation between equity markets during a crisis; Claessens, Dornbusch and Park (2010) use the term contagion when describing an increase in a cross market linkage after a shock to one country rather than only a strong linkage between countries.

The World Bank classifies levels of contagion by proposing three definitions (Billio & Pelizzon, 2003; Claessens & Forbes, 2001). The first definition is very broad defining contagion as a cross-country transmission of shocks or cross-country spillover effects; however, this definition takes into consideration transmission of shocks in both tranquil and crisis periods. The second definition is restrictive stating that contagion is the transmission or co-movement of shocks in excess of what can be explained by economic fundamentals. This definition is claimed as the most controversial one in order to identify the underlying fundamentals. The third definition is known as very restrictive definition emphasizing a transmission mechanism of a shock among countries during a period of crisis. This definition is similar to a 'shift contagion' given by Forbes and Rigobon (2002) defining contagion as a significant increase in cross-market linkages after a shock to a specific market and is widely used in the literature (see for example Kuper and Lestano (2007); Gupta and Donleavy (2009); Yiu, Alex-Ho and Choi (2010); Yu, Fung and Tam (2010). In the paper, we utilize the shift contagion definition to examine the propagation of transmissions of the shock caused by the GFC to East Asian equity markets.

Contagion effects can generally be explained by two main sources. In early studies, international trade and financial linkages and common shocks are often used to provide thoughtful explanations for the transmission mechanism of contagion (Kearney, 2000; Phylaktis & Ravazzolo, 2002; Pretorius, 2002). However, as many crises occurred more frequently in recent decades, empirical results find much evidence of transmissions of a shock from one country to other countries that do not have close fundamental linkages to a host country. As such, another source of contagion associated with investor behavior is suggested. Khalid and Kawai (2003), for instance, document three sources of contagion, namely common shocks, financial linkages and shifts in investors' sentiments. Dornbusch, Park and Claessens (2000) discuss two sources of contagion effect over turbulence periods. The first source is related to fundamental-based channels associated with real and financial linkages across borders, while the second is attributed from irrational behaviors of investors resulting from liquidity problems, imperfect information, and multiple equilibria. A similar viewpoint employs investor behavior to explain for the spillover of shocks across markets can be found in studies by Claessens and Forbes (2001), Karolyi (2003) and Caramazza; Ricci and Salgado (2004).

Equity market linkage refers to an interaction among equity markets through which investors can optimize their risk-adjusted returns by diversifying their investment portfolios across markets. The concept is based on two foundational theories. The first one is the Purchasing Power Parity Theory positing that relative prices of identical goods should be in equilibrium to represent their purchasing power across markets (Brooks 2002; Del Bianco 2008; Korap and Aslan 2010). The second theory is the Modern Portfolio Theory which states important

roles of risks, returns, and correlations in constructing investment portfolios of investors and suggests that investors may get higher returns if they diversify internationally (Elton and Gruber 1997; Gklezakou and Mylonakis 2010). Although both of these theories are based on a number of simplifying assumptions, they remain the cornerstones of modern finance in asset management.

In the existing literature, equity market linkages have been mainly identified under three headings;, namely co-integration, causality and contagion depending on the nature of linkages. Co-integration and causality describe fundamental linkages among equity markets which are known as a long-run and short-run linkage, respectively. Contagion relates to a transmission mechanism of a shock among equity markets during periods of crisis by capturing a significant increase in correlations of market volatilities (Note 2) (Forbes and Rigobon 2002; Corsetti, Pericoli and Sbracia 2005). These three linkages overall represent a comprehensive picture on cross-market linkages.

In early studies focused on global equity market linkages most researchers explain sources of linkages with regard to fundamental-based linkages, for example trade and finance links (Kearney 2000; Phylaktis and Ravazzolo 2002; Pretorius 2002; Khalid and Kawai 2003). However, in the 1990s as global markets experienced a series of crises, other sources of linkages – known as irrational linkages – emerged such as imperfect information, investor sentiment, and multiple equilibrium (Note 3) (Dornbusch, Park and Claessens 2000; Karolyi 2003).

Recently, several researchers document limitations of modern finance theories in the real world, particularly in a context of financial crises, as correlations of global equity markets appear to increase (Cheung, Fung and Tsai 2010; Chakrabarti 2011). Thus, an understanding of equity market linkages during periods of crises is of interest to researchers and practitioners. Due to the severity and ample effects of the GFC, a large number of studies examine impacts of the GFC on advanced and major emerging markets that have strong links with the United States rather than small and young equity markets. Therefore, the primary objective of this paper is to explore the impacts of the GFC of a small and young emerging market and on its linkages to global equity markets.

3. Data and Methodology

3.1 Data Collection

In order to investigate the transmission of the GFC to the East Asian equity markets, the paper employs time series data consisting of the daily closing prices of seven market indices in the region including the Hang Seng Index for Hong Kong, the TSE Composite Index for Taiwan, the Strait Times Index for Singapore, the Nikkei 225 Stock Average for Japan, the KLSE Composite Index for Malaysia, the SET Index for Thailand and the VN-Index for Vietnam. The S&P 500 Composite index of the United States is employed to take into account the transmission of the GFC to the region. According to the market classification of the MSCI (2012), we separate the seven East Asian market indices in the sample into three groups. The developed market group includes Hong Kong, Japan and Singapore. The emerging market group covers Malaysia, Taiwan and Thailand, and the frontier market includes Vietnam. The data is sourced from the DataStream International for the period from 1/7/2007 to 31/12/2010. On non-trading days of the market indices, we assume to stay the same compared to the previous trading day. In addition, the market indices in local currency are used to capture influences of local economic policy and economic conditions on market linkages.

It is notable that the trading hours of Asian markets are overlapping while those of the United States equity market are one day lagged. Hence, in this paper, the equity market returns of the United States are lagged one day compared to that of the other series data. The first differences of logarithms of market indices multiplied by 100 are constructed to measure market returns of the selected markets.

For capturing the transmission of the GFC to the selected markets, we separate the period of study into sub-periods according to the descriptions by Mishkin (2011) and Aït-Sahalia et al (2012). Particularly, the period of study is divided into three sub-periods. The pre-crisis period is from 1/7/2007 to 14/9/2008 comprising 315 observation of each series. The crisis period is from 15/9/2008 to 31/3/2009 comprising 142 observations of each series, and the post-crisis period starts on 1/4/2009 and ends on 31/12/2010 comprising 458 observations of each series

The descriptive statistics of the market returns over the sub-periods are shown in Table 1. In general, we can see some similar findings during the pre-crisis and crisis period. More specifically, all the markets have negative average rate of returns over the two periods implying declines of the market levels of the entire markets. It can be explained by the severity and ample effects of the sub-prime crisis and the GFC on the regional markets. Interestingly, the Vietnam index recorded the highest negative returns over the periods implying the strongest

impacts of the crises on the frontier market compared to the other markets in the sample. In the meantime, the Hong Kong equity market experience the highest standard deviation of market returns suggesting a high vulnerability of the market during the periods. It is notable that the higher standard deviations of developed markets relative to those of the emerging and frontier markets during the crisis period imply considerable influences of the GFC on the developed markets in the region.

During the post-crisis period, all the markets record positive average rates of return reflecting the recovery of the markets after the GFC; however, the pattern of recovery varies different within the region. The highest return is for the Taiwan index (0.19) while the lowest is for the Japan index (0.05). It suggests a weak recovery of Japan compared to the other markets. It could be due to its high dependence on the export of advanced manufacturing products. In addition, the skewness reveals some negative but some positive values over the three periods implying that market returns sometime change from the long right tail to left right tail and vise versa over the sub-periods. The high kurtosis values suggest the peak distributions of market returns.

During the pre-crisis period, the correlations between developed markets appear to be higher than between emerging markets. The highest correlation is found between Singapore and Hong Kong (0.79) and the lowest correlation is between Singapore and Vietnam (-0.02). The strong relationship between Singapore and Hong Kong can be explained by their close trading linkages in the long run. In addition, the Vietnam equity market reveals the lowest correlations with both the emerging and developed markets in the sample suggesting a quite isolated relationship of the market towards the regional and global markets. The United States reveals the highest correlations with Japan (0.53) and Singapore (0.51) while the lowest correlation exists with Vietnam (0.07).

Table 2 shows the correlation coefficients of market returns between the equity markets. Overall, the table almost shows higher correlations amongst the markets during the crisis period compared to the pre- and post-crisis period impling strong vulnerable of the East Asian equity markets during the GFC.

Table 1. Descriptive statistics of market returns

Pre-crisis period (from 1/7/2007 to 14/8/2008)				
	Mean	Std. Dev.	Skew	Kurtosis
US	-0.06	1.29	-0.06	3.4
HK	-0.04	2.16	0.03	5.24
JP	-0.13	1.6	-0.26	3.82
SG	-0.1	1.55	0	4.34
ML	-0.08	1.2	-1.84	17.71
TW	-0.05	1.37	0.24	3.75
TL	-0.11	1.72	-0.29	3.93
VN	-0.24	1.8	0.02	3.21
Crisis period (from 15/9/2008 to 31/3/2009)				
US	-0.32	3.54	0.12	3.71
HK	-0.25	3.78	0.28	5.02
JP	-0.29	3.62	-0.14	4.94
SG	-0.29	2.69	0.06	3.83
ML	-0.13	1.23	0.14	4.57
TW	-0.29	2.59	-0.76	6.61
TL	-0.13	2.28	-0.17	3.42
VN	-0.37	2.33	0.09	2.38
Post-crisis period (from 1/4/2009 to 31/12/2010)				
US	0.1	1.19	-0.23	4.48
HK	0.12	1.46	0.33	4.66
JP	0.05	1.35	-0.01	3.47
SG	0.14	1.13	0.57	6.24
ML	0.12	0.62	0.31	4.63
TW	0.19	1.28	-0.27	4.91
TL	0.12	1.21	-0.06	6.38
VN	0.12	1.76	-0.08	3.41

During the crisis, almost all correlations increased considerably, particularly the correlations between the equity markets of East Asia. The correlations between the advanced markets and emerging markets in the region span

from 0.5 (Thailand and Taiwan) to 0.78 (Singapore and Hong Kong) implying that these markets move in similar patterns in this period. Notably, the correlations between the Vietnam and other markets under investigation considerably increase, particularly with the United States (0.55) and Japan (0.47). This result implies a strong influence of the GFC on the Vietnam equity market which may enhance its linkages to global equity markets. Notably that among the East Asian markets, only Japan and Vietnam report impressively stronger correlations with the United States while almost other markets reveal weaker interactions. The findings may suggest different influences of the shock to the United States on the East Asian equity markets.

Table 2. Correlation coefficient of market returns

	US	HK	JP	SG	ML	TL	TW	VN
Pre-crisis period (from 1/7/2007 to 14/8/2008)								
US	1							
HK	0.49	1						
JP	0.53	0.66	1					
SG	0.51	0.79	0.67	1				
ML	0.43	0.50	0.48	0.57	1			
TL	0.35	0.54	0.42	0.57	0.48	1		
TW	0.43	0.57	0.59	0.60	0.50	0.49	1	
VN	0.07	0.04	0.08	-0.02	0.00	0.00	0.00	1
Crisis period (from 15/9/2008 to 31/3/2009)								
US	1							
HK	0.37	1						
JP	0.65	0.68	1					
SG	0.30	0.78	0.60	1				
ML	0.37	0.54	0.56	0.67	1			
TL	0.26	0.69	0.56	0.70	0.59	1		
TW	0.45	0.63	0.65	0.58	0.60	0.50	1	
VN	0.55	0.24	0.47	0.22	0.34	0.36	0.36	1
Post-crisis period (from 1/4/2009 to 31/12/2010)								
US	1							
HK	0.38	1						
JP	0.55	0.57	1					
SG	0.33	0.75	0.49	1				
ML	0.42	0.55	0.46	0.57	1			
TL	0.23	0.55	0.37	0.54	0.43	1		
TW	0.38	0.60	0.53	0.60	0.50	0.36	1	
VN	0.33	0.18	0.21	0.15	0.18	0.10	0.16	1

During the post-crisis period, the correlations among the markets appear to decline slightly with the exception of the Vietnam equity market which reports higher correlations with the other markets during the post-crisis period in comparison to those during the pre-crisis period. In addition, despite the slight decline, the United States remains the highest correlations with Japan (0.55) compared to the other markets in the region. It is notable that almost all the equity markets in the East Asian region reveal their highest correlations with Hong Kong and Singapore. It highlights considerable influences of the two markets in the region.

To visually inspect the volatilities of the selected markets over time, we plot the movements of the daily market returns of the eight markets over the period of 2007 – 2010. In general, the markets are relatively stable before the crisis, but appear to be highly volatile during the crisis. As we can see in Figure 1, the United States, Hong Kong and Japan are more volatile than the other markets because their volatilities span from -15 to + 15; while those of other markets range from -10 to +10. In addition, Malaysia is likely to be less influenced by the GFC except for a sharp drop in the first quarter of 2008 implying the quick response of the Malaysia Government to get rid of the crisis. Notably although that there is no dramatic drop in the market volatilites of Vietnam, the market is clearly impacted negatively over the crisis. This could be explained by strict controls of the Vietnamese Governments in supervising and managing the market, such as the narrow daily price-limit change regulation and a maximum proportion of foreign ownership of listing firms allowed to participate in the market.

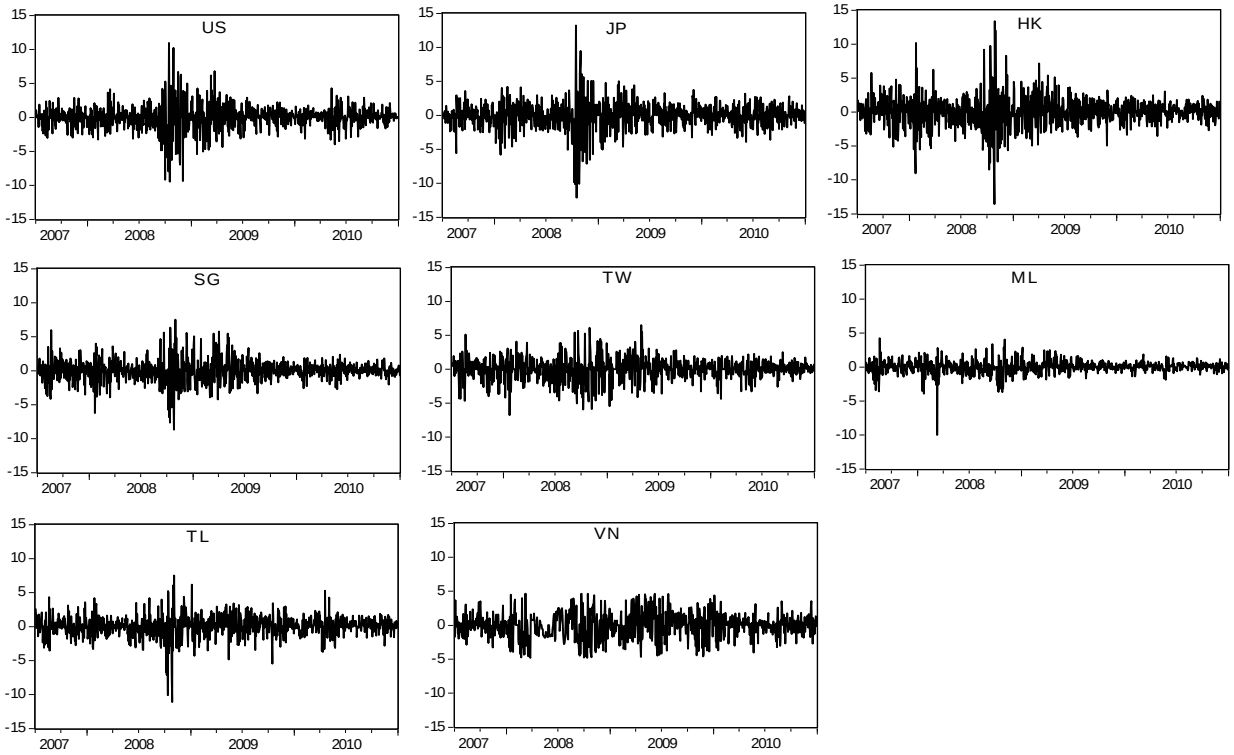

Figure 1. Movements of market returns

It be may concluded that due to differences in size and structure, the influences of the GFC on the East Asian equity markets be analysed as a exceptional case rather than following the general global pattern. However, when and where the GFC transmitted to the markets in the region cannot be determined by descriptive analysis. As such, other research approachs will be conducted to explore the transmission mechanism.

3.2 Research Methodology

In this paper, we investigate the transmission of a shock caused by the GFC to the East Asian markets by conducting empirical tests with regard to the existence of contagion effects across markets. As mentioned above, we follow the very strict definition of contagion as a significant increase in cross-market linkages after a shock or crisis. As such, we examine the contagion effect by measuring cross-market correlations. However, as discussed by Forbes and Rigobon (2002), a correlation between two markets is time-varying and conditional on market volatilities, particularly during a turbulent period because the correlation may be biased by increases of market volatilities. Hence, two models of time-varying correlations are used in the paper. The first model is the constant conditional correlation (CCC) suggested by Bollerslev (1990) and the second model is the time-varying dynamic conditional correlation (DCC) proposed by Engle (2002). These empirical methods estimate the dynamic of time-varying correlations tracking from multivariate generalized autoregressive conditional heteroskedasticity (MGARCH) model.

Specifically, to capture the time-varying variances of market returns, the univariate generalized autoregressive conditional heteroskedasticity model, GARCH (1,1) suggested by Bollerslev (1986) is firstly employed to estimate conditional return and conditional variance of individual market returns. The equations are given as follows:

Returns equation

$$r_t = \mu + \varepsilon \tag{1}$$

Volatility equation

$$h_t = w_i + \alpha \varepsilon_{i.t-1}^2 + \beta h_{it-1} \tag{2}$$

where i = 1, 2 … m indicate the ith equation in the model. r_t is a linear regression of individual market returns equation including a constant term μ and the error term $\varepsilon_{i.t-1}$ of the ith equation. The conditional variance, $h_{i.t}$, is a function of lagged values of square residuals $\varepsilon_{i.t-1}^2$. α captures innovations of its past square residuals

while β present influences of lagged values of its conditional variance. w_i is a constant term of the volatility equation. The necessary conditions to the equation (2) are both α and β are nonnegative and $\alpha + \beta < 1$.

After estimating the volatilites of individual markets in the sample, we measure the CCC between pairs of the markets. The constant conditional correlation (ρ_t) is decomposed into a matrix of conditional variance (h_{ij}) and a diagonal matrix of the square root of the conditional variances ($h_{ii,t}^{-1/2}$) by using the following model

$$\rho_t = h_{ii,t}^{-1/2} \, h_{ij,t} h_{jj,t}^{-1/2} \tag{3}$$

The CCCs are estimated in the paper over the pre-crisis, crisis and post-crisis periods. If the CCC significantly changes over the crisis and post-crisis period compared to that over the pre-crisis period, this coutome leads supports for the transmission of the GFC from the United States to the other markets. If the CCC is not significant over the crisis and post-crisis period compared to the pre-crisis period, we conclude that no transmission of a shock occurs. In case the CCC maintains the high values over the sub-period, a conclusion of interdependence between the markets is suggested.

Although the CCC model measures the conditional correlations of market volatilities; however, the correlations are static over our period of study. As such, we further employ the DCC model that allows for time-varying conditional correlation. This model is also firstly based on the univariate GARCH (1,1) model of market returns of individual markets to estimate their conditional variances σ_t. Each univariate error process is then transformed to the standardized residuals by

$$\delta_{t-1} = \frac{\varepsilon}{\sqrt{h_t}} \tag{4}$$

The conditional variance is assumed to be time varying by following the GARCH (1,1) model given by

$$\sigma_{ij,t} = (1 - \theta_1 - \theta_2)\bar{\sigma}_{ij} + \theta_1 \delta_{t-1} \delta'_{t-1} + \theta_2 \sigma_{ij,t-1} \tag{5}$$

where $\overline{\sigma}$ is the unconditional covariance of the standardized residuals (δ_t) resulting from the univariate GARCH, and $\theta_1$and θ_2 are parameters. Both $\theta_1$and θ_2 must be positive and $\theta_1 + \theta_2 < 1$. In other words, the DCC model includes the two GARCH (1, 1) processes of stock returns and standardized residuals. The DCC is decomposed into a matrix of conditional variance (σ_{ij}) and a diagonal matrix of the square root of the conditional variances ($\sigma_{ii,t}^{-1/2}$) is given below

$$\rho_t = \sigma_{ii,t}^{-1/2} \, \sigma_{ij,t} \, \sigma_{jj,t}^{-1/2} \tag{6}$$

To measure the coefficients, Engle (2002) proposes to maximize the likelihood function in the following equation

$$L_t = -\frac{1}{2}\sum_{t=1}^{T}[nlog(2\pi) + \log|D_t|^2 + \varepsilon'_t D_t^{-2} \varepsilon_t] - -\frac{1}{2}\sum_{t=1}^{T}[log|R_t| + \varepsilon'_t R_t^{-1} \varepsilon_t - \varepsilon'_t \varepsilon_t] \tag{7}$$

The results of DCC tests are plotted in the seven graphs presenting the time-varying conditional correlations between the United States and other markets in the sample over the period from 1/7/2007 to 31/12/2010. The *MATLAB* package is used to perform these tests.

4. Empirical Results

4.1 Volatilities of Individual Market

In order to estimate the conditional correlations of a pair of equity market volatilities, we firstly conduct the univariate GARCH(1,1) model for individual markets to estimate individual market volatility series. As we can be seen in Table 3, almost all of the parameters are statistically significant this result supports using the CCC and DCC models to investigate the transmission of shock among the markets. In addition, the sum of parameters in the volatility equation nearly equals to one, implying that the market volatilities highly measure the behavior of each market. There are some parameters, however which appear insignificant during the crisis period. This can be explained by the shorter period of study of the crisis period (142 observations) compared to the pre-crisis period (315 observations) and the post-crisis period (458 observations). It is notable that during the crisis period, the market volatilities of the Vietnam equity market cannot be measured effectively by its owns residuals and its lagged values because all the parametters are insignificant. This result add caution in interpreting empirical findings on the conditional correlations between the Vietnam and United States equity markets during the crisis period.

Table 3. Results of the volatility equations of individual market returns

Market	Coefficient	Pre-crisis (315 obs)	Crisis (142 obs)	Post-crisis (458 obs)
US	ARCH	0.03**	0.08***	0.10**
	GARCH	0.87	0.89***	0.89**
	constant	0.17	0.34	0.02**
HK	ARCH	0.16**	0.13***	0.03**
	GARCH	0.76***	0.83***	0.96**
	constant	0.40	0.57	0.01**
JP	ARCH	0.08**	0.19***	0.05**
	GARCH	0.86***	0.77***	0.91***
	constant	0.15***	0.56	0.07***
SG	ARCH	0.14**	0.08**	0.08**
	GARCH	0.78***	0.86***	0.90**
	constant	0.21	0.40	0.02**
ML	ARCH	0.24***	0.12***	0.18**
	GARCH	0.72***	0.76	0.68***
	constant	0.11***	0.18	0.05**
TL	ARCH	0.15***	0.06**	0.10**
	GARCH	0.79***	0.92**	0.87**
	constant	0.13***	0.04***	0.04**
TW	ARCH	0.10**	0.05***	0.07**
	GARCH	0.82***	0.16	0.91**
	constant	0.24	4.58	0.03**
VN	ARCH	0.31***	0.21	0.14**
	GARCH	0.62***	0.77	0.84**
	constant	0.28	0.16	0.07**

Notes: *, **, *** indicate statistical significance at 1%, 5% and 10%, respectively.

4.2 Constant Conditional Correlation

Table 4 presents the empirical estimations of the CCC-MGARCH(1,1) models. The results show not only the conditional correlation on market volatility between the United States and other markets but also those between the pairs of other markets

Over the pre-crisis period, the market volatility of the United States reveal high correlations with the developed markets rather than the emerging and frontier markets, while the regional markets reveal the higher conditional correlations with both Hong Kong and Singapore. It implies significant roles of Hong Kong and Singapore in the region in the region. The volatility of the Vietnam equity market is quite small suggesting for the less influences of the regional markets toward the Vietnam.

During the crisis, the United States reveals a significant increase in the conditional correlation with the Japan market, followed by Vietnam, Taiwan and Hong Kong. It implies that Japan is likely to be the first market in the region affected by the crisis. However, it may be surprising that the CCCs between the United States equity market and the East Asian equity markets do not increase except for those of the Japan and Vietnam. It is in line with our findings in the unconditional correlations among the markets. It may suggest that the contagion effect from the United States to the regional markets is not apparently. In addition, all the correlations of market volatility of the Vietnam market are reported to be significantly higher during the GFC than before the GFC giving implications on a sensitive characterize of the frontier market towards the shock originated in the United States. Interestingly, our findings reports that the Thailand equity market is less directly influenced by the GFC during the GFC as its conditional correlation of market volatility declines relative to that of the pre-crisis period. The fluctuation of the Thailand equity market over the crisis period may result from the volatilities of regional markets such as Hong Kong and Singapore.

Over the post-GFC, the conditional correlations of almost markets turn back relatively to the correlations during the pre-GFC. The market volatilities of both the Hong Kong and Singapore market still prominently influence the other markets in the region. The volatilities of the Japan market reveal the highest close linkage to the volatilities of the United States market. Importantly, we find significant increases in the conditional correlations between the Vietnam and both the United States and regional markets. It gives implications on significant

influences of the shock caused by the GFC on the frontier market.

In summary, we may conclude that the CCCs results suggest that the markets of East Asia are closely connected during the crisis period. The transmission of the shock originated from the United States which quickly transferred to Japan and Vietnam rather than other countries. This suggests that the shock by the GFC originated from the United States may transmit to the East Asian equity market via Japan.

Table 4. Constant conditional correlation of market volatilities

	US	HK	JP	SG	ML	TL	TW	VN
Pre-crisis period (from 1/7/2007 to 14/8/2008)								
US	1							
HK	0.52	1						
JP	0.53	0.64	1					
SG	0.52	0.79	0.65	1				
ML	0.43	0.51	0.43	0.55	1			
TL	0.35	0.54	0.43	0.54	0.45	1		
TW	0.43	0.60	0.59	0.60	0.47	0.47	1	
VN	0.12	0.09	0.11	0.04	0.04	0.03	0.06	1
Crisis period (from 15/9/2008 to 31/3/2009)								
US	1							
HK	0.43	1						
JP	0.66	0.66	1					
SG	0.30	0.76	0.59	1				
ML	0.36	0.58	0.58	0.65	1			
TL	0.28	0.67	0.58	0.71	0.60	1		
TW	0.43	0.65	0.70	0.59	0.60	0.52	1	
VN	0.52	0.22	0.44	0.19	0.30	0.30	0.33	1
Post-crisis period (from 1/4/2009 to 31/12/2010)								
US	1							
HK	0.41	1						
JP	0.54	0.57	1					
SG	0.35	0.72	0.49	1				
ML	0.44	0.52	0.45	0.56	1			
TL	0.23	0.51	0.36	0.51	0.39	1		
TW	0.39	0.60	0.55	0.58	0.46	0.35	1	
VN	0.34	0.19	0.23	0.12	0.19	0.08	0.17	1

4.3 Dynamic Conditional Correlation

As indicated by Corsetti, Pericoli and Sbracia (2005), a correlation between two market returns is not static but varies over time. As such, in the paper, we capture the time-varying correlations between the United States and the East Asian equity markets. Specifically, we employ the DCC-MGARCH model suggested by Engle (2002) to measure the time-varying conditional correlation coefficients between two markets. The results of the time-varying conditional correlation coefficients between the United States and the East Asian markets are plotted in Figure 2. In general, we can see that the highest volatility of the DCCs is found between the United States and Japan (spanning from 0.35 to 0.67) while the lowest volatility of the DCCs is found between the United States-Vietnam (spanning from 0.2 to 0.4).

During the pre-GFC, the graphs show a relatively high correlation in the dynamic path of several markets such as Hong Kong, Singapore, Malaysia and Thailand which can be explained by their significant influences by the sub-prime mortgage crisis in the United States. It is also notable that the time-varying conditional correlations of the United States and almost markets decline significantly around January 2008 as some large U.S international corporations reported losses in their performances in 2007. However, the DCCs then recover quickly implying that the negative effects of the sub-prime mortgage crisis do not cause significant impacts on the East Asian equity markets.

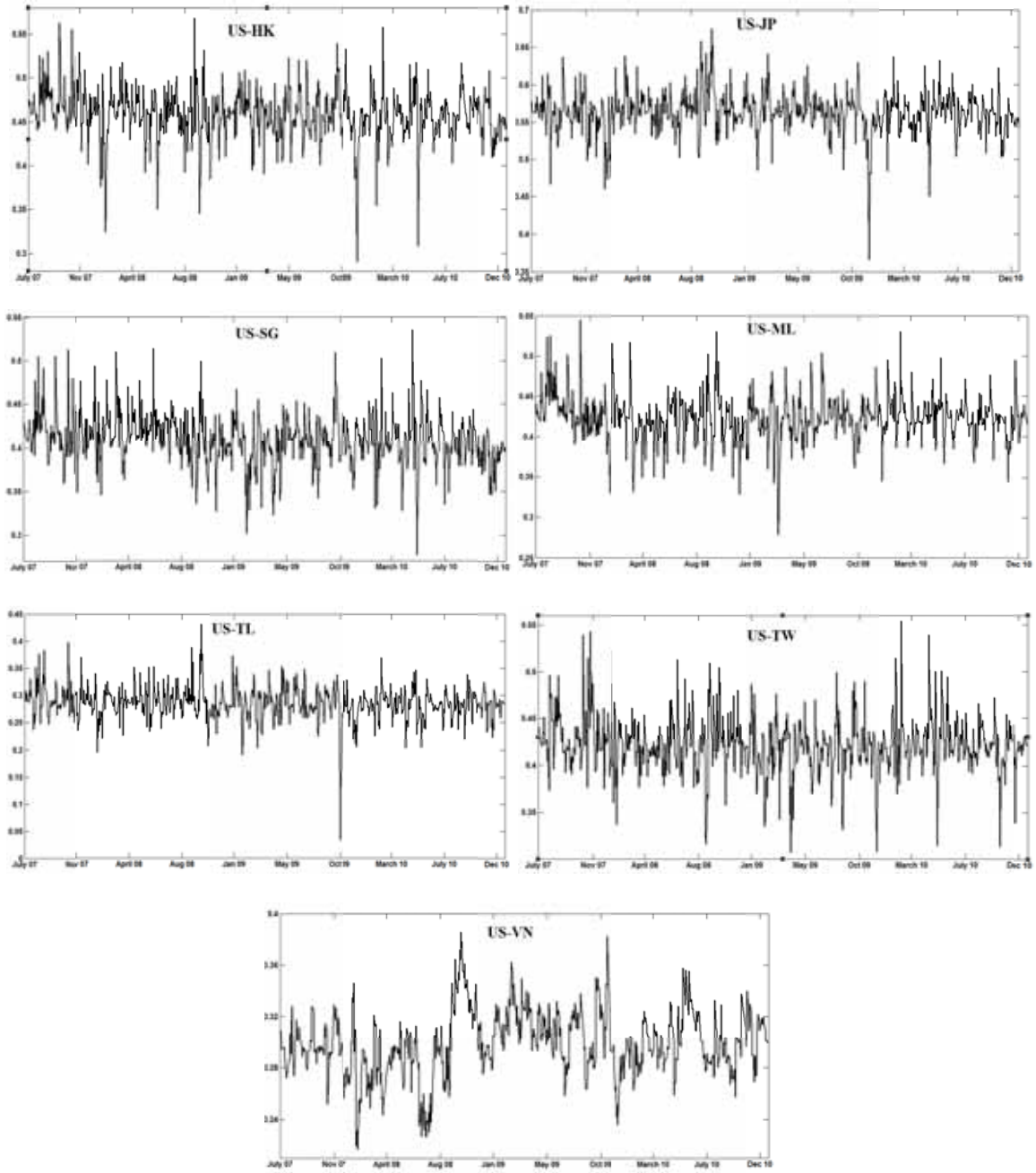

Figure 2. Time-varying dynamic conditional correlations of market volatilities

Figure 2 also shows that the high conditional correlation in the market volatilities of Japan, Hong Kong, Malaysia, Thailand and Vietnam markets over the period from September 2008 to October 2008. It implies for the transmission of the GFC to these markets particularly in September 2008 after the bankruptcy of the Lehman Brother and the collapse of the AIG. Notably that both the DCCs of Singapore and Taiwan do not significantly increase during this period in comparison to the DCC during the pre-crisis period. It can be explained by the fact that the United States is the largest importers of industrial products from Singapore and Taiwan. Hence, these countries are severely affected during the sub-prime mortgage crisis. As such, their responses to over the GFC period are not sharply. Interestingly, the DCCs of the frontier market, Vietnam, significantly increase during the crisis period suggesting strong impacts of the market during the GFC.

It is noteworthy that the influence of the GFC on the East Asian equity markets vary significantly. While many markets reveal the relatively low conditional correlations to the United States around March 2008, the correlation of Hong Kong remains moderate, and that of Vietnam is still high. These results imply the

transmission of the GFC shock from the United States to the East Asian equity markets during the crisis.

During the post-GFC, the time-varying conditional correlations between the developed and emerging markets in the East Asian region and the United States appear to decline slightly, implying a lesser impact to the shock from the United States. However, the DCCs between the Vietnam and United States market maintain a relatively highe level of interdependence during the post-crisis period compared to those during the pre-crisis period implying stronger correlations between the Vietnam and the United States after the crisis.

In summary, our findings suggest evidence of a transmissions mechanism operating from the United States to the East Asian market. This result is in line with the results by Yiu; Alex-Ho and Choi (2010) and Hwang (2012) who find evidence of contagion between the United States andHong Kong, Japan and Singapore during the period from 9/2007 to 3/2009. However, our findings extends their results by showing that the contagion effect exists between the United State and Hong Kong and Singapore during the subprime crisis. In addition, our results are consistent with a study by Gupta and Guidi (2012) who find evidence of contagion effect from the United States to the equity market of India, as well as a study by Syllignakis and Kouretas (2011) who provide evidence of the transmission of the shock in the United States to the CEE stock returns during the 2007– 2009 financial crises.

5. Conclusion

This paper employs the constant and dynamic conditional correlation models based on the MGARCH (1,1) to investigate the transmission of the global financial crisis to the developed, emerging and frontier markets in the East Asian region. The models allow us to trace the existance of time-varying correlation of market volatilities between the United States and each of the selected markets. By partitioning the period of study into the pre-crisis, crisis and post-crisis period, we can explore the transmission of the crisis to the East Asian equity market over time.

The empirical findings suggest that among the examined markets, Japan is the most significantly influenced market by the GFC due to its highest correlations with the US markets. In addition, both the Hong Kong and Singapore market are more severely influenced by the sub-prime mortgage crisis in the United State in the mid 2007 rather than the GFC. This result is explained by the close linkages in the international trades because the United States, Hong Kong and Singapore. Furthermore, although the emerging markets in the region are influenced by the shock from the United States over the crisis period; the linkages are more correlated to the developed markets in the region rather than the United States. In addition, the GFC is likely to transmit to the East Asian markets via Japan. Finally, the transmission effects of the GFC to the frontier market Vietnam, is more significant than any other market in the region. The results suggest some implications for policy makers and international fund managers. Firstly, an understanding of the transmission of a shock caused by one market to another markets may give policy makers a clear viewpoint on the linkages between the markets. In the paper, we not only find empirical evidences of the transmission of the shock caused by the United States to the East Asian markets, but also identify specific time periods during which the crisis is transmitted to these markets. Thus, policy makers can understand the relationships between the volatilities of their equity markets and the regional and global markets which may improve the monitoring and supervision of their markets. In addition policy makers may take account of international monetary policies in avoiding the negative impacts from a shock caused by another market. International fund managers can identify the transmission mechanism of shocks to the East Asian markets which inturn may improve their portfolio diversification strategies across equity markets in the region.

References

Ahlgren, N., & Antell, J. (2010). Stock market linkages and financial contagion: A cobreaking analysis. *Quarterly Review of Economics & Finance, 50*(2), 157-166. http://dx.doi.org/10.1016/j.qref.2009.12.004

Aït-Sahalia, Y., Andritzky, J., Jobst, A., Nowak, S., & Tamirisa, N. (2012). Market response to policy initiatives during the global financial crisis. *Journal of International Economics, 87*(1), 162-177. http://dx.doi.org/10.1016/j.jinteco.2011.12.001

Allen, F., & Carletti, E. (2010). An Overview of the Crisis: Causes, Consequences, and Solutions. *International Review of Finance, 10*(1), 1-26. http://dx.doi.org/10.1111/j.1468-2443.2009.01103.x

Arestis, P., Sobreira, R. R., & Oreiro, J. L. S. (2011). *The financial crisis: origins and implications*. Palgrave Macmillan.

Bartram, S. M., & Bodnar, G. M. (2009). No place to hide: The global crisis in equity markets in 2008/2009. *Journal of International Money & Finance, 28*(8), 1246-1292.

http://dx.doi.org/10.1016/j.jimonfin.2009.08.005

Billio, M., & Pelizzon, L. (2003). Contagion and interdependence in stock markets: Have they been misdiagnosed? *Journal of Economics and Business, 55*(5-6), 405-426. http://dx.doi.org/10.1016/S0148-6195(03)00048-1

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics, 31*(3), 307-327. http://dx.doi.org/10.1016/0304-4076(86)90063-1

Bollerslev, T. (1990). Modelling the coherance in short-run nominal exchange rates: A multivariate generalized arch model. *Review of Economics & Statistics, 72*(3), 498. http://dx.doi.org/10.2307/2109358

Caramazza, F., Ricci, L., & Salgado, R. (2004). International financial contagion in currency crises. *Journal of International Money and Finance, 23*(1), 51-70. http://dx.doi.org/10.1016/j.jimonfin.2003.10.001

Claessens, S., & Forbes, K. (Eds.). (2001). *International financial contagion*. Boston: London Kluwer Academic Publishers. http://dx.doi.org/10.1007/978-1-4757-3314-3

Claessens, S., Dell'Ariccia, G., Igan, D., & Laeven, L. (2010). Cross-country experiences and policy implications from the global financial crisis. *Economic Policy, 25*(62), 267-293. http://dx.doi.org/10.1111/j.1468-0327.2010.00244.x

Corsetti, G., Pericoli, M., & Sbracia, M. (2005). 'Some contagion, some interdependence': More pitfalls in tests of financial contagion. *Journal of International Money and Finance, 24*(8), 1177-1199. http://dx.doi.org/10.1016/j.jimonfin.2005.08.012

Dooley, M., & Hutchison, M. (2009). Transmission of the U.S. subprime crisis to emerging markets: Evidence on the decoupling–recoupling hypothesis. *Journal of International Money & Finance, 28*(8), 1331-1349. http://dx.doi.org/10.1016/j.jimonfin.2009.08.004

Dornbusch, R., Park, Y. C., & Claessens, S. (2000). Contagion: Understanding How It Spreads. *The World Bank Research Observer, 15*(2), 177-197. http://dx.doi.org/10.1093/wbro/15.2.177

Dungey, M., Fry, R., Gonzalez-Hermosillo, B., & Martin, V. L. (2005). Empirical Modelling of contagion: a review of methodologies. *Quantitative Finance, 5*(1), 9-24. http://dx.doi.org/10.1080/14697680500142045

Engle, R. (2002). Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. *Journal of Business & Economic Statistics, 20*(3), 339-350. http://dx.doi.org/10.1198/073500102288618487

Forbes, K. J., & Rigobon, R. (2002). No Contagion, Only Interdependence: Measuring Stock Market Comovements. *Journal of Finance, 57*(5), 2223-2261. http://dx.doi.org/10.1111/0022-1082.00494

Gklezakou, T., & Mylonakis, J. (2010). Links and interdependence of developed stock markets under global economic crisis conditions. *Journal of Financial Services Marketing, 14*(4), 314-327. http://dx.doi.org/10.1057/fsm.2009.24

Guo, F., Chen, C. R., & Huang, Y. S. (2011). Markets contagion during financial crisis: A regime-switching approach. *International Review of Economics & Finance, 20*(1), 95-109. http://dx.doi.org/10.1016/j.iref.2010.07.009

Gupta, R., & Donleavy, G. D. (2009). Benefits of diversifying investments into emerging markets with time-varying correlations: An Australian perspective. *Journal of Multinational Financial Management, 19*(2), 160-177. http://dx.doi.org/10.1016/j.mulfin.2008.10.001

Gupta, R., & Guidi, F. (2012). Cointegration relationship and time varying co-movements among Indian and Asian developed stock markets. *International Review of Financial Analysis, 21*, 10-22. http://dx.doi.org/10.1016/j.irfa.2011.09.001

Hwang, J. K. (2012). Dynamic Correlation Analysis of Asian Stock Markets. *International Advances in Economic Research, 18*(2), 227-237. http://dx.doi.org/10.1007/s11294-012-9343-6

Karolyi, G. A. (2003). Does International Financial Contagion Really Exist? *International Finance, 6*(2), 179. http://dx.doi.org/10.1111/1468-2362.00114

Kearney, C. (2000). The determination and international transmission of stock market volatility. *Global Finance Journal, 11*(1-2), 31-52. http://dx.doi.org/10.1016/S1044-0283(00)00015-6

Kenourgios, D., Samitas, A., & Paltalidis, N. (2011). Financial crises and stock market contagion in a multivariate time-varying asymmetric framework. *Journal of International Financial Markets, Institutions*

and Money, 21(1), 92-106. http://dx.doi.org/10.1016/j.intfin.2010.08.005

Khalid, A. M., & Kawai, M. (2003). Was financial market contagion the source of economic crisis in Asia?: Evidence using a multivariate VAR model. *Journal of Asian Economics, 14*(1), 133. http://dx.doi.org/10.1016/S1049-0078(02)00243-9

Kuper, G. H., & Lestano. (2007). Dynamic conditional correlation analysis of financial market interdependence: An application to Thailand and Indonesia. *Journal of Asian Economics, 18*(4), 670-684. http://dx.doi.org/10.1016/j.asieco.2007.03.007

Marcal, E. F., Valls Pereira, P. L., Martin, D. M. L., & Nakamura, W. T. (2011). Evaluation of contagion or interdependence in the financial crises of Asia and Latin America, considering the macroeconomic fundamentals. *Applied Economics, 43*(19), 2365-2379. http://dx.doi.org/10.1080/00036840903194204

Markwat, T., Kole, E., & van Dijk, D. (2009). Contagion as a domino effect in global stock markets. *Journal of Banking & Finance, 33*(11), 1996-2012. http://dx.doi.org/10.1016/j.jbankfin.2009.05.008

Mishkin, F. S. (2011). Over the Cliff: From the Subprime to the Global Financial Crisis. *The Journal of Economic Perspectives, 25*(1), 49-70. http://dx.doi.org/10.1257/jep.25.1.49

MSCI. (2012). MSCI Frontier Markets Indices. Retrieved from http://www.msci.com/products/indices/country_and_regional/fm/

Naoui, K., Liouane, N., & Brahim, S. (2010). A Dynamic Conditional Correlation Analysis of Financial Contagion: The Case of the Subprime Credit Crisis. *International Journal of Economics & Finance, 2*(3), 85-96.

Phylaktis, K., & Ravazzolo, F. (2002). Measuring financial and economic integration with equity prices in emerging markets. *Journal of International Money and Finance, 21*(6), 879-903. http://dx.doi.org/10.1016/S0261-5606(02)00027-X

Pretorius, E. (2002). Economic determinants of emerging stock market interdependence. *Emerging Markets Review, 3*(1), 84-105. http://dx.doi.org/10.1016/S1566-0141(01)00032-2

Syllignakis, M. N., & Kouretas, G. P. (2011). Dynamic correlation analysis of financial contagion: Evidence from the Central and Eastern European markets. *International Review of Economics & Finance, 20*(4), 717-732. http://dx.doi.org/10.1016/j.iref.2011.01.006

Yiu, M. S., Alex-Ho, W. Y., & Choi, D. F. (2010). Dynamic correlation analysis of financial contagion in Asian markets in global financial turmoil. *Applied Financial Economics, 20*(4), 345-354. http://dx.doi.org/10.1080/09603100903494946

Yu, I. W., Fung, K. P., & Tam, C. S. (2010). Assessing financial market integration in Asia - Equity markets. *Journal of Banking & Finance, 34*(12), 2874-2885. http://dx.doi.org/10.1016/j.jbankfin.2010.02.010

Notes

Note 1. The market classification is based on the 2012 MSCI global equity indices.

Note 2. In case that volatilites of markets are simultaneous increase during times of crisis, an interdependent linkage is suggested.

Note 3. Multiple equilibrium relates to changes in expectations of investors that are subject to multiple quilibriums.

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Diversification in a Small Market: Some Evidences from Namibia

Udai Lal Paliwal[1]

[1] Faculty of Economics and Management Sciences, University of Namibia, Namibia

Correspondence: Udai Lal Paliwal, Faculty of Economics and Management Sciences, University of Namibia, Namibia. E-mail: ulpaliwal@unam.na

Received: February 3, 2013 Accepted: April 3, 2013 Online Published: April 24, 2013

doi:10.5539/ijef.v5n5p184 URL: http://dx.doi.org/10.5539/ijef.v5n5p184

Abstract

Maximizing returns and minimizing risk through diversification has been a popular topic in economics and finance research. Studies have shown that correlation among international portfolio returns increases during periods of turbulence in capital markets, meaning that benefits from international diversification are lost exactly when they are needed most (Bodie, Kane & Marcus, 2008). This and other similar findings pave the way for nontraditional diversification strategies. The present paper is an attempt to analyse portfolio returns and diversification benefits of including gold, bonds, real estate and stock in portfolio of a Namibian investor.

Keywords: Namibia, portfolio diversification, overall index, local index

1. Introduction

Despite a plethora of research supporting the notion of international diversification, recent studies have shown that correlation among international portfolio returns increases during periods of turbulence in capital markets, meaning that benefits from international diversification are lost exactly when they are needed most (Bodie, Kane & Marcus, 2008). This and other similar findings pave the way for nontraditional diversification strategies. Inspired from this the current paper is an attempt to identify innovative diversification opportunities and to identify the effect of including direct investment in gold and real estate as one of the diversification strategies. Several studies (Chua, 1999; Goetzmann, 1993; Lee, 2008) have shown that including housing investment in asset portfolio increases portfolio returns and decreases portfolio risk. Although many researchers have studied the effect of real estate in multi-asset portfolio in several countries, little research has been done in Namibia on diversification in general and the diversification effect of non-traditional asset classes such as gold and real estate in particular. The remaining of this article is organized as follows. In the section two, literature review, earlier research on portfolio diversification is discussed while the section three briefly explains the objectives of the present study. The section four succinctly describes the methodology used while the section five presents discussion and analysis of findings. The section six presents conclusion of the research.

2. Literature Review

Diversification for maximizing returns and minimizing risk is an important economic task for individual investors and portfolio managers. Modern portfolio theory, dating back to the seminal work of Markowitz (1952), says that an investor should optimize her portfolio's return-risk-exposure trade-off by carefully spreading out her scarce resources over various assets. Unfortunately, this task is quite demanding, as infinitely many possible combinations have to be considered (Baltussen & Post; 2011). Investors and researchers have long debated over the two popular maxims, "put all your eggs in one basket and then watch the basket" and "do not put all your eggs in one basket"; however, the later appears to be the belief of many (Olaleye & Aluko, 2007). Based on several research studies, they further conclude that diversification benefits may be captured by combining different classes of real estate assets in different locations or by acquiring different property types or using both strategies (Olaleye & Aluko, 2007).

Over the last two decades, the international financial markets have experienced a series of financial crises and turbulences in different parts of the world, which resulted in drastic drop and excessive volatility in the stock markets of the crisis-originating countries as well as markets of other economies through the "contagion" effect. The recurring heightened volatility in the stock markets imposes substantial risk to stock investment (Ibrahim & Baharom, 2011). Existing studies on stock market risk have a predominant focus on characterizing the risk using GARCH-type models and whether the risk can be diversified through international diversification. Studies on the

benefits of international diversification tend to suggest increasing interactions among national markets and their interactions are more intense during crisis episodes and accordingly limit the benefits of diversifying away financial risks originating from a specific market, thus highlighting the need to identify other types of financial assets as a protection against this risk (Ibrahim & Baharom, 2011).

A large body of recent literature exists on the benefits of international equity diversification, which emanates from the Markowitz's theory, "the less the assets are correlated, the greater the benefit of risk diversification". However, in today's volatile global environment, with increasing interdependence among world stock markets, especially after the global financial crisis of 2008-2009, it has been questioned by many "whether it still makes sense to diversify globally" or "can the investments in global equity portfolios be protected in today's volatile and interdependent markets?" (Hsu, 2011).

Traditionally, investment managers in direct real estate have focused on a single geographical region. To achieve diversification, they have invested across different property types, in assets with different characteristics, or by selecting assets in targeted areas within that region. Achieving diversification through international investment, common in other asset classes, has not been considered as attractive for direct real estate because real estate markets are less transparent and there are higher risks and costs involved (Wit I de, 2010).

Liow (2010), in an analysis of integration among securitized real estate markets found that conditional correlations are (substantially) weaker than the broader stock market correlations; implying the existence of potential benefits in international portfolio diversification that includes real estate. Liow, (2010), also found stronger return linkages between some pairs of real estate securities markets as well as between the securitised real estate markets and the global stock market over the past decades, implying that international linkages have been increasing over time, although their integration process has been much slower than that among the corresponding broader stock markets and from the world stock market. This further implies the potentialities of portfolio diversification benefits across the major real estate securities markets and the world stock markets might reduce/diminish in the long run. Masron & Fereidouni, (2010) in their study of performance and diversification benefits of housing investment in Iran concluded that housing is not only an effective asset for investment but also a good vehicle of diversification if included in a mixed-asset portfolio. They further concluded that investment in housing sector produces the real investment returns as the housing returns exceed the rate of growth in the CPI (inflation rate). Gold has proven to be a solid investment choice, stable in times of global geopolitical instability and economic uncertainty, recession and depression. Used correctly, gold and silver can be effective components of a properly diversified investment portfolio (O'Byrne, 2007).

3. Objectives of the Paper

The objectives of this paper are:

- To identify trend of returns offered by various asset classes in Namibia
- To analyse whether direct investment in gold and real estate provided diversification benefits to Namibian investors

4. Methodology

The present study is based on secondary data collected from variety of sources. Data for overall index and local index were collected from Namibia Stock Exchange Limited (NSX). Both index prices were then converted into monthly returns. Rate of return on risk free assets is interest rate on treasury bonds and was collected from the publications of Bank of Namibia (BON). Since monthly interest rates were not available, the annual interest rates for treasury bonds were converted into monthly rates. Monthly gold prices were obtained from the website of the World Gold Council and monthly returns on investment in gold were determined. Monthly real estate price data were obtained from the First National Bank of Namibia (FNB), which published this data since October, 2007. Using the FNB data the rates of return on investment in physical real estate were computed. It should be noted that real estate data were not available for the whole period of study; as prior to October 2007 no reliable data were available on housing prices.

The first part of discussion and analysis thus explains the portfolio returns on three assets and diversification potential of these assets viz.; bonds, overall index and local index. This is followed by discussion on portfolio returns and diversification including gold as fourth asset class. Further, since about half the study period, from third quarter of 2007 represents more volatile returns on stock market investments, the data was divided into two parts and the first part was used to analyse the diversification effect of these assets during the period before the start of global financial crisis and the second sub sample was used to analyse the contribution of these four assets to portfolio returns as well as their diversification potential during the period of volatility (second half of the

study period). Incidentally, as the data for housing prices was also available for this period; the effect of including real estate in portfolio was also analyzed for the second part of the study period.

5. Discussion and Analysis

5.1 Namibian Stock Exchange (NSX) – A Brief Profile

Namibian Stock Exchange (NSX) is a small stock exchange with 24 securities listed on overall index and 7 securities listed on local index, which means that 17 of the companies listed on overall index are dual listed elsewhere in the world and are multinational companies operating in Namibia. The year to date volume traded at the beginning of April 2012 was 19,989,577 shares on local index and 40,481,113 shares on overall index respectively. The year to date value traded on the same date for both indexes amounted to N$ 247.91 Million on local index and N$ 1150.59 Million on overall index (1USD = N$ 7.8 on the same date).

5.2 Analysis

First of all the portfolio returns were calculated assuming that an investor takes equal position in local index, overall index and bonds. Table 1 presents the average monthly returns, standard deviation and risk to return profile of the three assets for the period September 2003 – December 2011.

Table 1. Average monthly returns, standard deviation and return to risk ratio

	Overall index	*Local index*	*Bonds*
Mean (Monthly return %)	1.18	1.38	0.65
Standard Deviation	6.36	2.52	0.15
Mean / SD	0.19	0.55	4.42
Sharpe ratio	0.0908	0.3090	0.3329

It is evident from the above table that investment in bonds during this period proved to be nearly risk free (SD = 0.15) with an average monthly return of 0.65% and highest Sharpe ratio of 0.3329 among the three assets classes available. Investment in local index also proved to be worthwhile with monthly average returns of 1.38% with standard deviation of 2.52%. Based on the following correlation matrix (Table 2) it is clear that overall index and local index have no correlation at all and overall index is negatively correlated with bonds (r = -0.18), which means that mixing these assets provided good diversification benefits. It is clear that a position in local index together with bonds provided good returns, while lowering the portfolio risk.

Table 2. Correlations: average monthly returns on overall index, local index and bonds

	Overall index	*Local index*	*Bonds*
Overall index	1		
Local index	0.00	1.00	
Bonds	-0.18	0.13	1.00

Table 3 indicates average monthly returns of the minimum variance portfolio invested in three assets:

Table 3. Average monthly returns and Sharpe measure for minimum variance portfolio

Portfolio weights			SD	Return	Ret/SD	Sharpe
Overall index	*Local index*	*Bonds*				
0.07	0.57	0.36	1.49	1.10	0.74	0.33

As concluded by many researchers (AlKulaib & Almudhaf, 2012; Ibrahim & Baharom, 2011; Kristof, 2011; McCormick, 2010) adding gold into ones investment basket has provided both diversification as well as hedging benefits. Following from such empirical findings it was tested whether gold does shine in portfolio of Namibian Investor. Since Namibia is a small market, there is no option for securitized investment in gold locally, therefore, direct investment in gold was considered as an option. Following section presents the effect of including direct investment in gold in one's portfolio. Figure 1 presents an overview of average monthly returns on gold, overall index, local index and bonds. As can be observed from the Figure 1, the overall index returns have been most volatile during this period. As most of the companies included in overall index are dual listed multinational companies; they were less resilient to the shocks of global economic meltdown. Table 4 shows the portfolio returns including gold for the period from September 2003 to December 2011.

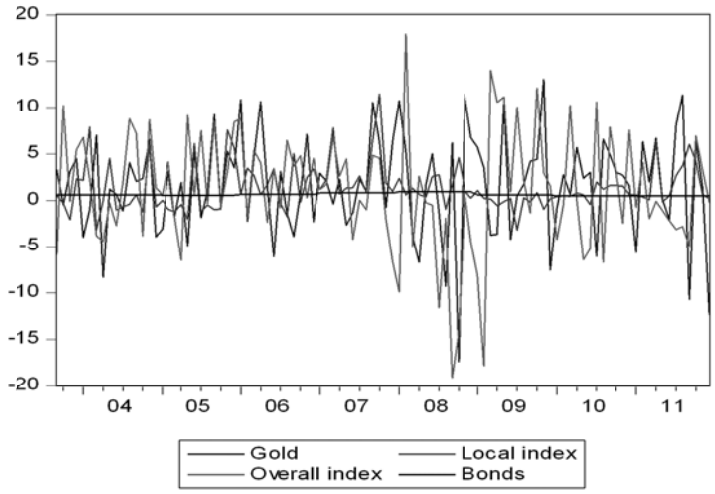

Figure 1. Trend of average monthly returns (%) September 2003 to December 2011

Table 4. Average monthly returns and sharpe measure including direct investment in gold

Portfolio weights				SD	Return	Ret/SD	Sharpe
Gold	*Overall index*	*Local index*	*Bonds*				
0.1295	0.0591	0.5505	0.2609	1.6502	1.2000	0.7272	0.3636

It is clearly evident that including gold in the portfolio pushed monthly returns upward from 1.1% to 1.2%. At the same time Sharpe ratio has also increased from 0.33 to 0.36 after including gold into portfolio.

As it may be noted from Figure 1, the study period witnessed one of the worst volatile movements in security returns; it was felt necessary to divide the study period into two parts; viz., September 2003 to October, 2007 and November 2007 to December 2011, each covering 50 months; to study the trend of asset as well as portfolio returns to draw some meaningful conclusions. The following part presents the relevant statistics for two periods respectively.

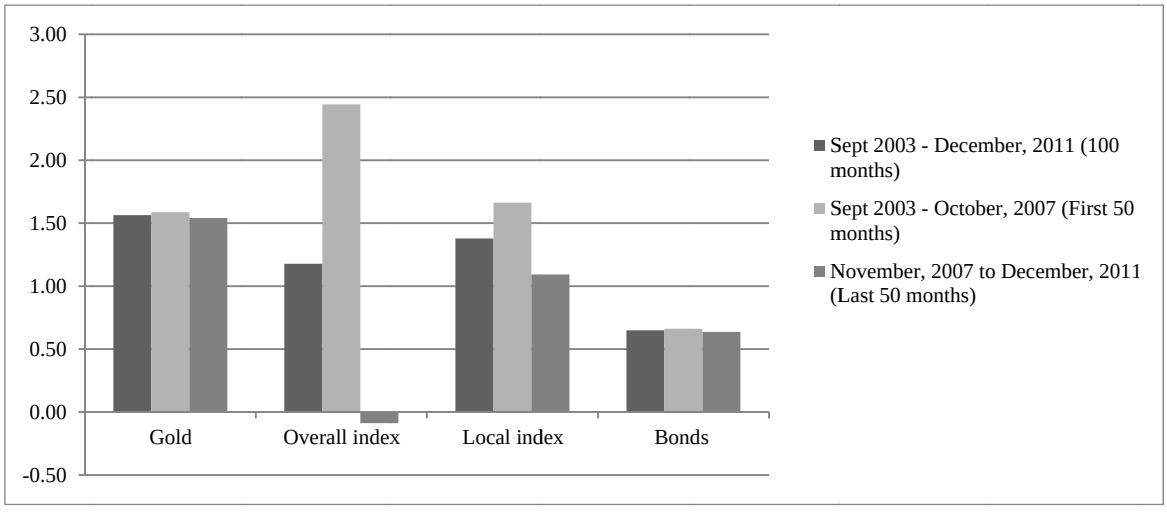

Figure 2. Average monthly returns over different investment horizons

It may be noted from Figure 2 that during the study period gold returns were most stable and attractive followed by returns on bonds, local index and overall index respectively. During the second half of the study period investment in overall index resulted in negative monthly returns of 0.09% due to its exposure to capital markets

around the globe and resulting shocks. It may be observed from Table 4 and the following Table 5 showing correlation matrix that investment in gold proved to be a good diversification option to minimize risk as it had very low correlation with other assets especially during the second half of the study period, when it was most needed.

Table 5. Correlation between monthly returns on gold and other assets during two periods

	Sept 2003 - Oct 2007	Nov 2007 - Dec 2011
Gold	1	1
Overall index	0.156	0.037
Local index	0.175	-0.029
Bonds	0.088	-0.049

Table 6 presents the portfolio returns with and without gold for the second half of the study period.

Table 6. Average monthly returns and sharpe measure (November 2007 – December 2011)

	Portfolio weights							
Portfolio	*Gold*	*Overall index*	*Local index*	*Bonds*	SD	Return	Ret/SD	Sharpe
Without gold	N.A.	0.00	0.15	0.85	0.28	0.70	2.47	0.35
With gold	0.04	0.00	0.28	0.68	0.54	0.80	1.48	0.37

As observed earlier, overall index returns have been negative during the second half of the study period; an appropriate strategy would have been no investment in overall index during this period. It may be further concluded that a small position in gold would increase portfolio's monthly returns from 0.7% to 0.8% and push Sharpe ratio from 0.35 to 0.37.

Having observed the effect of investment in gold on portfolio returns and diversification, the next step was to study the effect of direct investment in real estate. Since housing price data was available from October 2007, its effect could be analyzed for the second half of the study period only. As depicted in Figure 3, housing returns have outperformed returns from bonds and that from overall index.

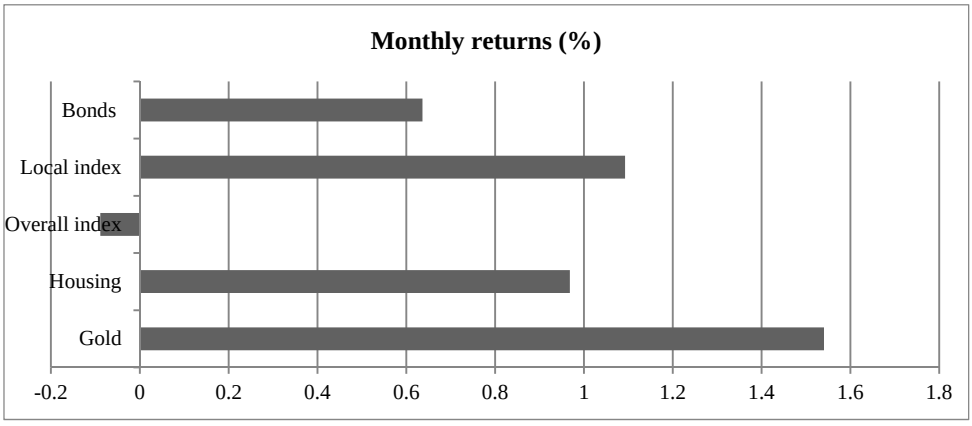

Figure 3. Average monthly returns during November 2007 – December 2011

Table 7. Diversification effect of real estate investment on portfolio returns

	Portfolio weights								
Portfolio	Real estate	*Gold*	*Overall index*	*Local index*	*Bonds*	SD	Return	Ret/SD	Sharpe
Without housing	N.A.	0.04	0.00	0.28	0.68	0.54	0.80	1.48	0.37
With housing	0.01	0.05	0.00	0.36	0.58	0.68	0.85	1.24	0.37

Table 7 shows a small position in real estate increased monthly return from 0.8% to 0.85%, however, a corresponding increase in portfolio risk (standard deviation) kept the Sharpe measure unchanged. It is interesting to note that effect of real estate investment in the portfolio of Namibian investor is less attractive when compared

with real estate returns elsewhere as found by empirical research (Chua, 1999; Goetzmann, 1993; Lee, 2008; Masron & Fereidouni, 2010).

6. Conclusion

As evident from the foregoing discussion, the Namibian overall index was affected by the global economic crisis to a large extent. As may be noted from the preceding section, including gold into portfolio resulted in much needed diversification benefit for Namibian investors (monthly returns increased from 1.1% to 1.2% and Sharpe ratio increased from 0.33 to 0.36). Direct investment in real estate was also found to provide diversification benefit. However, real estate returns as well as its contribution to diversification was not very impressive when compared to the findings from other countries (Chua, 1999; Goetzmann, 1993; Lee, 2008; Masron& Fereidouni, 2010). As a conclusion it may be noted that though the historical evidence supports the diversification benefits provided by gold and real estate, it may not continue to be so in future, therefore, investors have to continuously monitor their investment strategies and keep changing their position in various assets to achieve desired outcomes from their investment.

References

AlKulaib, Y., & Almudhaf, F. (2012). Does gold shine in the portfoho of a kuwaiti investor? *International Journal of Economics and Finance, 4*(1), 160-166.

Baltussen, G., & Post, G. T. (2011). Irrational diversification: an examination of individual Portfolio choice. *Journal of Financial and Quantitative Analysis, 46*(5), 1463-1491. http://dx.doi.org/10.1017/S002210901100041X

Bodie, Z., Kane, A., & Marcus, A. J. (2008). *Essentials of Investments.* Singapore: McGraw Hill International Edition.

Chua, A. (1999). The role of international real estate in global mixed-asset investment portfolios. *Journal of Real Estate Portfolio Management, 5*, 129-137.

Goetzmann, W. N. (1993). The Single family home in the investment portfolio. *Journal of Real Estate Finance and Economics, 6*, 201-222. http://dx.doi.org/10.1007/BF01096958

Hsu, H. C. (2011). Global risk diversification: an empirical investigation from the U. S. perspective. *International Business & Economics Research Journal, 10*(8), 57-65.

Ibrahim, M. H., & Baharom, A. H. (n.d.). The role of gold in financial investment: a Malaysian perspective. *Economic Computation & Economic Cybernetics Studies & Research.*

Kristof, K. (2011, November). Golden opportunity? The price of gold could still go higher, but invest in small doses. *Kiplinger's Personal Finance*, 32-33.

Lee, C. L. (2008). Housing in Australia as a portfolio investment. *International Journal of Housing Markets and Analysis, 1*, 352-361. http://dx.doi.org/10.1108/17538270810908641

Liow, K. H. (2010). Integration among USA, UK, Japanese and Australian securitized real estate markets: an empirical exploration. *Journal of Property Research, 27*(4), 289-308. http://dx.doi.org/10.1080/09599916.2010.500872

Markowitz, H. M. (1952). Portfolio selection. *Journal of Finance, 7*, 77-91.

Masron, T. A., & Fereidouni, H. G. (2010). Performance and diversification benefits of housing investment in Iran. *International Journal of Economics and Finance, 2*(4), 7-11.

McCormick, D. (2010, July 15). How good is gold? *Money Management*, 22-23.

O'Byrne, M. (2007, October). Why diversifying into gold may be prudent. *Accountancy Ireland, 39*(5), 76-78.

Olaleye, A., & Aluko, B. T. (2007). Evaluating managers diversification of real estate portfolios: evidence from Nigeria. *International Journal of Strategic Property Management, 11*, 179-189.

Wit, I. D. (2010). International diversification strategies for direct real estate. *J Real Estate Finan Econ*, 433-457. http://dx.doi.org/10.1007/s11146-009-9173-3

International Journal of Economics and Finance; Vol. 5, No. 5; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Efficiency of Tunisian Commercial Banks According to the Intermediation Approach

Ilhèm Gargouri[1]

[1] School of Business, University of Sfax, Tunisia

Correspondence: Ilhèm Gargouri, School of Business, University of Sfax, BP 1081 Sfax 3018, Tunisia. Tel: 216-96-363-900. E-mail: ilhèmgargouri@gmail.com

Received: March 8, 2013 Accepted: March 30, 2013 Online Published: April 24, 2013

doi:10.5539/ijef.v5n5p190 URL: http://dx.doi.org/10.5539/ijef.v5n5p190

Abstract

This work focuses on the performance of the banking sector through the analysis of the efficiency of Tunisian commercial banks according to intermediation approach. To measure the cost inefficiencies in banks in Tunisia, we use a translog specification for single-product cost function. The estimated cost efficiency shows a strong correlation between positive and significant efficiency scores according to the approaches (SFA) and (SFAA). The empirical results show that the efficiency cost, depending on the approach SFAA has evolved mixed between 1993 and 2010. Regarding the estimation of efficiency depending on the size of banks, the results show that banks in small and medium size of our sample show medium cost efficiencies better than those made by banks in large sizes. While on the side of profit estimates show that banks of large and medium sizes are more efficient than banks of smaller sizes. Internal determinants of the productive performance of Tunisian banks show that the preponderance of credit activity in relation to other outputs represents a source of efficiency for banks.

Keywords: bank efficiency, intermediation approach, translog cost function, Tunisia

1. Introduction

The banking system plays a crucial role in the functioning of the economy. For this reason, several studies have been conducted to determine the essential components of bank performance. One of these components is concerned with the notion of efficiency. The efficiency of financial institutions has long been investigated. The results have obvious implications for the management of banks seeking to improve operational performance and decision makers who are concerned about bank competition, bank security and soundness of banks.

There is a strong relationship between the efficiency and performance as they are interpreted in the same direction. Indeed, when a bank is efficient, it is obviously effective. According to Chaffai and Diesh (1998), bank profitability is dependent on the efficiency with which the bank organizes its production. Therefore, it seems that efficiency is a determinant of productivity and therefore the performance of the bank. The term performance is more comprehensive than the term efficiency. Moreover, according to the approach of performance in social management, performance covers the notion of productivity of men (efficiency) and social goals assigned to managers such as the development of skills and employee engagement (efficiency). Our goal is to test the hypothesis of positive correlation between efficiency and performance from some performance indicators and scoring efficiency.

Several studies on the efficiency of banks have adopted the intermediation approach (Florian 2012; Kablan 2012; Allen, Engert and Liu, 2006; Allen and Liu, 2005; Isik and Hassan, 2002; Burkart, Gonsard and Dietsch (1999); Chaffai 1998; Berger and Mester, 1997; Zaim, 1995). For example, the article by Burkart, Gonsard and Dietsch (1999) presented an analysis of the cost efficiency and profit efficiency of French banks. These authors showed that the average cost efficiency is around 12% and the dispersion of efficiency scores is quite low, which means that the French credit institutions are relatively close to each other in terms of productive performance. The average profit inefficiency is around 9% and it appears that the behaviors are more similar in terms of ability to extract profits.

2. Research Methodology

Our goal is to analyze the performance of the banking sector through the analysis of the efficiency of Tunisian banks. The first observation we can give on this subject is that there is no unanimity on the explicit definition and

measurement of inputs and outputs of a bank. In general, each input definition and production carries with it a particular set of concepts that influence and limit bank analysis of the characteristics of the production industry.

The data of our work is mainly based on activity reports published by banks and databases of the Tunisian Professional Association of Banks and Financial Institutions (TPABFI). Our sample consists of all commercial banks with the exception of two banks which are the Tunisian Solidarity Bank (TSB) and Arab Banking Corporation (ABC) who had no regular activity during the period of our study. In addition, for reasons of statistical homogeneity, we excluded from our study another small bank which is Citibank (CB).

Our work is limited to the deposit banks because they occupy the most important place in the financing of the Tunisian economy. In fact, over 90% of the savings is collected by commercial banks and over 80% of loans are granted by banks. Our final sample includes observations starting from 1993 to 2010, 18 years, corresponding to the period of banking sector reforms. It refers to 11 Tunisian commercial banks namely:

• T.B.C: Tunisian Banking Company

• A.N.B: Agricultural National Bank

• I.A.B.T: International Arab Bank of Tunisia

• I.U.B: International Union of Bank

• ATTI.B: Attijari Bank

• B.T: Bank of Tunisia

• U.B.T.I: Union Bank for Trade and Industry

• A.B: Amen Bank

• A.T.B: Arab Tunisian Bank

• H.B: Housing Bank

• B.F.T: Bank Franco-Tunisian

2.1 Using the Intermediation Approach

Our methodological approach is based on the intermediation approach which seemed the most appropriate to address our concern, given the importance of interbank activity and weight of the interest costs. Tunisian banks use the funds at their disposal to give primarily loans. It follows that the liability of Tunisian banks tends to be regarded as an input rather than output. It should be noted that deposits are the financial capital of the bank and are considered an input. It should be noted that the financial costs are included in our work.

2.2 Definition of Variables

Variables that will be analyzed are two in number: the banking inputs and the banking outputs.

2.2.1 The Bank Outputs

The outputs provided by the Tunisian commercial banks are classified into two categories: Total Credits (TC) and portfolios of securities. These two types of outputs are measured in monetary units, that is to say dinar directly from the bank's balance sheet.

2.2.1.1 Total Credits (TC)

The total of credits includes the Customer loans (CC) and interbank loans (PI). Indeed, customer loans portfolio is formed by discount accounts receivable from customers, loans on special resources and other loans to customers. While for interbank loans, they gather loans to banks and agencies, cash, Central Bank of Tunisia (CBT), certificates of deposit, treasury bills purchased and giro.

2.2.1.2 Securities Portfolios (PT)

Portfolios securities represent securities portfolios and investments considered services provided by the bank. Securities portfolios included as a line item in the balance sheet (PT = trading securities portfolios + investment portfolios). To measure banking, we have taken as a proxy aggregate output (Q) obtained by aggregation method proposed by BHH (1982) and is as follows:

$$\boldsymbol{Q_i} = \frac{\sum_s \boldsymbol{n_{si}}}{\sum_s \overline{\boldsymbol{n_s}}}\ \overline{\boldsymbol{Q}}$$

With: $\mathbf{Q_i}$: Aggregate output of the bank i;

s: Banking services mentioned above (CC, PI and PT);

$\mathbf{n_{si}}$: The amount of the output **s** of the bank i;

$\overline{\mathbf{Q}}$: A geometric average of the sum of different bank outputs defined as: $\overline{\mathbf{Q}} = \boldsymbol{\pi_i}[\sum_{\mathbf{s}} \mathbf{n_{si}}]^{\frac{1}{m}}$;

m: The number of banks in the sample;

$\overline{\mathbf{n_s}}$: A geometric average of bank outputs defined as: $\overline{\mathbf{n_s}} = \boldsymbol{\pi_i}[\mathbf{n_{si}}]^{\frac{1}{m}}$.

2.2.2 Banking Inputs

The outputs listed above are produced by the combination of factors of production, namely labor input (**L**), physical capital input (**K**) and the financial capital factor (**F**). Various forms of deposits which constitute the financial capital input are considered, as stipulated supporters of intermediation approach. These inputs are measured as follows:

- **L**: The number of employees;
- **K**: Net Fixed Assets;
- **F**: Borrowing from (CBT), money market and specialized agencies + Demand deposits Customer deposits + Savings + Coupon accounts and other financial terms + Other amounts due to customers + Special resources + Bonds and other loans.

2.2.3 Bank Production Costs

Endogenous variable is defined by the Total Cost (TC), which includes all the operating and financial costs. Financial costs are mainly interest expenses. Operating costs correspond to the costs of labor and capital, that is to say, the payroll and general operating expenses.

2.2.4 Bank Input Prices

After determining the cost of each input bank, we can evaluate the prices of these inputs. In fact, the price of each factor of production is measured by the ratio between its cost and quantity. Bank input prices are determined as follows:

- The price of labor "$\mathbf{P_L}$" is obtained by dividing personnel expenses by the number of bank employees: $\mathbf{P_L} = \frac{\mathbf{CL}}{\mathbf{L}}$
- The price of physical capital "$\mathbf{P_K}$" is obtained by dividing the general operating expenses by property: $\mathbf{P_K} = \frac{\mathbf{CK}}{\mathbf{K}}$
- The price of financial capital "$\mathbf{P_F}$" is obtained by dividing the financial burden on borrowed resources: $\mathbf{P_F} = \frac{\mathbf{CF}}{\mathbf{F}}$

Table 1 shows the descriptive statistics (mean, standard deviation, minimum and maximum) of the total cost, total profit, aggregate output, inputs and their prices. We emphasize that public banks (TBC, ANB and HB) are ranked the first in almost all inputs and outputs. Thus, they have larger amounts of deposits, capital, labor, total credit. Only (IABT) ranks sometimes with these three banks.

But on the prices of inputs, we note that private banks offer higher salaries. The price of physical capital and financial capital are relatively lower compared to the price of labor. The (IABT) offers the highest salary about one and a half times higher than the average TBC. This could be explained by the different recruitment policies between banks (in terms of qualifications, for example).

Table 1. Descriptive statistics of sample variables

Variable	**Observations**	average	Standard deviation	**Minimum**	**Maximum**
CT	198	90501	58370	3276	246630
PROFT	198	111070	72665	5701	324268
L	198	1393	826	180	3154
K	198	27902	21850	673	101347
F	198	1237630	910448	53928	3965021
PL	198	15,7903	6,8127	5,3676	34,4047
PK	198	0,8304	0,5193	0,1698	2,9897
PF	198	0,0445	0,0170	0,0097	0,1169
TC	198	1221445	895009	43076	4013283
PT	198	140678	140316	253	654960
Q	198	1389036	1028474	46737	4413806

• Source: Calculated from data provided by the (TPABFI). We note that these data are in thousands of dinars, with the exception of labor (L) which is measured by the number of employees.

3. Analysis of the Econometric Method Used

The method of stochastic frontier when panel data assumes that the specific inefficiency of the company varies over the time, which is the major advantage of this method of efficiency estimation. For our work, we use the cost function translogaritmique.

3.1 The Translog Cost Function

To measure the inefficiencies cost in banks in Tunisia, we use a translog specification for single-product cost function:

$$Ln\,(CT)_{it} = \alpha_0 + \beta_Q Ln\,(Q_{it}) + \frac{1}{2}\beta_{QQ}[Ln\,(Q_{it})]^2 + \sum_j \alpha_j Ln(P_j)_{it} + \sum_j \beta_j Q Ln(P_j)_{it} Ln\,(Q_{it}) + \frac{1}{2}\sum_j\sum_k \beta_{jk} Ln(P_j)_{it} Ln(P_k)_{it} + v_{it} + u_{it} \quad (1)$$

i ∈ (1→11): Denotes the number of banks;

t ∈ (1→18): Refers to years of study. (1993 → 2010)

j ∈ {L, K, F}

With:

$\mathbf{CT_{it}}$: The cost function to estimate the bank i in year t.

$\mathbf{Q_{it}}$: The aggregate output of bank i at time t.

$\mathbf{PL_{it}}$: The price of labor bank i at time t.

$\mathbf{PK_{it}}$: The price of physical capital factor of bank i at time t.

$\mathbf{PF_{it}}$: The price factor financial capital of bank i at time t.

$\mathbf{v_{it}}$: The term random error identically and independently distributed according to a normal law $N(0, \sigma_v^2)$.

$\mathbf{u_{it}}$: The term asymmetric error measuring inefficiency: $u_{it} \rightarrow N(m_{it}, \sigma_u^2)$.

Distribution of random term ($\mathbf{u_{it}}$) on the extent of inefficiency is that of a truncated normal distribution with zero variance ($\boldsymbol{\sigma_u^2}$) and expectation ($\mathbf{m_{it}}$) defined by: $\mathbf{m_{it} = Z_{it}\,\delta}$

Where ($\boldsymbol{\delta}$) is a vector of ($\mathbf{p}$) parameters to be estimated, and ($\mathbf{Z_{it}}$) a vector of ($\mathbf{p}$) variables can affect the efficiency of bank (i) at time t. However, the Hessein the cost function is symmetric, the equality $\left(\frac{\partial^2 CT}{\partial x_i\,\partial x_j} = \frac{\partial^2 CT}{\partial x_j\,\partial x_i}\right)$ must be satisfied for any pair of variables $(\mathbf{x_i})$ and $(\mathbf{x_j})$.

Symmetry leads to the following restrictions: $\boldsymbol{\beta_{jk} = \beta_{kj};\ j, k \in \{L, K, F\}}$

In addition, any cost function must be homogeneous of degree one in input prices. Thus a proportional increase in prices increases the total cost in the same proportion without demand factors being affected. This homogeneity condition implies other constraints expressed as follows:

$$\sum_j \alpha_j = 1\,;\ \sum_j \beta_{jk} = 0\,;\ \sum_j \beta_{jQ} = 0 \quad Avec:\ j, k \in \{L, K, F\}$$

Homogeneity constraint is taken into account by normalizing the Total Cost (**TC**), the price of physical capital ($\mathbf{P_K}$) and the price of financial capital ($\mathbf{P_F}$) by the price of capital work ($\mathbf{P_L}$). A choice that does not affect the results since the estimators are obtained by the method of maximum likelihood.

Within these constraints, we obtain the following transformed model:

$$\mathbf{Ln}\left(\frac{\mathbf{CT}}{\mathbf{PL}}\right)_{\mathbf{it}} = \alpha_0 + \alpha_Q Ln(Q_{it}) + \frac{1}{2}\beta_{QQ}\,[Ln(Q_{it})]^2 + \alpha_K Ln\left(\frac{\mathbf{PK}}{\mathbf{PL}}\right)_{\mathbf{IT}} + \alpha_F Ln\left(\frac{\mathbf{PF}}{\mathbf{PL}}\right)_{\mathbf{IT}} + \beta_{KQ} Ln\left(\frac{\mathbf{PK}}{\mathbf{PL}}\right)_{\mathbf{IT}} . Ln(Q_{it}) + \beta_{FQ} Ln\left(\frac{\mathbf{PF}}{\mathbf{PL}}\right)_{\mathbf{IT}} . Ln(Q_{it}) + \beta_{LK}\left[Ln(PL_{it}).Ln(PK_{it}) - \frac{1}{2}\,[Ln(PL_{it}).]^2 - \frac{1}{2}\,[Ln(PK_{it})]^2\right] + \beta_{LF}\left[Ln(PL_{it}).Ln(PF_{it}) - \frac{1}{2}\,[Ln(PL_{it}).]^2 - \frac{1}{2}\,[Ln(PF_{it})]^2\right]$$

$$+\boldsymbol{\beta}_{KF}\left[\boldsymbol{Ln}(\boldsymbol{PK}_{it}).\boldsymbol{Ln}(\boldsymbol{PF}_{it})-\frac{\mathbf{1}}{\mathbf{2}}[\boldsymbol{Ln}(\boldsymbol{PK}_{it}).]^{2}\frac{\mathbf{1}}{\mathbf{2}}[\boldsymbol{Ln}(\boldsymbol{PF}_{it})]^{2}\right]+\boldsymbol{v}_{it}+\boldsymbol{u}_{it} \quad (2)$$

3.2 Test of Homogeneity Total

We start first by testing complete homogeneity: the latter is noted as Fisher's test A; B = A_i, B_i in the result file of TSP. The letter A is the constant here, while the letter B denotes the vector of coefficients of the explanatory variable.

$$\mathbf{H_0^1}: \boldsymbol{\beta}_\mathbf{i} = \boldsymbol{\beta}\ \boldsymbol{\alpha}_\mathbf{i} = \boldsymbol{\alpha}\ \forall\ \mathbf{i}\ \in [\mathbf{1}, \mathbf{N}]$$

$$\mathbf{H_a^1}: \exists\ (\mathbf{i}, \mathbf{j})\ \in [\mathbf{1}, \mathbf{N}]/\ \boldsymbol{\beta}_\mathbf{i} \neq\ \boldsymbol{\beta}\ \mathbf{or}\ \boldsymbol{\alpha}_\mathbf{i} \neq\ \boldsymbol{\alpha}_\mathbf{j}$$

As part of our sample, the realization of the Fisher statistic associated with the test $\mathbf{H_0^1}$, denoted $\mathbf{F_1}$ is 0.7385.

The software also shows the number of degrees of freedom for this statistic (Note that F1 followed a Fischer with [**(N-1)(K+ 1)**] and [**NT-N(K +1)**] degrees of freedom).

Given the size of our sample and the number of explanatory variables (**K = 9**), we must compare the value of this achievement to the threshold of a Fischer **F** (100, 88). The software gives us directly the p-value associated with this test. In this instance, the p-value indicates here that until the 75% threshold, the null hypothesis can not be rejected. So our panel represented by equation (2) is completely homogeneous (pooled). This homogeneity is explained by the fact that banks in our sample are of the same nature (commercial banks and we excluded development banks and offshore banks). In addition, these banks are indirectly controlled and supervised by the State and apply the same banking reforms.

We can regain our panel structure (pooled model) performing the test $\mathbf{H_0^3}$ that is to test the equality of **N** individual constants $\boldsymbol{\alpha}_\mathbf{i}$:

$$\mathbf{H_0^3}: \boldsymbol{\alpha}_\mathbf{i} = \boldsymbol{\alpha}\ \forall\ \mathbf{i}\ \in [\mathbf{1}, \mathbf{N}]$$

$$\mathbf{H_a^3}: \exists\ (\mathbf{i}, \mathbf{j})\ \in [\mathbf{1}, \mathbf{N}]/\ \boldsymbol{\alpha}_\mathbf{i} \neq\ \boldsymbol{\alpha}_\mathbf{j}$$

This test is denoted as Fisher's test **A**; **B** = $\mathbf{A_i}$, **B** in the result file of **TSP**. This test is to confirm or refute the test results $\mathbf{H_0^1}$, given the fact that reducing the number of linear restrictions can increase the power of the test of Fischer (Note that with $\mathbf{F_3}$ followed a Fischer **[(N-1)** and **N(T-1)-K**] degrees of freedom, ie by an F (10; 178)). As part of our sample, the realization of the Fisher statistic indicates a value of 1.5786. The p-value (0.5536) is well above the 5% threshold. So we can not reject $\mathbf{H_0}$ equality of constants $\boldsymbol{\alpha}_\mathbf{i}$.

3.3 Determination of the Level of Inefficiency

Added to the estimation of the efficiency of Tunisian banks, our goal is to highlight the link between performance and productive variables in banking supervision on the one hand and external variables on the other. Since each bank has its own characteristics, this study uses the internal characteristics of the bank to assess managerial efficiency. The first relates to the financial characteristics of banks and the second concerns its organizational characteristics.

3.3.1 The Financial Characteristics

Financial characteristics are assessed by three variables:

3.3.1.1 Variable Trade Policy

To examine the relationship between efficiency and trade policy of banks, we used the following ratio: total active credit (**RC**). Given the nature of the debt economy, causing economic agents in Tunisia to be funded primarily through the banking system, it is tempting to equate this indicator with an enviable achievement, which is a performance as it relates to deposits collected, the ability to refinance the money market and the importance of equity. A bank is successful in this regard when this ratio is high. Thus a positive impact ratio (**RC**) on bank efficiency is expected.

3.3.1.2 Variable Regulatory

Among the variables related to the regulation, it holds the weight of equity to total assets (**CAP**), variable reflecting the state of regulatory constraints on capital: its orientation depends on the degree of risk aversion.

3.3.1.3 Variable PPC

To account for the influence of non-performing loans on efficiency in the banking sector, we introduce the variable (**PPC**) measured by the ratio of provisions for credit losses (as a proxy of non-performing loans) to total loans: a negative impact is expected.

3.3.2 The Organizational Characteristics

Organizational characteristics are assessed by two variables: the variable logarithm of total assets (**Ln(TA)**) and the variable Trend (**T**).

3.3.2.1 Variable Logarithm of Total Assets (Ln (TA))

The final impact of this variable on expected efficiency depends on the critical size. Indeed, Aly et al (1990), Berger et al (1993) found a positive relationship between size and efficiency of large U.S. banks, and Isik et al (2005) for banks in Jordan. On the other hand, Hermalin and Wallace (1994), Kaparakis et al. (1994), De Young and Nolle (1996), Isik and Hassan (2002a) found a negative relationship. However, other studies did not find any significant relationship between the size and the level of efficiency, for example the work of Aly and al. (1990), Cebenoyan and al. (1993), Mester (1993), Pi and Timme (1993), Mester (1996), Berger and Hannan (1995), Berger and Mester (1997) and Chang and al. (1998).

3.3.2.2 Trend Variable (T)

To take account of technological developments in the Tunisian banking sector during the period of our study, a positive impact on productive efficiency is expected. To isolate the effects of the internal characteristics of the bank on efficiency, it is necessary to control by other factors that were used as determinants of bank efficiency. We also examine how the efficiency of the banking sector is related to the structure of the banking market. Therefore, we analyze the competition by Tunisian banks index approach, and more specifically by the index of concentration of Herfindahl Hirshman Index (**HHI**).

Several studies have highlighted a negative relationship between concentration and efficiency (Fecher and Pestieu, 1993; Berger and Hannan 1997), while others have identified a positive relationship. Indeed, the Cournot model of oligopolistic behavior, predicts that market power is positively related to the profitability and efficiency, as banks with large market shares can charge higher prices, discourage competition and be more productive (Berger 1995; Berger and Mester 1997; Weill, 1998, Isik and Hassan 2003; Isik and al. 2005 for banks in Jordan).

The final impact of the expected concentration on efficiency is therefore ambiguous.

Thus, the expected random term on the extent of inefficiency is defined by:

$$\mathbf{m_{it} = \delta_0 + \delta_1 T_{it} + \delta_2 TA_{it} + \delta_3 IHH_{it} + \delta_4 PPC_{it} + \delta_5 CAP_{it} + \delta_6 RC_{it}} \quad (3)$$

Table 2 shows the main statistical characteristics of the variables of inefficiency term.

Table 2. Statistical characteristics of the explanatory variables of the inefficiency term

Variable	Observations	Average	Standard deviation	Minimum	Maximum
ln(TA)	198	13,9163	0,9372	11,3833	15,3646
HHI	198	0,1252	0,0098	0,1125	0,1410
PPC	198	0,0812	0,0530	0,0013	0,2593
CAP	198	0,0790	0,0315	0,0192	0,1780
RC	198	0,6695	0,1111	0,4193	0,8825

4. Interpretation of Model Results

To assess the relevance of the results obtained in this analysis, on the one hand we have based our arguments on the significance of the explanatory variables used in this study and on the other hand, we have based on apparent sign of the coefficient. The estimated parameters of the cost frontier function (II) are shown in the following table. Coefficients and degrees of efficiency of each bank are estimated by the method of maximum likelihood using the software FRONTIER 4.1 (Coelli, Prasada Rao and Battese, 1998). It uses alternative parameterization of the likelihood function, which substitutes:

$$\boldsymbol{\sigma_u^2 \text{ and } \sigma_v^2 \text{ by } \sigma^2 = \sigma_u^2 + \sigma_v^2 \text{ and } \gamma = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2} \in [0, 1]}$$

In particular, a value of zero indicates that the deviations around the border are entirely due to noise, while a value of unity indicates that all deviations are due to inefficiency. The quality of the estimates is satisfactory and the coefficients are significant at the threshold of 1%.

From Table 3, the first result that can be drawn concerns the test of maximum likelihood. In fact, this test checks whether a model is generally explanatory. When the empirical ratio in question (**L.R**) is greater than the theoretical value of chi-square at the 1% level, we conclude that the fit is generally considered explanatory. In our case, the

overall explanatory model, the theoretical value of chi-square, 21.67, at the 1% and 9 degrees of freedom is less than the respective empirical ratio (the degree of freedom is the number of exogenous variables model).

The second result shows that the parameter is significantly different from zero. This result rejects the hypothesis that the variance of the efficiency is zero. Therefore the term can not be excluded from the regression and parameter estimation by ordinary least squares method is inadequate.

Table 3. Parameter estimates of the translog cost function (SFAA)

C		Coefficient	Standard deviation	Student's t-Tests
Constant	α_0	7,07	1,557	4,540
LN (Q)	β_Q	-0,0879	0,250	0,351
LN (Q) ^2	β_{QQ}	0,0386	0,021	1,867
LN (PKL)	α_{KL}	-0,063	0 ,243	-0,261
LN (PFL)	α_{FL}	1,276	0,345	3,696
PKQ	α_{KQ}	-0,019	0,014	-1,347
PFQ	α_{FQ}	-0,016	0,017	-0,690
BLK	BLK	0,055	0,028	1,954
BLF	BLF	-0,061	0,040	1,509
BKF	BKF	-0,103	0,044	-2,315
Square Sigma	$\sigma^2 = \sigma_u^2 + \sigma_v^2$	0,008	0,001	7,646
gamma	γ	0,376	0,111	3,393
Log of Vraisemblance	195,712			
LR Test	85,607			
Nombre of restrictions		8		
Nombre of iterations		38		

4.1 Hypothesis Testing for the Model Parameters

Before interpreting the results of the function of stochastic cost frontier we make various specification tests. The following table presents a number of statistical tests based on the likelihood ratio, which are expected to examine our model in comparison to more limited forms.

The first hypothesis examines the extent to which it is possible to assume a more limited form of the translog specification of the cost function. Indeed, this first hypothesis examines whether the cost function can be represented by a Cobb-Douglas. This hypothesis is rejected at a significance level of 99%. Other additional hypotheses examine alternative features of the equation that determines the cost inefficiency, because the cost function remains in its translog form.

The second hypothesis is to examine whether it is possible to assume a model in which the cost inefficiency does not exist, ie, if it is possible to work with a model of ordinary least squares (OLS). This hypothesis is strongly rejected at a significance level of 99%. The third hypothesis examines the case in which the inefficiency is not a linear function of the independent variables. This hypothesis is strongly rejected at the 1% level. In the latter case, we performed the reasonableness test to test the hypothesis of technological change in the Tunisian banking sector. The null hypothesis of no technological change was strongly rejected at the 1% level.

In conclusion, the proposed model represents an improvement when compared to functional characteristics and particularly restrictive in comparison with these characteristics in which the inefficiency component is not based on financial and managerial variables that determine the activity of the bank.

Table 4. Tests of hypothesis likelihood ratio on the parameters of the stochastic cost frontier approach according to (SFAA)

Null hypothesis H_0	**Log of Vraisemblance**	**LR Test***	**Critical Value** $\chi^2_{0.99}$ **
(1) $H_0: \beta_{QQ} = \alpha_{KQ} = \alpha_{FQ} = BLK = BLF = BKF = 0$ [1]	148,05	95,32	16,81
(2) $H_0: \gamma = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$ [2]	152,91	85,61	18,47
(3) $H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$ [3]	152,90	98,13	16,59
(4) $H_0: \delta_1 = 0$ [4]	152,90	85,60	7,88

Notes: (*) It should be noted that the likelihood ratio test is given by the following statistic: **LR = - 2[Ln (H_0) - Ln (H_1)]**; where Ln (H_0) and Ln (H_1): represent the logarithms of the likelihood of the estimated models under the null and alternative hypothesis. This statistic is asymptotically follows chi-square with two degrees of freedom as the number of restrictions under the null hypothesis. (**) Value likelihood ratio test given by the table. 1. The cost function can be represented by a Cobb-Douglas. 2. The term inefficiency has no effect. 3. The inefficiency is not a linear function of the independent variables. 4. No technological change in the Tunisian banking sector.

4.2 Interpretation of Efficiency Scores

Our goal is to interpret the evolution of efficiency scores over time. Indeed, the following table shows annual estimates respectively of cost inefficiency scores obtained from the two approaches (SFAA) and (SFA). By definition, the method (DFA) can not give annual scores, but only an estimation of the average efficiency over the entire period (that is to say by bank). From this table, we see that the efficiency cost, depending on the approach (SFAA) has evolved mixed between 1993 and 2010. This allows to deduce that the efficiency of Tunisian commercial banks fluctuates. This result was verified by Chaffai and Dietsch (1998) and Cook, Hababou and Gordon (2000). It is from 2000 that the Tunisian banking sector marked a steady increase in efficiency, saving the cost efficiency scores large enough to reach, in 2009, its highest level of the period which is to the order of 85.67%. In fact, the average cost efficiency has increased by 8.17% during the period 2000-2005.

Table 5. Average scores of cost efficiency in time according to the approach (SFAA)

	1993	**1994**	**1995**	**1996**	**1997**	**1998**
SEC*	0,6428	0,6348	0,6374	0,6303	0,6419	0,6571
	(0,1363)	(0,1237)	(0,1350)	(0,1317)	(0,1289)	(0,1217)
	1999	**2000**	**2001**	**2002**	**2003**	**2004**
SEC	0,6739	0,7010	0,7351	0,7412	0,7928	0,7696
	(0,1152)	(0,1153)	(0,1127)	(0,1103)	(0,1050)	(0,1058)
	2005	**2006**	**2007**	**2008**	**2009**	**2010**
SEC	0,7871	0,7846	0,8103	0,8322	0,8567	0,8513
	(0,0985)	(0,0941)	(0,0895)	(0,0797)	(0,0761)	(0,0693)
AVERAGE	**0,7322**					
	(0,1315)					

On the approach (SFA), we see that the average efficiency has increased during our study. Indeed, examining the evolution of cost efficiency over the study period, we note that efficiency levels increase from one year to another almost on a regular basis. Indeed, the efficiency scores have increased from 68.37% in 1993 to 74.62% in 2010. In fact, the average cost efficiency has increased by 6.25% during the period 1989-2006.

Table 6. Cost efficiency average scores in time according to the approach (SFA)

	1993	**1994**	**1995**	**1996**	**1997**	**1998**
SEC	0,6837	0,6877	0,6916	0,6955	0,6993	0,7032
	(0,1413)	(0,1397)	(0,1382)	(0,1367)	(0,1352)	(0,1336)
	1999	**2000**	**2001**	**2002**	**2003**	**2004**
SEC	0,7069	0,7107	0,7144	0,7181	0,7217	0,7253
	(0,1321)	(0,1306)	(0,1291)	(0,1277)	(0,1262)	(0,1247)
	2005	**2006**	**2007**	**2008**	**2009**	**2010**
SEC	0,7289	0,7324	0,7359	0,7394	0,7428	0,7462
	(0,1233)	(0,1218)	(0,1204)	(0,1190)	(0,1176)	(0,1162)
AVERAGE	**0 ,7158**					
	(0,1246)					

4.3 Evolution of Efficiency Scores between Banks

According to the approach (S.F.A.A), the bank (ANB) is classified as the least efficient in terms of cost. Conversely, (BFT) seems to be the most efficient bank in terms of its ability to minimize its costs. The graph shows the average scores of cost efficiency by bank.

Table 7. Average scores on cost efficiency by banks (Banks are arranged in ascending order of efficiency scores)

		S.F.A.A			
ANB	**TBC**	**IABT**	**HB**	**AB**	**ATTI.B**
0,6093	0,6327	0,6547	0,6912	0,7011	0,7103
(0,1144)	(0,0936)	(0,0888)	(0,0906)	(0,0703)	(0,0771)
IUB	**BT**	**UBTI**	**ATB**	**BFT**	
0,7315	0,7376	0,7512	0,8537	0,9810	
(0,0878)	(0,0856)	(0,0968)	(0,0958)	(0,0198)	
ANB	**IABT**	**TBC**	**HB**	**AB**	**ATTI.B**
0,5517	0,5800	0,5946	0,6691	0,6794	0,7091
(0,0281)	(0,0270)	(0,0265)	(0,0230)	(0,0225)	(0,0209)
IUB	**UBTI**	**BT**	**ATB**	**BFT**	
0,7237	0,7436	0,7631	0,8701	0,9891	
(0,0200)	(0,0189)	(0,0177)	(0,0104)	(0,0009)	
IUB	**UBTI**	**IABT**	**ATTI.B**	**ATB**	**ANB**
0,8814	0,8917	0,9048	0,9048	0,9064	0,9168
TBC	**BT**	**AB**	**BFT**	**HB**	
0,9310	0,9345	0,9431	0,9614	1	

Note: The type difference in parentheses.

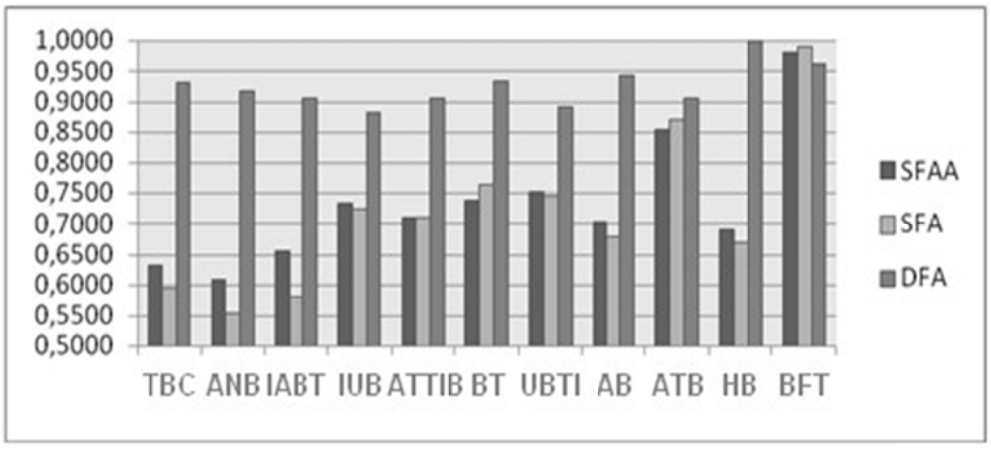

Figure 1. Average scores of cost efficiency by bank (According to the different approaches)

4.3.1 Estimated Cost Efficiency

Banks of small and medium size of our sample show better than average efficiencies realized by banks of large sizes. In this context it's important to emphasize that the results by size of banks, shown in the following table, draw a trend toward decreasing relationship between the size and the degree of efficiency cost.

The average efficiency reaches Indeed, 86.20% for small banks, 71.44% for medium-sized banks and 57.54% for large banks. This confirms the words of Berger and De Young (1997), suggesting that inefficiencies are primarily the result of a misallocation of financial resources (deposits and borrowed funds) and of miscalculating the risk of non-performing loans which is on a large scale in financial institutions and public and private banks of large sizes.

Table 8. Average scores of cost efficiency in Tunisian commercial banks according to their size

Great banks		**Medium banks**		**Small banks**	
TBC	0,5946	**IUB**	0,7315	**UBTI**	0,7512
ANB	0,5517	**ATTI.B**	0,7103	**ATB**	0,8537
IABT	0,5800	**BT**	0,7376	**BFT**	0,9810
		AB	0,7011		
		HB	0,6912		
Average	**0,5754**	**Average**	**0,7144**	**Average**	**0,8620**
	Industry average 0,7173				

4.3.2 Explanatory Factors of the Productive Performance of Tunisian Banks

The estimated parameters and the hope of inefficiency (III) are shown in Table 9. These estimates of the determinants of productive efficiency provide a first insight into the managerial assumptions that we would evaluate.

Table 9. Explaining the level of cost inefficiency

Constant	δ_0	-3,453	0,538	-6,413
T	δ_1	-0,039*	0,006	-6,968
LN (TA)	δ_2	0,222	0,034	6,504
IHH	δ_3	5,896	1,255	4,694
CNP	δ_4	0,931*	0,314	2,965
CAP	δ_5	-0,239	0,465	-0,515
RC	δ_6	-3,653	0,117	-3,119
Square Sigma	$\sigma^2 = \sigma_u^2 + \sigma_v^2$	0,008	0,001	7,646
gamma	γ	0,376	0,111	3,393
Log of Vraisemblance	195,712			
LR Test	85,607			
Nombre of restrictions		8		
Nombre of iterations		38		

Note: * A positive sign indicates a significant and negative impact of the variable on inefficiency score of the bank and have a positive effect on cost efficiency.

Our results show that there is a negative relationship between the provision for credit losses (as a proxy for non-performing loans) and the level of cost inefficiency. This result can tell us that after a deterioration in the level of productive efficiency of Tunisian banks in a year, the amount of non-performing loans increases in the following year. This evidence was also confirmed by testing Spearman correlations and Kendall. Spearman's rho (which is equal to -0.4919 and significant at 1%) and Kendall's score (which is equal to -6861 and significant at 1%) allow us to reject the hypothesis $\mathbf{H_0}$ that the non-performing loans and cost efficiency are independent. Negative signs tests show that the two variables are negatively correlated.

We also find a positive relationship between the variable capitalization and cost efficiency but not significant. After the period has been marked by fluctuations in the cost efficiency Tunisian banking sector has improved

considerably. Thus, even if the process of modernization and reorganization was launched in 1997, it is from the year 2000 that we could report a significant effect of this process on bank efficiency scores. Which justifies the negative sign and significant coefficient on Trend (T), reflecting technological developments in the banking industry.

In fact, investments in new technologies at the interbank clearing or development of the network atmosphere (ATM), were allowed to develop banking with a lower cost. But some time was needed so that the predicted effects of these investments appear because these new technologies are accompanied by a reorganization of the business and a new allocation of functions to the bank.

Technological advance has a positive effect on the development of the banking sector mainly in the field of information technology and communication. In fact, this technological advance has created new channels of distribution of banking products and services such as online banking, Internet, electronic funds transfer and others. These changes reduce transaction costs and increase competition in the banking sector. Thanks to technological progress, we can properly perform several operations with minimum cost such that the operation of collection or analysis and provision of information.

In addition, new technologies have contributed greatly to the transparency of information which was often hidden for strategic reasons. The information is obtained quickly and with less cost. Technology is a favorable asset to improve the profitability of banks. It is present at all stages of the bidding process. Innovation in products can also be a competitive advantage. Each bank has to offer a new product or service that will take advantage and increase its visibility.

In addition, we find a positive relationship between cost efficiency and total assets ratio credits (RC), which is a measure of credit risk. This result suggests that the most active banks in the credit segment tend to be more efficient.

As logarithm of total assets (Ln (TA)), its coefficient is significantly positive for the banking sector. This source of inefficiency appears to be related to the critical size, that is to say the presence of diseconomies of scale. Thus, the size of the bank affects negatively the level of efficiency. The more the size increases, the more the efficiency level decreases.

This result shows that Tunisian banks do not have the managerial capacity to manage an important total assets. The more the size increases, the more the waste of resources increases. This result is consistent with the work of Hermalin and Wallace (1994), Kaparakis et al. (1994), DeYoung and Nolle (1996), Isik and Hassan (2002a) who found a negative relationship between efficiency and total assets.

Finally, concerning the structure of the banking market which is measured by the index of concentration of Herfindahl Hirshman Index (HHI), its impact on bank efficiency is negative. This result can be supported by the fact that financial liberalization in the banking sector in Tunisia was meant as it seems, to increase competition, to improve the productive efficiency of banks.

Which justifies the negative impact of the market share variable (PM) on the level of efficiency. In fact, the three major Tunisian banks (ANB, TBC and IABT) which are less efficient on average, share almost 50% of market share of the Tunisian banking sector. This shows that the concentration is less beneficial in terms of efficiency in Tunisian commercial banks than the competition. Therefore, these banks will be forced to diversify their activities.

We can account for these results by the fact that (ANB) is heavily involved in the agricultural sector subject to weather conditions and thereby erecting in a very risky sector, which implies that the bank has relatively high provision risks and therefore very low margins. The (TBC) continues its role as the centerpiece of the economic state policy in financing industrial firms which are in difficulty. In additional to that, (IABT) finances a large part of SMEs whose size is lower and whose risk of default is high.

The results of the efficiency side of profit show a positive and significant relationship between efficiency and profit capitalization ratio. This shows that an increase in bank capitalization leads to an improvement in the quality of capital and subsequently an increase for banks. In addition, this could be explained by the fact that, in light of the high standards of equity, banks may decide to replace loans by alternative forms of capital (see Vanhoose, 2007; Pasiouras and al. 2008).

However, it is hard to notice that our estimates do not imply causality between productive efficiency and managerial behavior. We simply find a correlation between non-performing loans and cost efficiency, which supports the view that most Tunisian banks are saddled with an overhang of non-performing loans which obviously affect their efficiency levels.

5. Conclusion

In this model, we have used an extension of the stochastic frontier approach which assumes a truncation parameter specific to each bank. This allowed us to assess changes in the level of cost efficiency of Tunisian commercial banks and to identify relationships between the productive performance and a combination of internal and external determinants.

The estimated cost efficiency shows a strong correlation between positive and significant efficiency scores according to the approaches (SFA) and (SFAA). The empirical results show that the efficiency cost, depending on the approach SFAA has evolved mixed between 1993 and 2010.

Regarding the estimation of efficiency depending on the size of banks, the results show that banks of small and medium size of our sample show medium cost efficiencies better than those made by banks of large sizes. While on the side of profit, estimates show that large and medium-sized banks are more efficient than smaller ones.

Focusing on the determinants of internal productive performance of Tunisian banks, our results show that the preponderance of credit activity in relation to other outputs represents a source of efficiency for banks.

Among the factors that negatively affect the level of efficiency, there is the size. Thus, the larger the size, the more the level of efficiency decreases. In addition, a negative relationship between the provision for credit losses (as a proxy for non-performing loans) and the level of cost inefficiency is clear. Finally, concerning the structure of the banking market, we find a negative relationship with bank efficiency. This shows that a competitive environment is more beneficial in terms of efficiency for Tunisian commercial banks.

References

Abdelkhalek T., & Solhi, S. (2009). Efficience et productivité des banques commerciales marocaines: approche non paramétrique. Economic Research Forum, *Working papers* 01/2009.

Allen, J., & Engert, W. (2007). Efficience et concurrence dans le secteur bancaire canadien. Revue de la banque de CANADA. Eté 2007.

Allen, J., & Liu, Y. (2005). Efficiency and Economies of scale of large Canadian Banks. Document de travail n° 2005-13. *Banque du Canada, et Revue canadienne d'économique, 40*(1), 225-244.

Allen, J., Engert, W., & Liu, Y. (2006). Are Canadien Banks Efficient? A Canada-U.S. Comparison. Document de travail n° 2006-33. Banque du Canada.

Aly, H., Grabowsky, R., Pasurka, C., & Rangan, N. (1990). Technical, Scale and Allocative Efficiencies in U.S. Banking: An Empirical Investigation. *The Review of Economics and Statistics, 72*, 211-218. http://dx.doi.org/10.2307/2109710

Ben Naceur, S. (2003). The determinants of the Tunisian banking industry profitability: Panel evidence 1980-2000. *Papier présenté à la 11^{e} conférence de L'Economic Research Forum (EFR)*. Marrakech. Vovembre.

Berger, A. N. (1995). The Profit-structure Relationship in banking: Test of Market-Power Efficient-Structure Hypothesis. *Journal of Mony, Credit and Banking, 27*, 404-431. http://dx.doi.org/10.2307/2077876

Berger, A. N. (2007). International comparisons of banking efficiency. *Financial Markets, Institutions and Instruments, 16*(3), 119-144. http://dx.doi.org/10.1111/j.1468-0416.2007.00121.x

Berger, A. N., & De Young, R. (1997). Problem Loans and Cost Efficiency in Commercial Banks. *Journal of Banking and Finance, 21*, 849-870. http://dx.doi.org/10.1016/S0378-4266(97)00003-4

Berger, A. N., & Hannan, T. H. (1995). The Efficiency Cost of Market Power in the Banking Industry: A Test of the 'Quiet Life' and Related Hypotheses. *Working Paper*, Board of Governors of the Federal Reserve System.

Berger, A. N., & Mester, L. (1997). Inside the black box what explains differences in the efficiencies of financial institutions? *Journal of Banking & Finance, 21*(7), 895-947. http://dx.doi.org/10.1016/S0378-4266(97)00010-1

Berger, A., & Hannan, T. (1997). Using Measures of Firm Efficiency to Distinguish among Alternative Explanations of the Structure-Performance relationship in banking. *Managerial Finance, 23*, 6-31. http://dx.doi.org/10.1108/eb018599

Berger, A., Humphrey, D., & Smith, F. W. (1993). Economies d'échelle, fusions, concentration et efficacité. *Revue d'Economie Financière,* n° 27, Hiver.

Burkart, O., Gonsard, H., & Dietsch, M. (1999). L'efficience coût et l'efficience profit des établissements de crédit français depuis 1993. *Bulletin de la commission bancaire, 20*(Avril), 43-66.

Cebenoyan, A. S., Cooperman, E. S., Register, C. A., & Hudgins, S. C. (1993). The relative Cost Efficiency of Stock Versus Mutual S&Ls: A Stochastic Cost Frontier Approach. *Journal of Financial Services Research, 7*, 151-170. http://dx.doi.org/10.1007/BF01046903

Chaffai, M. E. (1998). Estimation des Inefficiences Techniques et Allocatives des Banques de Dépôts Tunisiennes: une Frontière de coût Fictif. *Economie et Prévision, 5*, 117-129. http://dx.doi.org/10.3406/ecop.1998.5942

Chaffai, M. E., & Dietsch, M. (1998). Productive efficiency performances of Tunisian and Moroccan banks: an econometric analysis using panel data. Paper presented at *the ERF Fourth annual conference*, Beirut 7-9 September.

Chang, C., Hasan, I., & Hunter, W. (1998). Efficiency of Multinational Banks: An Empirical Investigation. *Applied Financial Economics, 8*, 1-8.

Coelli, T. J., Prasada Rao, D. S., & Battese, G. E. (1998). *An Introduction to Efficiency and Productivity Analysis*. Boston, U.S.A: Kluwer Academic Publishers. http://dx.doi.org/10.1007/978-1-4615-5493-6

Cook, W. D., Hababou, M., & Gordon, S. R. (2000). The effects of Financial Liberalization on the Tunisian Banking Industry: A Non-Parametric Approach. *Working Paper*, Schulich School of Business, York University.

De Young, R., & Nolle, D. E. (1996). Foreign-Owned Banks in the United States: Earning Market Share of Buying it? *Journal of Money, Credit, and Banking, 28*(4), 622-636. http://dx.doi.org/10.2307/2078074

Dietsch, M. (1992). *Coûts et concurrence dans l'industrie bancaire*. Rapport pour le Conseil National du crédit et l'Association Française des Banques, Mars, 98 p.

Dietsch, M. (2005). *La place de la concurrence dans l'organisation et le fonctionnement du secteur bancaire*. Cycle de conférences: Droit, Economie et Justice dans le secteur bancaire.

Fecher, F., & Pestieu, P. (1993). Efficiency and Competition in OECD Financial Services. In Fried H. O., C. A. Lovell & S. S. Schmidt (Eds.), *the Measurement of Productive Efficiency*. OUP.

Florian, L. (2012). Effet de la concurrence sur l'efficience bancaire en Afrique: le cas de l'UEMOA. *CERDI, Etudes et Documents*, E 2012.2, Janvier.

Hermalin, B., & Wallace, N. (1994). The Determinants of Efficiency and Solvency in Savings and Loan. *Rand Journal of Economics, 25*, 361-381. http://dx.doi.org/10.2307/2555767

Isik, I., & Hassan, M. K. (2002a). Technical, scale and allocative efficiencies of Turkish banking industry. *Journal of Banking and Finance, 26*, 719-766. http://dx.doi.org/10.1016/S0378-4266(01)00167-4

Isik, I., & Hassan, M. K. (2002b). Cost and profit efficiency of the Turkish banking industry: An empirical investigation. *The Financial Review*, *37*, 257-280. http://dx.doi.org/10.1111/1540-6288.00014

Isik, I., & Hassan, M. K. (2003a). Governance, corporate control and Efficiency of the Turkish Banking Industry. *Journal of Business Finance and Accounting, 30*(9-10), 1363-1421. http://dx.doi.org/10.1111/j.0306-686X.2003.05533.x

Isik, I., & Hassan, M. K. (2003b). Financial Disruption and Bank Productivity: The 1994 Experience of Turkish Banks. *The Quarterly Revew of Economics and Finance, 43*, 291-320. http://dx.doi.org/10.1016/S1062-9769(02)00194-1

Isik, I., Gunduz, L., & Omran, M. (2005). Impacts of Organizational Forms, Stock Performance and Foreign Ownership on Bank Efficiency in Jordan: A Panel Study Approach. *Communication à l'Economic Research Forum*, 19-21 Décembre 2005.

Kablan, S. (2012). *Efficacité des institutions de microfinance en UEMOA: une approche outreach-intermédiation financière*. Equipe de Recherche sur l'Utilisation des Données Individuelles Temporelles en Economie (ERUDITE); Université Paris-Est Créteil Val-de-Marne (UPEC); 30/04/2012.

Kaparakis, E. I., Miller, S. M., & Noulas, A. G. (1994). Short-Run Cost Inefficiency of Commercial Banks: A Flexible Frontier Approach. *Journal of Money, Credit and Banking, 26*(4), 875-893. http://dx.doi.org/10.2307/2077953

Koetter, M., Kolari, J. W., & Spierdijk, L. (2008). Efficient Competition? Testing the 'quiet life' of U. S banks

with Adjusted Lerner Indices. Paper presented at *the 44 th Bank Market Structure Conference*, Federal Reserve Bank of Chicago.

Lapteacru, I., & NYS, E. (2011). L'impact de la concurrence sur l'efficience des banques: le cas des PECO. *Revue Economique, 62*. http://dx.doi.org/10.3917/reco.622.0313

Mester, L. J. (1993). Efficiency in the Savings and Loan Industry. *Journal of Banking & Finance, 17*, 267-286. http://dx.doi.org/10.1016/0378-4266(93)90032-9

Mester, L. J. (1996). A study of bank efficiency taking into account risk-preferences. *Journal of Banking and Finance, 20*, 1025-1045. http://dx.doi.org/10.1016/0378-4266(95)00047-X

Pasiouras, F., Liadaki, A., & Zopounidis, C. (2008). Bank efficiency and share performance: evidence from Greece. *Applied Financial Economics, 18*, 1121-1130. http://dx.doi.org/10.1080/09603100701564346

Pi, L., & Timme, S. (1993). Corporate Control and Bank Efficiency. *Journal of Banking and Finance, 17*, 515-530. http://dx.doi.org/10.1016/0378-4266(93)90050-N

Vanhoose, D. (2007). Theories of Bank Behavior Under Capital Regulation. *Journal of Banking and Finance, 31*(12), 3680-3697. http://dx.doi.org/10.1016/j.jbankfin.2007.01.015

Weill, L. (1998). Concurrence et efficience dans la banque: modélisation théorique et vérification empirique. *Revue Française d'Economie, 13*(2), 101-127. http://dx.doi.org/10.3406/rfeco.1998.1051

Zaim, O. (1995). The effect of financial liberalization on the efficiency of Turkish commercial banks. *Applied Financial Economics, 5*, 257-264. http://dx.doi.org/10.1080/758536876

Call for Manuscripts

International Journal of Economics and Finance (IJEF) is a double-blind peer-reviewed international journal dedicated to promoting scholarly exchange among teachers and researchers in the field of economics, financial economics and finance. The journal is published monthly in both print and online versions by the Canadian Center of Science and Education.

The scope of IJEF includes the all fields in the economics and finance. Authors are encouraged to submit complete, unpublished, original, and full-length articles that are not under review in any other journals. The online version of the journal is free access and download. If you want to order print copies, please visit: www.ccsenet.org/store

We are seeking submissions for forthcoming issues. All manuscripts should be written in English. Manuscripts from 3000–8000 words in length are preferred. All manuscripts should be prepared in MS-Word format, and submitted online, or sent to: ijef@ccsenet.org

Paper Selection and Publishing Process

a) Upon receipt of a submission, the editor sends an e-mail of confirmation to the submission's author within one to three working days. If you fail to receive this confirmation, your submission e-mail may have been missed.

b) Peer review. We use a double-blind system for peer review; both reviewers' and authors' identities remain anonymous. The paper will be reviewed by at least two experts: one editorial staff member and at least one external reviewer. The review process may take two to three weeks.

c) Notification of the result of review by e-mail.

d) If the submission is accepted, the authors revise paper and pay the publication fee.

e) After publication, the corresponding author will receive two hard copies of the journal, free of charge. If you want to keep more copies, please contact the editor before making an order.

f) A PDF version of the journal is available for download on the journal's website, free of charge.

Requirements and Copyrights

Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the authorities responsible where the work was carried out, and that, if accepted, the article will not be published elsewhere in the same form, in English or in any other language, without the written consent of the publisher. The editors reserve the right to edit or otherwise alter all contributions, but authors will receive proofs for approval before publication.

Copyrights for articles are retained by the authors, with first publication rights granted to the journal. The journal/publisher is not responsible for subsequent uses of the work. It is the author's responsibility to bring an infringement action if so desired by the author.

More Information

E-mail: ijef@ccsenet.org

Website: www.ccsenet.org/ijef

Paper Submission Guide: www.ccsenet.org/submission

Recruitment for Reviewers: www.ccsenet.org/reviewer

The journal is peer-reviewed

The journal is open-access to the full text

The journal is included in:

ABDC	Gale's Academic Databases	ProQuest
Cabell's	Google Scholar	Standard Periodical Directory
DOAJ	JEL	Ulrich's
EBSCOhost	Lockss	Universe Digital Library
EconLit	Open J-Gate	
ERA	PKP Open Archives Harvester	

International Journal of Economics and Finance

Monthly

Publisher	Canadian Center of Science and Education
Address	1120 Finch Avenue West, Suite 701-309, Toronto, ON., M3J 3H7, Canada
Telephone	1-416-642-2606
Fax	1-416-642-2608
E-mail	ijef@ccsenet.org
Website	www.ccsenet.org/ijef