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

International Journal of Economics and Finance

Vol. 5, No. 9 August 2013

Canadian Center of Science and Education®

Editorial Board

Contents

International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971XE-ISSN 1916-9728
Published by Canadian Center of Science and Education

Implications of Lender Values for Risk Management in the Microfinance Industry

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Received: April 23, 2013 Accepted: August 8, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p1 URL: http://dx.doi.org/10.5539/ijef.v5n9p1

Abstract

This paper investigates the extent to which the microfinance sector should be influenced by risk management policies from the banking industry. The increasing commercialisation of microfinance is resulting in a greater impetus to implement formal risk policies and practices. Such actions, if conceived with due care and attention to the purpose of microfinance, could be an important step for the industry. However, there is a danger that generic procedures of risk assessment and management, particularly those adapted from purely for-profit industries, could impede this relatively young industry, or subvert its mission.

The discussion centres around a survey of public opinion on the riskiness of a range of investment options and the factors that influence investment decisions, seeking to determine whether the public's perception of the riskiness might be affected by qualitative factors, such as societal benefits. The survey finds no relationship between overall risk perception and the qualitative factors tested, but does suggest that investment decisions can be explained by two opposing dimensions: social and financial. This leads to a number of implications for the evolution of risk management within the microfinance industry, and highlights dangers of focusing purely on technical risk.

Keywords: governance, lenders, microfinance, risk, sustainability, values

1. Introduction

Although microfinance has been practiced worldwide in various forms for several centuries, in the last few decades it has become a more formalised industry, caught up in a wider drive, originating from the banking sector, which aspires to better governance practices and sustainable financial performance. These aspirations have, in turn, entrained the use of a variety of qualitative and quantitative risk management tools. However, microfinance is a specialist sector with its own distinct objectives and motivations, and research has clearly identified that its success and penetration is influenced by both socio-political factors (Rahman & Luo, 2011; Al-Azzam, Mimouni & Ali, 2012; Al-Mamun, Adaikalam & Wahab, 2012) as well as operational subtleties (Ayayi, 2012; Bhattamishra & Barrett, 2010; Hartaska & Nadolnyak, 2007).

In this paper we are particularly concerned with the influx to microfinance of new practices related to the management of risk which emanate from the formal, for-profit, banking sector and our fundamental question is:

To what extent should risk management practices from the formal banking sector determine the risk management policies of microfinance institutions?

From this three sub-questions arise:

1) How much influence should values have in formulating risk policies?
2) Do differences between the perceptions and attitudes of stakeholders of the banking industry and the microfinance industry lead to the need for different risk policies and hence approaches to risk management?
3) Should the microfinance industry incorporate its own value system into its risk policies?

Microfinance here refers to the provision of financial services to poor people who are excluded from the formal financial sector, with the aim to aid poverty alleviation. The growth of microfinance institutions (MFIs) since the 1970s has been rapid - there are now thought to be in the region of 10,000 MFIs operating globally with investments projected to rise to $20 billion by 2015 (ADA, 2006; Dieckmann, 2007). This has led the sector to gain much attention from the traditional finance industry, as well as social organisations, academics, and microfinance practitioners, not to mention the media.

The consequence has been that the microfinance industry receives funding from a wide range of donors and investors with a variety of different characteristics, motivations, business models, risk appetites, and pre-conceptions about the aim of microfinance (Figure 1). Over 350 foundations and 90 specialised microfinance investment vehicles are among the funders, as well as governments, charities, development agencies, development banks such as the World Bank and UN Capital Development Fund, international NGOs, institutional investors, and private individual investors including both high net-worth and ordinary 'retail' investors. In fact, the split between donors and investors is approximately fifty-fifty (CGAP, 2008).

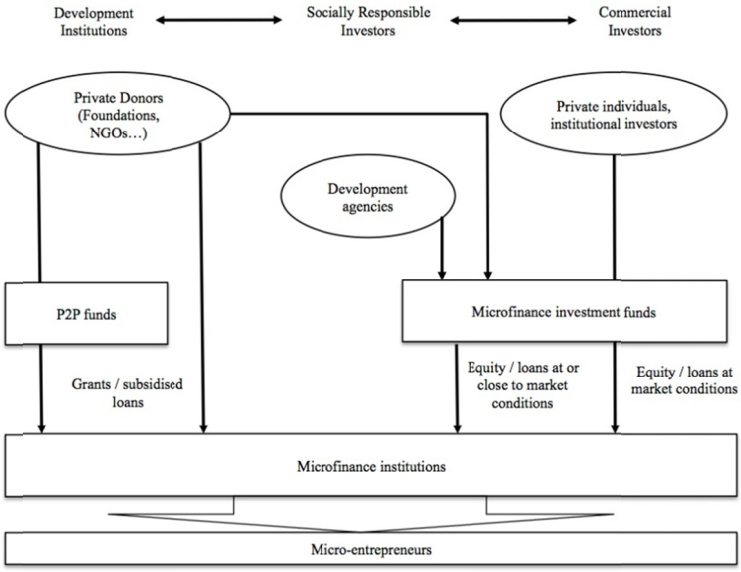

Figure 1. The different funders of the microfinance industry (adapted from Microfinance Investment Funds: Key Features; Goodman, 2005)

At the outset of the growth surge in the 1970s the motives were purely social, as pioneered initially by Yunus (1999) and since replicated by NGOs, governments, and international agencies that saw an opportunity to increase financial inclusion and reduce poverty in countries where years of aid had had little impact. It was only later, when it was discovered that microfinance was actually a viable, and even profitable, business, that investors with dual motives of profit and social impact began to take an interest. As a result, the past twenty years has seen a significant increase in the diversity of institutions providing financial services to the poor, as NGOs transformed into regulated financial entities, commercial banks entered the market, specialised microfinance banks started up, and cooperatives and rural banks increased their involvement. The consequence of this is that the main stakeholders in the microfinance industry come from two very different backgrounds. One represented by the multinational banks, pension funds and investment funds that is at least to some extent focused on profit maximisation, and a second, represented by the NGOs, donors, foundations, development agencies and the general public, for which profit, and sometimes even sustainability, may not be primary considerations or motivators.

There is no doubt that the importation of many tried-and-tested risk management techniques has been valuable for the microfinance industry, particularly with regards to basic credit risk management techniques (Fernando, 2007). Yet a comparatively rarely discussed topic is whether the social mission of the microfinance industry is compatible with the technical and process-driven risk management techniques used in the banking industry, an industry whose primary aim is profit maximisation. Banking industry regulation often stems from crises or

scandals, meaning they are conceived and implemented rapidly, often more for compliance purposes than to add value to the business model. Adopting a similar approach, particularly at such early stages, might be incompatible with the wider and specific interests of the microfinance industry.

In order to investigate this matter we describe in Section 2 the implementation of a survey technique for eliciting underlying preferences from microfinance lenders and potential lenders. The subsequent survey data, and their statistical analysis, are reported in Section 3, using methodologies from psychometrics which have themselves been used widely in studying risk attitudes (see, for example, Slovic, 2010). Section 4 discusses the implications of the results for microfinance institutions with respect to policy issues, the management of risk, and lender preferences. Section 5 summarises the main themes to emerge from this paper which we consider MFIs need to reflect upon.

2. Methodology

To answer the questions posed we investigated the perceptions and motivations of a sample of the general public regarding their views of the riskiness and the functions of a range of investment options. A convenience sample of 55 respondents was used, primarily drawn from contacts and associates. Such a sampling strategy may have introduced a number of biases that limit the extrapolation of the data to the wider public. It was felt, however, that it was suitable for obtaining an initial group that would have sufficient awareness of finance, micro-finance and philanthropy to elicit preliminary indications of attitudes to risk and motivation. A wider or more random sample would be likely to capture many people that did not invest or give to charity. The prevalence of captured views from a wider population could, of course, be evaluated later.

A large proportion of the participants had a minimum of a university degree, and worked in academia, financial services, or in the development or non-profit field. Knowledge of P2P (Note 1) (peer to peer) microfinance websites was higher among this group than the general population. In addition, the data collection methodology which utilised email required that participants be computer literate. Thirty-six of the 55 respondents were male, and the spread of ages ranged from under twenty-five to over sixty-five. The UK and USA were the most common countries of origin, with 15 countries represented overall. Twenty-four of the participants had made a loan on a P2P website.

The questionnaire asked each participant to perform two tasks. The first was to rate seven investment options according to their 'riskiness.' 'Riskiness' was purposely not defined in order to capture as much of the participants personal perspective on risk as possible. The seven options were:

1) Money deposited in ordinary bank account.
2) Money lent on Kiva.org (Note 2) (loans made via a website to poor individuals in developing countries to help them start businesses and improve their standard of living).
3) Money invested in shares.
4) Money invested in ethical investments.
5) Money invested in hedge fund.
6) Donation to charity.
7) Money invested in pension (occupational or private).

The second task was to rate each investment option against nine qualitative factors in terms of their importance in the decision-making process when considering whether to invest. The factors were:

1) Return on investment.
2) Reputation of institution.
3) Credit rating of institution.
4) Risk of losing investment (Note 3).
5) Proximity to end beneficiary of investment (Note 4).
6) Feedback (information on what your money is used for).
7) Professionalism and experience of institution.
8) Social impact of investment.
9) Control (over how the investment is used).

Several of the factors, such as proximity, feedback, and control, were specifically chosen with P2P microfinance

in mind, as this is where it is generally different to other investment types. 'Charity' was chosen to assess how closely aligned microfinance investments are with charitable giving over financial investments, even though some of the factors are not applicable to it, such as risk of losing investment (as the investment is a donation).

3. Results and Data Analysis

The questionnaire data were first analysed to determine if there was a difference in the importance of the qualitative decision factors across the investment options, and secondly to see if there were correlations between these factors and the overall perceptions of riskiness.

Figure 2 shows the average scores for the overall perception of riskiness, as well the scoring for each of the nine qualitative factors per investment option. As might reasonably have been expected, Figure 2 confirms that bank accounts were most consistently rated as low risk, while hedge funds were most consistently rated as high risk. It can also be seen that some qualitative factors, such as reputation and professionalism, are, on average, rated as important factors for all investment types, while other factors, such as risk, proximity, and social impact, exhibit noticeable differences in importance across the investment options.

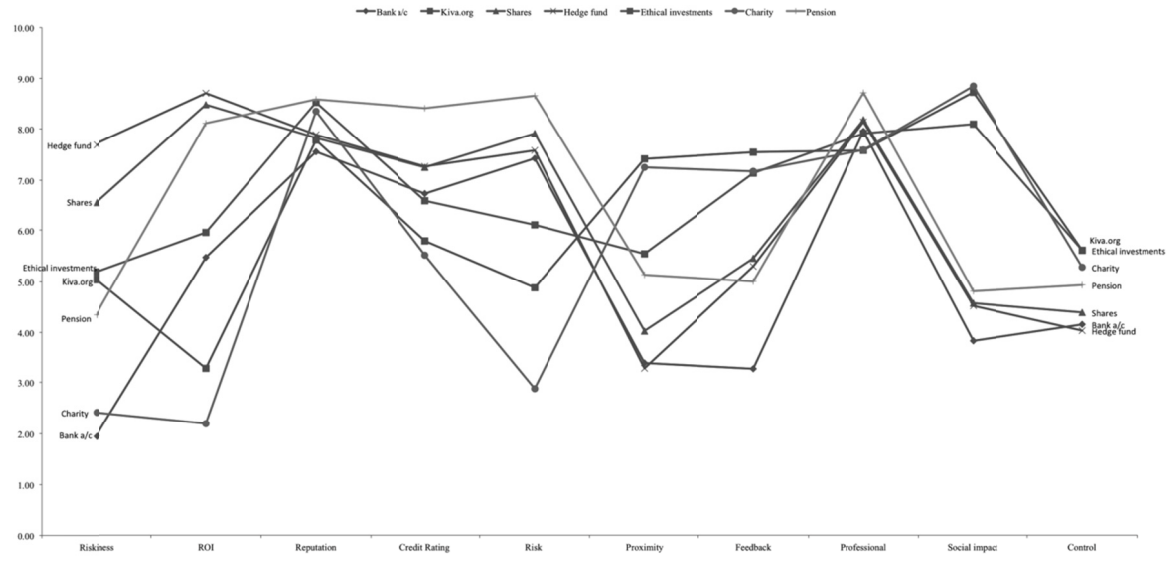

Figure 2. Graph of mean scores of riskiness and qualitative factors against investment type

The broadest spread of results is from the overall risk perceptions of each of the investment options, ranging from just under 2 to over 7.5 (out of 10). Broad spreads can also be observed on the factors *return on investment* and *risk.* For pensions, hedge funds and shares, return on investment is of high importance, while for Kiva.org and charity, return on investment is of lower importance. It is also noticeable that factors which are important when choosing to invest in Kiva.org follow a similar 'fingerprint' to those that are important when donating to charity, a pattern different from that exhibited by shares or bank accounts.

Figure 3 shows in more detail the spread of responses regarding the overall perceived risk of each investment type, and Figure 4 the spread of responses for two important qualitative variables, namely, risk of losing one's investment and the social impact of the investment. What is evident is that risk is considered to be an important factor when choosing to invest in bank accounts, hedge funds, pensions and shares, but is less important for ethical investments and Kiva.org. On the other hand, the importance of social impact also varies, showing that this is of moderate importance with hedge funds, pensions, and shares, and that it is of high importance for Kiva.org, ethical investments and charitable donations.

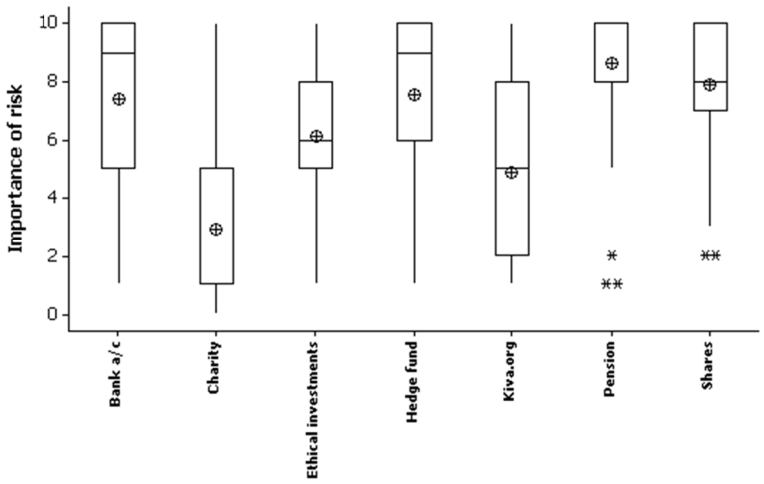

Figure 3. The perceived risk of different investment options

Note: Y-axis scale: 0 = low overall risk; 10 = high overall risk.

The extent of the correlation between the risk perception of an investment option and any of the qualitative factors chosen, or between the qualitative factors themselves was evaluated. One might postulate that, for example, there would be a positive correlation between the risk level and the importance of return on investment, as the risk-return relationship is one of the key principles of financial theory. To this effect Table 1 shows firstly the inter-correlations between the qualitative factors, calculated using the average score given by the 55 participants. Many strong correlations can be seen, and those that are statistically significant are marked with asterisks. There are strong positive correlations between return on investment (ROI) and credit rating, risk and professionalism, and negative correlations with proximity (to the end recipient of the investments) and social impact. Interestingly, social impact and proximity have strong negative correlations with risk, implying that on average, where the participants see risk as an important decision factor, they do not rate social impact as important, and vice versa.

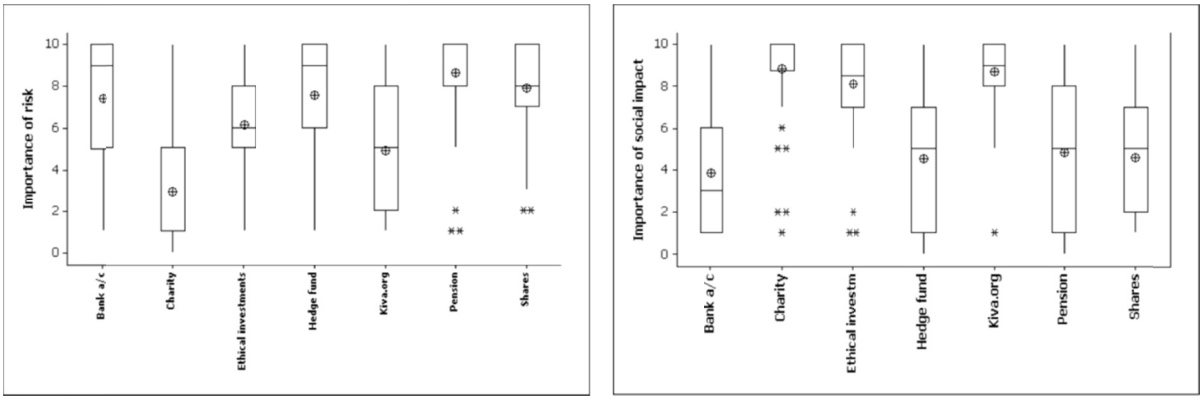

Figure 4. The left box-plot shows the importance of risk in making an investment decision

Note: (0 = unimportant, 10 = important). The right box-plot shows the importance of social impact in making an investment decision (0 = unimportant; 10 = important)

Factor analysis has also been applied to search for the existence of a smaller number of underlying variables which might account for the complex patterns exhibited by the nine qualitative factors. Table 2 shows that just two factors can explain almost 99% of the variation, suggesting that this two-factor solution is highly representative of the nine qualitative variables. A Varimax rotation has been applied to the data, which seeks to make the factors more responsive to a smaller subset of the variables.

The strongest factor, explaining 53% of the variance across the 9 qualitative factors, is highly correlated with variables such as social impact and proximity to the end recipient of the investments, as well as feedback and control over how the investment is used. For the purpose of this study, we name this first factor the 'social' factor. Factor two in contrast is highly correlated with return on investment, the credit rating of the institution, the risk of the investment and the professionalism of the institution. We call this the 'financial' factor.

Table 1. Correlation matrix showing the correlation coefficients between each of the qualitative factors

	ROI	Reputation	Credit Rating	Risk	Proximity	Feed-back	Professio-nal	Social Impact
Reputation	-0.004							
Credit Rating	**0.887****	0.217						
Risk	**0.915****	-0.124	**0.92****					
Proximity	**-0.796***	0.39	-0.63	**-0.804***				
Feedback	-0.529	0.416	-0.587	-0.719	**0.836***			
Professional	**0.839***	0.302	**0.991*****	**0.868***	-0.561	-0.555		
Social Impact	**-0.786***	0.381	-0.756	**-0.873***	**0.923****	**0.927****	-0.711	
Control	-0.629	0.554	-0.476	-0.623	**0.898****	**0.84***	-0.427	**0.905****

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Strong correlations are highlighted. Level of significance is indicated with asterisks.

Table 2. Factor analysis of averaged data across all nine qualitative factors

Rotated Factor Loadings and Communalities Varimax Rotation			
Variable	Factor1	Factor2	Communality
ROI	0.214	**0.964**	0.976
Reputation	**0.725**	0.683	0.993
Credit Rating	0.556	**0.828**	0.995
Risk	0.326	**0.94**	0.99
Proximity	**0.949**	0.291	0.985
Feedback	**0.897**	0.414	0.976
Professional	0.663	**0.743**	0.992
Social Impact	**0.967**	0.245	0.994
Control	**0.832**	0.551	0.996
Variance	4.7589	4.1369	8.8958
% Var	0.529	0.46	0.988

A value of 1 would indicate a perfect correlation of the values in the factor 1 and factor 2 columns, with each variable in the left-hand column (so they are correlations against the factors, rather than just factor scores). Strongest correlations are highlighted.

Plotting the position of the 7 different investment options in factor space using these variables as axes (Figure 5), shows that there are marked differences between the factors affecting decisions to invest in each option. It can be seen that Charity and Kiva.org, in the bottom right quadrant, score very highly on the social factor scale but low on the financial factor scale, while bank account, hedge fund, shares, and pension are high on the financial factor scale but low regarding social factors and thus in the top left quadrant. Thus the analysis is consistent with the idea that public investment decisions are not made purely in one dimension, based on a rational quantitative risk-return calculation, but include a second, negatively-correlated, dimension that incorporates more qualitative, social aspects of the investment.

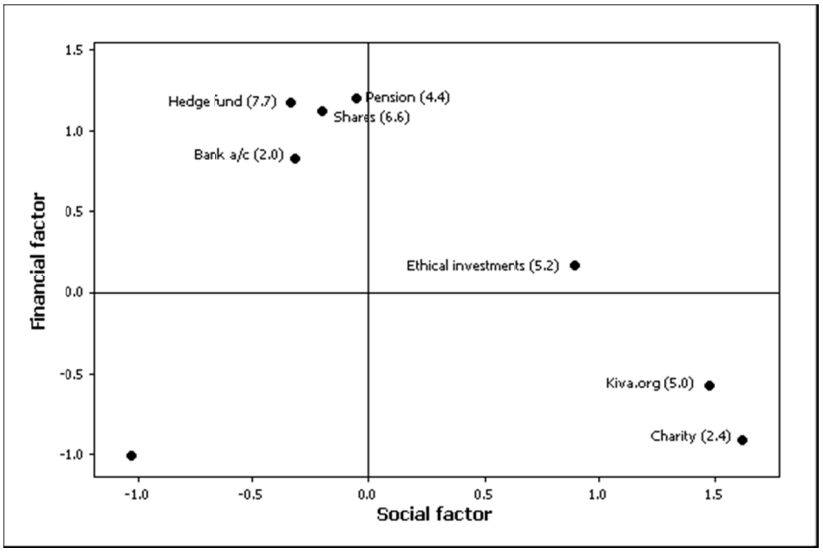

Figure 5. Two-factor diagram showing the positioning of each of the investment options against the two identified factors. The overall risk perception rating of each investment option is shown in brackets

Figure 5 also shows the average overall perceived risk rating of each option (in brackets next to each label). However, there is no discernable relationship between the perception of the overall risk of each investment type, and its position in this factor space. Were such a relationship to exist we would expect there to be a separation between the high risk investments and the low risk investments, with higher social impact causing a lower level of perceived risk. This would be consistent with the findings of Schutz and Wiedemann (2008), for example, who found that the risk perception of nanotechnology among the public decreases with the amount of societal benefit it is perceived to have, and with earlier work by Finucane *et al.* (2000) on the relationship between the risks and benefits of various technologies, and with theoretical studies by Vlaev *et al.* (2010) on domain effects and financial risk attitudes.

What might account for this departure? To answer this, it is first necessary to understand where the results differ from expectations. Charity, for example, is positioned as both very low risk and high on the social factor scale, in line with expectations. However charity is somewhat of an anomaly in this study because, unlike any of the other investment options, it offers zero chance of recouping one's initial investment. For this reason it is more prone to inconsistencies in its scoring, with this perplexity evident in the comments of some of the participants: "I wasn't sure how to rate charity in terms of risk – I thought the whole point was that you don't get your investment back!"

Bank accounts, on the other hand, scored very low on the social scale and high on the financial scale, but had the lowest risk rating of all the options, at just 2 out of 10 on average. Yet it is easy to understand why this would be the case – bank accounts are extremely safe investments in general and the risk perception clearly reflects that. They also have little social impact, apart from in the broadest sense of providing the public with a safe place to keep their money, and providing banks with funds upon which to leverage their lending activities. Therefore banks are represented more or less in their expected location on the factor space. In fact, the conclusion that this evidence seems to point to is that overall risk perception is not as important in influencing investment decisions as might have been expected.

4. Discussion

4.1 Contrasting Ideologies

A clear implication of these results is that perceived social impact, a feeling of proximity to the end beneficiary, feedback, and control over an investment are important to microfinance investors and can override the importance of risk levels in decision making. This is demonstrated by Kiva.org with its medium risk perception rating and which offers zero return on investment, but which is still a popular investment because of its high rating on social factors. In the absence of social factors, financial factors become understandably more important and judgements become based upon return on investment, credit rating and risk, regardless of whether the

investment in question is perceived to be high or low risk.

These 'domain effects' are consistent with the view of Rhyne (1998), who believes that the two main schools of thought in microfinance, that of social impact and that of sustainability, are mutually exclusive, explaining that 'the sustainability camp views the private sector as the future home of microfinance, while those in the poverty camp seem wary of allowing that future to be dominated by commercial, for-profit operators.' The factor analysis indeed implies that this dichotomy is recognised within the wider public, including potential microfinance lenders.

4.2 The Danger of Transferred Protocols

What does this reveal about risk management in financial institutions? It may well be true that traditional financial institutions, such as banks, hedge funds, and pension funds are correct to place great importance in formal risk management, using tools such as credit ratings, and balancing risk with return on the investment, because this is how the public judge this type of investment. But for microfinance institutions or ethical investment firms who offer a social impact with their investments, these financial factors are apparently less important to their investors, and instead social factors take precedence. Therefore these institutions need to take this into account when designing their risk management policies, and indeed their general policies too.

Unfortunately, however, it is relatively rare that reports on the microfinance sector adequately acknowledge the contextual issues including consideration of mission and reputation, which are indicated here as important. Instead, there is a tendency to presume that what is good for the finance sector in general is also good for microfinance, a phenomenon which can be observed in the approach taken to risk assessment and management.

For example, one illuminating paper by consultants Oliver Wyman, on the future of risk management in microfinance draws comparisons between the microfinance industry and the US mortgage market, the latter a well-established market with sophisticated participants and risk management systems, and attempts to understand how the market collapse of 2007 can be avoided in the microfinance industry (Tantia, 2008). The author predicts that the microfinance industry could evolve to mirror the US mortgage market in many ways as the sophistication of the market increases, and the report goes on to advocate the use of ‘best practice’ risk management techniques, particularly in the areas of credit, market, and operational risk. This, however, begs the question of how one should define ‘best practice’ in the context of MFIs.

While it is clear that, faced with an increasing awareness of risks, old and new, the microfinance industry is placing more emphasis on risk management than ever before, the drivers to the implementation of subsequent risk policies are almost universally external forces, originating from the demands of the commercial investment funds and regulators that wish to impart a level of order on the industry that will result in greater stability and returns for them in the long-term. The danger is that, with a lack of internally driven risk management devices, the social mission of microfinance may not be reflected in the bulk of its decision-making procedures. That this could happen may be gleaned from scrutiny of the risk management protocols being proffered to MFIs, which seldom mention the social function of the sector.

As another example, a second report on risks to be managed by microfinance institutions lists counterpart risk, asset and liability balance, foreign currency exposure, and cash-flow risk as the four primary risks of concern (Bruett, 2004), all of which are financially-focused risks. Likewise, a leading framework for risk management in MFIs by a large German development organisation laments that: 'The social mission of MFIs attracts many high profile bankers and business people to serve on their boards. Unfortunately, these directors are often reluctant to apply the same commercial tools that led to their success (in banking) when dealing with MFIs.' In neither report is there clear acknowledgement of how suitable these tools might or might not be. The framework itself focuses primarily on financial and operational risks, only mentioning mission goals under the heading 'Additional Challenges for MFIs' (GTZ, 2000).

Likewise, some of the most comprehensive toolkits on offer barely mention risks to social function at all. MicroSave, an experienced and well-respected microfinance capacity-building organisation, brought out their Risk Management Toolkit in 2005. This highly detailed document on developing risk management policies for MFIs goes no deeper than an occasional sentence on mission goals, in fact using the word mission only four times during the 137 page document (Microsave, 2005). The CGAP MFI Appraisal Guide also recommends items that investors should look for when assessing MFIs. The section on risk management asks about the MFI’s financial and operational risk management, but makes no mention of mission or reputational risk (Isern, Abrams and Brown, 2008).

A more modern approach to risk management is taken by an organisation called OSS360, whose risk

management computer-based application aims 'to develop a 360° risk management methodology for MFIs, including all kinds of risks (operational, financial, economic, strategic, et cetera)' and has the involvement of over 25 MFIs from around the world. Despite this involvement, its current iteration deals only with the more quantitative side of risk, such as portfolio and financing risk (Open Scenario Solution, 2011).

4.3 Steering a True Course

What should MFIs do? It is clear that within any complex system, such as that faced by an MFI, there are a large number of decisions to be made each day which, due *inter alia* to finite resources, are likely to have opportunity costs elsewhere. The philosopher David Seedhouse (2004) has proposed that in order to have an effective risk management policy, it is important to first decide on a philosophy or agreed purpose that underpins all decisions, and that this should be clearly stated and communicated. Without this, organisations are leaving themselves vulnerable to mission drift, as there will be no means of ensuring consistency in decisions and resource allocation.

This situation, it would appear, has been recognised in the new international standard on risk management, ISO 31000, which states that ‘Management should align risk management objectives with the objectives and strategies of the organisation’ (ISO, 2009). Also endorsing the importance of a properly designed risk philosophy, is the International Risk Governance Council (IRGC, 2008), an independent organisation whose purpose is to 'improve the understanding and management of emerging systemic risks that may have significant impacts on human health and safety, the environment, the economy and society at large.' The IRGC risk governance framework provides a logical analytic framework to aid comprehensive risk assessment and management strategies. One of the unique attributes of the model is that it takes into account the impact of societal context and the categorisation of different levels of risk-related knowledge, as well as promoting the value of a clearly defined purpose in forming the basis of any risk policy.

While all of this may seem obvious, it is often overlooked. With a huge number of risks to manage, references to the overall mission of the MFI often comprise just one small part of a gargantuan policy document, and seemingly comprise just one additional risk to manage but with no reference to its interconnectedness with the other parts of the policy. In fact, the MFI’s mission, and overall philosophy, should be embedded in all decisions made by the organisation. It is salutary to note that many MFIs who state their primary mission as being poverty reduction make decisions that have the opposite effect, examples of which include collateral requirements, efficiency drives and cost reduction, and lending in hard currencies. The events in the Indian state of Andhra Pradesh in 2010, in which MFIs were subject to scandal and government criticism due to their over-zealous credit policies, could themselves be said to be the result of a lack of consistency of internal policies and insufficient awareness of social risks, as profit motives and credit policies clashed with the social goals of microfinance (CGAP, 2010).

4.4 Inevitability of Trade-Offs

It is inevitable that risk managers in MFIs will face complex issues arising from the varying beliefs of stakeholder groups. Consequently they should be prepared for, and understand, the nature of the conflicts. Although, in some circles, there exists the idea that risk management is something to look to in times of conflict and uncertainty as a way to organise debates and arrive at rational decisions, the reality is that society has multiple goals and difficult trade-offs have inevitably to be made, often on grounds which are not strictly 'rational' (Graham and Wiener, 1995). This is likely to be particularly so in the microfinance industry with its dual and often opposing motives.

It may also be worth bearing in mind that in the wider risk world it has been noted that the incorporation of values into risk management policies, the need for which is argued here, is in itself tantamount to adopting a certain philosophy, and that there are many who oppose this. Those who have argued in favour of this tend to be ones who believe risks to be social constructions, otherwise known as '*constructivists*,' such as Hillgartner (1992), or Luhmann (1995). However, there is a second camp, the '*realist*s,' who fervently believe that risks can be reduced to accurate technical representations of the hazards that exist, and that will affect people in the same manner regardless of their perceptions (Catton, 1980; Dickens, 1992).

Constructivists, such as Freudenberg and Pastor (1992), contend that cognitive perceptions must be integrated into the regulatory decision process to enable effective decision-making, as assessments are not valid outside of the logical framework of the group conducting them. In other words, one must take into account those affected by the risk and how much they are willing to tolerate, before making judgements on what to do about it. An example from the microfinance industry is that, while realists would argue that requesting collateral from all clients can statistically reduce the risk that they will default and the MFI lose its money, constructivists would

point out that MFIs with a social mission are likely to have a higher tolerance of this type of risk in favour of reaching poorer clientele.

5. Conclusions

Divergence of opinion over the nature and conduct of the business of MFIs is well known. Zeller and Meyer (2002) describe it in terms of a 'triangle of microfinance' - a constant balancing act that microfinance institutions must walk between outreach (reaching large numbers of poor clients), financial sustainability (generating sufficient revenues to cover all costs), and impact (showing a positive effect on clients' quality of life). Rhyne (1998) describes the split as a dichotomy between those who believe microfinance should focus on poverty reduction, and those who believe it should focus primarily on being sustainable. These are seen as mutually exclusive, because in order to reach the very poor, one must travel to more and more remote areas to deliver smaller and smaller loan sizes, thus increasing operating costs and reducing efficiency.

There are, evidently, two main drivers behind the framing of the microfinance industry, the first being differing motivations and values of the key industry stakeholders, including governments and increasingly the lending public. These stakeholders are split between those with a purely social motive, and those with a dual profit and social motive. The second dimension is the context of the industry itself, started with the primary purpose of alleviating poverty, but which, almost coincidentally, shares many practical similarities to the global financial services sector, hence attracting resources, its practices and values.

Overall, this indicates that MFIs would be well advised to put more resources into measuring and reporting their social impact, and providing investors with transparency on the use of their funds and the motivations behind the decisions which they make, things that are often not included in current risk audits. Furthermore, other social factors which are important to lenders rarely receive a mention in the risk management protocols which have been developed. MFIs need to respond firmly by integrating consideration of their mission into all their management protocols.

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Notes

Note 1. P2P refers to the recent development in microfinance whereby socially-minded internet users can lend small sums of money via the internet to microfinance institutions such as Kiva.org, MicroPlace.com and MicroWorld.org and their clients.

Note 2. Kiva.org was used to represent microfinance investments as it is the best known of all peer-to-peer platforms.

Note 3. How important is the risk to you in making the decision, not how risky is the option overall.

Note 4. How close you feel to the person that eventually uses the investment, e.g. if you buy shares, the end beneficiaries could be the employees and customers of the company you buy shares in.

International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Causality Relationship between Foreign Direct Investment, GDP Growth and Export for Tanzania

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Received: May 24, 2013 Accepted: July 31, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p13 URL: http://dx.doi.org/10.5539/ijef.v5n9p13

Abstract

Deep analysis on how foreign direct investment (FDI) interacts with the host country's GDP growth and export is very important for the identification of the strategies that will enable a developing country like Tanzania to achieve its development objectives. Hence we continue to analyze the causality relationship between FDI, Export and GDP growth of Tanzania for about 33 years starting from the year 1980 to 2012.In this study the co integration and granger causality test analysis is conducted. The co integration test reveals that there is existence of a long run association ship among the variables in questions. While the granger causality results suggests that there is a causality relationship which is unidirectional running from FDI to export and no causality was discovered between FDI and GDP growth suggesting that FDI is a good predictor of export and hence FDI led export growth for Tanzania might be necessary for the country to boost export.

Keywords: foreign direct investment (FDI), gross domestic product growth (GDPGR), export (EX), co integration test and granger causality, Tanzania

1. Introduction

In an effort to develop strategies and policy frameworks that will boost the economy of Tanzania to reach the developmental goals such as eradicating poverty. Tanzanian policy makers and academicians needs to know which variable among the three in question causes another so that the right strategies can be identified and well implemented that will have the major impact in the general economic development. Therefore Identifying the interrelationship between FDI, GDP growth and export is important in explaining the economic performance of the country particularly Tanzania.

From the past decades the study that focuses on the relationship between Export and GDP growth has been very important as evidenced by many researchers and discovered that these studies can help in understanding their impact and linkage on each other. In fact, the importance of FDI in the process of developing the economy of a country has been a very hot topic of discussion until recently. Efforts have been done by most developing nations mainly for the attraction of FDI by providing the conducive environment for the foreign investors as it has been one of the tool to bring capital that is insufficient to most developing nations.

In this case it seems reasonable to undertake studies of the linkage between FDI, GDP growth, and export. Since it has been observed from the fact that to the great extent these variables from theoretical point of view have the tendency to impact one another. Hence it is clear that without deep understanding of the direction of these variables it will be difficult to find the most effective policy for the sake of promoting the development of the country. Therefore it makes sense to analyze the causality relationship between these variables to make it easier in policy formulation in Tanzania.

In showing the linkage of FDI on GDP growth and export most studies have used the Granger Causality test as one of the method for analysis which will also be used for the analysis of the variable in question in this study.

This study follows three main stages of analyzing the three variables which are analysis of the stationarity of the variables in question, the test of co integration and finally employ the Granger causality test to find out the direction of the variables.

It should be noted that there are a lot of studies that explains relationship between FDI, GDP growth and export with very mixed results. Although to the best of my knowledge only few researches have been done basing on

Tanzania economy.

The main objective to conduct this study is:

To provide the recent analysis of understanding the three variables in questions and add up to the existing literature while the specific objective is to find out the causal relationship of the variables for a case of Tanzania.

This study is organized into four parts. Part 1 covers introduction of the study ,part two that covers the literature review which is followed by part 3 that Covers the Methodology of the study, data source and interpretation of the results part 4 covers Conclusion and policy recommendations.

2. The Literature Review

Generally, most of the previous empirical studies discovered that causality linkage between foreign direct investment (FDI), export and GDP growth to be so mixed. With Some researchers indicating the unidirectional response while others indicating the bi-directional response and remaining group find no response at all among the three variables in questions.

To see how those linkage between the variables in question is mixed observe the following studies.

The studies by M. Dritsaki, C. Dritsaki and A. Adamopoulos (2004) on the analysis of how FDI, export and economic growth relate to each other in Greece for the years between of 1960-2002 shows that the there is existence of a long run equilibrium relationship among the variables analyzed using the co integration test while Granger causality results shows a causal relationship existed on those variables. Miankhel, Thangavelu and Kalirajan (2009) did the causality test between FDI, export and GDP (economic growth) for Pakistan, India, Malaysia, Mexico, Thailand and chile.

Their findings were different for all the six nations .Their findings specifically reveal that economic growth attracts FDI in India in the long run that while GDP influence export in Pakistan.

The study shows that Thailand had a bidirectional relationship between FDI and GDP implying that FDI leads to GDP and hence GDP attracts FDI.

Dasgupta (2007) examined the long run impact of export, imports and FDI inflows on the outflows of FDI in India. His empirical results suggested the presence of Unidirectional causality running from the export and import to FDI out flows. The results found no causality existed from FDI inflows to the outflows.

According to the study by Syed Imran Ali Meerza (2012) on the investigation of the causal linkage between trade FDI and economic growth of Bangladesh between 1973 to 2008.In his study he found that in the co integration test there was a long run relationship on the variables being analyzed while he also found that economic growth influences both FDI and export and that there was the existence of a unidirectional causal relation between FDI and export which runs from export to FDI.

An empirical study by Shimul and Siddiqua (2009) found no existence of the linkage of FDI and GDP for Bangladesh for a period between 1973-2007.

Mohammad Sharif karimi (2009) using the methodology of Toda and Yamamoto examined the causal relationship between FDI and economic growth for a period between 1970 to 2005 and found no strong evidence of bi-directional causality between the two variables hence he suggested that FDI has an indirect effect on economic growth in Malaysia.

An empirical investigation of the study by Chow P. (1987) on the causal relationships between export growth and industrial development in eight newly industrializing countries found out that there is a strong bidirectional causality relationships between the export growth and industrial development which support the export led growth strategy in the sense that with the export expansion there will be the national income growth of the country.

Chakraborty and Basu (2002) Investigated on the relationship between economic growth and foreign direct investment (FDI) in India by employing the co integration and error correction model method and found out that there is unidirectional relationship with causation running from GDP to FDI and not otherwise.

In his study Athukorala (2003) on The Impact of FDI on Economic Growth in Sri Lanka showed that FDI inflows did not exert an independent influence on economic growth and the direction of causation was from GDP growth to FDI rather than FDI to GDP growth.

Many researchers have used the granger causality test to explore the linkage of the variables in question hence these studies employ the same methodology for the case of the developing country like Tanzania and observe directions of how these variables react towards one another.

It should also be noted that most of the studies (some not covered in the literature review above) has been focused on the cross sectional data in their research for causality which is contrary on this study in the sense that it puts focus on one individual developing country of Tanzania which gives it an advantages of avoiding the problem of country's uniqueness behavior that would have happened incase other countries were involved for case of a cross section data analysis. In a cross section data analysis usually all countries involved are assumed to be homogeneous in their economical state. Another disadvantage is with the sensitivity in fixing up a model.

However according to other previous studies a panel data analysis can still capture a countries individual uniqueness behavior successfully incase more than one country is involved although it has been pointed out there is a possibility that it cannot explain to the great extent the influence of the variables which usually cannot be the same in different countries. Therefore for simplicity only Tanzania as one country will be analyzed in this study to determine the causation of the variables I question.

3. The Methodology of the Study, Data Source and Interpretation of the Results

In this study we employ the granger causality test for the estimation of the causality relation between FDI, GDP growth and export of Tanzania. The functional form is as shown below:

$$EX=f\ (FDI,\ GDPGR) \tag{1}$$

Note:

EX= Export

FDI=Foreign Direct Investment inflows

GDPGR= Gross Domestic Product Growth

The measurement of export (EX) is taken as the real merchandise of export of Tanzania. Gross Domestic Product Growth (GDPGR) is taken as the real GDP growth rate annually and Foreign Direct Investment inflows (FDI) is taken as the FDI inflows to Tanzania.

The study uses the annual (secondary) time series data covering the period 1980-2012. This period has been chosen because data to be used in the foreign direct investment inflow is likely to be available. Most of these data were collected from the World Bank indicators covering the period between 1980-2012 annually.

The data are then put in logarithmic forms denoted by **ln** in each variable to avoid heteroscedasticity problem. The model involves the analysis of the relationship between GDPGR, FDI and export.

Once it is observed that the variables analyzed have the same trend and the first differences are also stationery in that case we can proceed with the process of co integration.

The preliminary step will be to find the order of integration by using the unit root tests. When it happens that the variables have a unit root then to become stationary we will have to differentiate the data on the first difference.

Then the following stage will be using the Johansen and Juselius co integration test to find the number of co integration. If the co integration is found then there is a need to test for Granger causality.

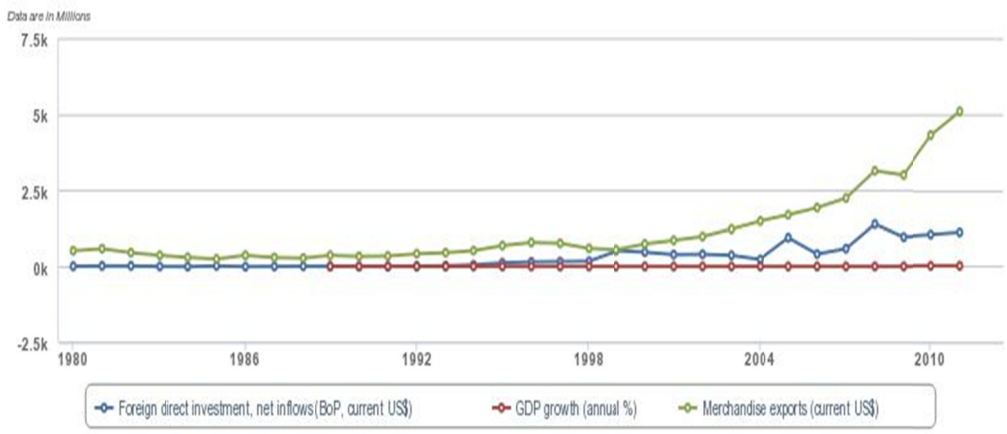

Figure 1. FDI inflows, GDP growth and export trend of Tanzania from 1980 to 2012

Source: world development indicators 2012 (WDI).

Figure 1 above shows the trend of the three variables under investigation i.e. FDI inflows, GDP growth and export trend of Tanzania from the year1980 to 2012

3.1 Augmented Dickey-Fuller (ADF)

The ADF tests for the presence of a unit root of a variable Y_t, at time t. Where Δ the difference operator, the variable Y_{t-i} indicates the first differences with k lags and ε_t is the variable that makes adjustment of the errors of correlation. The coefficients β is to be estimated for the variable Y. The hypothesis for the existence of a unit root in variable Y_t, is:

Null hypothesis; $\boldsymbol{\beta = 0}$.

Alternative hypothesis; $\boldsymbol{\beta \neq 0}$.

$$\Delta Y_{t-1} = \alpha + \beta Y_{t-1} \sum_{j=1}^{k} \gamma_i \Delta Y_{t-k} + \varepsilon_t \quad (2)$$

Table 1. Stationary (unit root) test for variables (ADF TEST)

	At level		First differences	
Variables	ADF Statistics	Critical Value	ADF Statistics	Critical Value
ln FDI	1.320841 (0.9982)	1% -3.670170 5% -2.963972 10%--2.621007	-8.160161* (0.0000)	1% -3.670170 5% -2.963972 10%--2.621007
ln GDPGR	-1.588418 (0.4768)	1%=-3.653730 5%=-2.957110 10%=-2.617434	-6.179983* (0.0000)	1%= -3.661661 5%=-2.960411 10%=-2.619160
lnEX	-4.702082* (1.0000)	1% -3.670170 5% -2.963972 10%--2.621007	1.548099 (0.9990)	1%= -3.679322 5%= -2.967767 10%=-2.622989

Note: *, **, *** indicates 1%, 5%, 10% level of significance respectively.

First of all we conduct the augmented Dickey-Fuller (ADF) unit root tests for each variable in a model which is a method developed by Dickey and Fuller (1979) testing for the significance of the independent variables .The results are presented in Table 1.

The augmented Dick Fuller results in table 1 shows that the two variables which are FDI (Foreign Direct investment) and GDPGR(Gross Domestic Product Growth) were not stationary at level but they became stationary after the first differences however the results found out that only one variables which is EX(Exports) was stationery at level hence in this case we follow Harris (1995), who made suggestion that the variables which integrated of different orders I(0) ,I(1) and I(2) may be co integrated especially when the theory supports that variable is relevant and that should be included on the research, LNEX is therefore considered in the regression model to proceed with the following steps in the analysis. Most of the time when the I (1) variables are put together, their linear combination will become I (1). On the other hand, when it happen that the variables have not the same order of integration, then in that case their combination will attain an order of integration of highest order (Brooks, 2008). Brooks indicated that a linear combination of I (1) variables will only become I (0), when the variables are co integrated.

3.2 Johansen Co Integration Analysis

The Johansen test is a method that can be used for testing co integration of several I (1) time series data. This test allows more than one co integrating relationship so is most widely used than other methods.

Generally two types of Johansen test are identified one is with trace and the other is eigenvalue .The null hypothesis to be tested for the case of trace test is there at most" r "number of co integration vectors while the null hypothesis for the eigenvalue test is there "r" co integrating vectors against the existence of alternative r+1.The null hypothesis of no co integration against the presence of co integration is checked on this test. johansen and juselius (1990).

A general VAR (p) model can be depicted as:

If x_t indicates a k×1 vector that are not integrated in order higher than 1, in that case x_t can be represented as

a Vector Auto regression of order p:

$$X_t = \mu + \Phi Dt + \Pi_p X_{t-p} + \ldots + \Pi_1 X_{t-1} + e_t, \ t=1, \ \ldots, \ T \quad (3)$$

Where; e_t residual term, D_t deterministic term, Π_1, u , Π_{t-p} matrices coefficients

Table 2. Johansen co integration tests

Series: LNFDI LNGDPGR LNEX

Test (Trace)				
Hypothesized no of CE(s)	Eigen value	Trace Statistics	0.05 Critical value	Prob. **
None *	**0.930574**	**77.67534**	**29.79707**	**0.0000**
At most 1	0.259432	8.320411	15.49471	0.4318
At most 2	0.019486	0.511641	3.841466	0.4744
Test (Maximum Eigen value)				
Hypothesized no of CE(s)	Eigen value	Max Eigen Statistics	0.05 Critical value	Prob. **
None *	**0.930574**	**69.35493**	**21.13162**	**0.0000**
At most 1	0.259432	7.808769	14.26460	0.3985
At most 2	0.019486	0.511641	3.841466	0.4744

Source: world development indicators 2012(WDI).

Note; both trace and max Eigen test indicates 1 co integrating eqn (s) at the 0.05 level.

In conducting this test the number of lags determination is very important therefore by selecting Akaike information criterion and Schwarz criterion an optimal number of lags 6 is achieved hence on performing the co integration test we get 1 co integration vector from both the trace statistics and eigenvalue statistics at 5 percent level. Table 2 indicates the results.

3.3 Analysis of the Granger Causality Test

We perform the Granger-Causality test in order to examine whether one economic variable is useful in forecasting another in short-run. In this study, we employ the method developed by (Granger, 1969). If we assume two variables e.g. X_t *and* Y_t, affect each other with some lags. The relationship of these two variables can be formulated in a VAR model .Then, if we test whether X_t causes Y_t, we check that how much of the present Y_t can be represented by lagged values of Y_t and X_t. In the Granger causality we check the null hypothesis that X_t does not granger cause Y_t; and if we can reject the null hypothesis, it implies that X_t does Granger causeY_t. As Granger-causality tests require stationary data therefore all the variables have to be tested for the existence of unit roots. Only when we fail to find the presence of a unit roots estimation models will be conducted with only long-run coefficients to be used for the estimation hence, the estimate of a VAR model will be as follows.

$$X_t = \sum_{i=1}^{m} \alpha_i X_{t-i} + \sum_{j=1}^{m} \beta_j Y_{t-j} + \mu_t \quad (4)$$

$$Y_t = \sum_{i=1}^{n} \lambda_i Y_{t-i} + \sum_{j=1}^{n} \delta_j X_{t-j} + \varepsilon_t \quad (5)$$

Where X_t and Y_t indicates the variables to be estimated at time t.The u_t and ε_t are the residual prediction errors which are uncorrelated to each other. Equation 4 depicts the variable x is decided by a lagged variable of Y and X.the same applies to equation 5 except that in this equation its dependent variable is represented by a variable Y instead of X. In this test usually we check if the estimated lagged coefficient α_i are λ_i different from zero by using the F-statistics. When the jointly test rejects the two null hypothesis that α_i and λ_i are both different from zero, then in that case the casual relationships between X and Y are confirmed. Generally speaking granger causality has been used by many researchers for investigation of the causal relationship although it is not without limitations for example being sensitive to the number of lags to be used and the model specifications as pointed out by Gujarat (1995). So it must always be used with care.

Following is the results of the granger causality test as indicated by table no.3 below

Table 3. Pair wise Granger causality test

Null Hypothesis	Obs	F-Statistic	Prob.	Conclusion
lnGDPGR does not Granger Cause LNFDI	26	0.24537	0.9634	
lnFDI does not Granger Cause LNGDPGR		0.31893	0.9300	
lnEX does not Granger Cause LNFDI	26	1.58632	0.2371	
lnFDI does not Granger Cause LNEX		**3.83477**	**0.0234**	**lnFDI→lnEX**
lnEX does not Granger Cause LNGDPGR	26	1.09573	0.4279	
lnGDPGR does not Granger Cause LNEX		1.22962	0.3642	

Source: world development indicators 2012(WDI).

The Granger causality test results shows that the causal unidirectional relationships exist only between FDI and Export with the direction running direct from FDI to export which imply that FDI is can be used in forecasting Export growth in Tanzania although in reality it is hard to find this evidence for the case of Tanzania as we have not seen any significant impact of FDI on export in the economy of Tanzania which raise questions on the motives of foreign investors to Tanzania or some other factor might have an influence on export. This finding collaborates with the findings of M. Dritsaki, C. Dritsaki and A. Adamopoulos (2004) and Samsu et al. (2008). However, this result contradicts with that found by study by Syed Imran Ali Meerza (2012) for Bangladesh. All in all this study still support the FDI led export growth for Tanzania as evidenced by the results although care must be taken on the motives of multinational company intending to invest in Tanzania.

Despite the fact that FDI is known to be the most contributing factor for GDP growth of the country, this study has not find any evidence to prove this for the case Tanzania as we can see from the results that no causation between FDI and GDP growth which supports the results obtained by Mohammad Sharif karimi (2009).

4. Conclusion and Policy Recommendations

The study has been conducted using the annual data spanning from 1980 to 2012 for the sake of identifying the causality relation between FDI, GDP growth and export of Tanzania. We first started with the test of stationarity of the three variables in question using augmented Dickey-Fuller (ADF) test and the results showed that the two variables which are FDI(Foreign Direct investment) and GDPGR(Gross Domestic Product Growth) were not stationery at level but they became stationery after the first differences however the results found out that only one variables which was EX(Exports) to be stationery at level hence in this case we followed Harris (1995:80), who made the argument that the variables which are integrated of different orders i.e I(0) ,I(1) and I(2) may be co integrated especially when the theory supports that variable is relevant and that should be included on the research, since LNEX was an important variables in this study and was therefore taken in the regression model to proceed with the next steps of the co integration analysis.

The co integration test found one co integration equation on both the max-Eigen and Trace statistics implying the existence of a long run association ship on the variables in question. While the granger causality test results showed that there is a causality relationship which is unidirectional running from FDI to export and no causality was found between FDI and GDP growth suggesting that more policies to attract FDI is important to boost export, the results also implies that either FDI or GDPGR cannot be used to predict one another since no significant causal relationship was found between the two. However the study suggests that Multinational Company motives should be taken into consideration if FDI led export growth has to bring the desired results basing on the reality situation in Tanzania.

The findings of this study may contribute to the existing literature especially for Tanzania and other developing countries on the factors in questions when it comes to policy making in the country. The research is also limited basing on the fact that the data for Tanzania are not so exhausted therefore interpretation should be done with care and further studies should focus on those limitation that might bring a more robust results for the case of Tanzania.

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International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Dynamic Analysis of Money Demand Function in Turkey

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Received: June 19, 2013 Accepted: July 24, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p20 URL: http://dx.doi.org/10.5539/ijef.v5n9p20

Abstract

In this paper, the dynamic determinants of money demand function and the long-run and short-run relationships between money demand, real product and nominal interest rates are examined in Turkey for the time period 1980-2012. In particular we estimate a dynamic specification of a long money demand function based on Keynesian liquidity preference theory to ascertain the relevant elasticity of money demand using DOLS and FMOLS methods. The empirical results of the study show that in Turkey inflation, exchange rates and money demand are co-integrated, i.e., they converge to a long run equilibrium point. In this regard, correction procedure corrects nearly 31 percent of the biases from long run equilibrium in one year. Therefore, the real money demand in Turkey is positively related with income and negatively related with nominal interest rates.

Keywords: dynamic ordinary least squares, vector error correction, money demand function

1. Introduction

A tremendous growth in variety of new trends and innovations has been seen in financial sector during past three decades. This growth also needed to design reliable monetary policies depending on refresh data. These reasons could explain why similar studies from different countries have appeared in macroeconomic literature on money demand policies. There are many studies on money demand function for both developed and developing countries (Eatzaz and M. Munir, 2000). The macroeconomic modeling of money demand function has a crucial importance for monetary policy. Although there is a consensus that central banks have been deactivated and have little role under an interest rate based monetary policy, the demand for money is still believed to be important in terms of macroeconomic models and monetary policies (Bae and De Jon, 2007).

There is an extensive literature on estimation of money demand function. However most of this literature depends on a stable and linear money demand function. Some of these reputable references are Chow (1966), Laidler (1985, 1977), Lucas (1988), Hoffman and Rasche (1991), Miller (1991), Baba et al. (1992), Kallon, (1992) Stock and Watson (1993), Mehra (1993), Miyao (1996), Choi et al (1998), Ahmet and Munirs (2000), Ball (2001), Anderson and Rasche (2001), Sriram (2001), Nell (2003), Handa (2009) and Drama and Yao (2010). Additions to these studies, recently the dynamic money demand function have been estimated for both country groups and individuals by many notable references: Adam (1992), Bae and De jong (2007), Baba et al (2013), Terasvirta and Eliasson (2001), Chen and Wu (2005), Park and Phillips (1999, 2001), Chang et al. (2001), De Jong (2002) and Asuamah et al (2012). Short-run dynamics of the money demand function has largely been estimated in the framework of "Error Correction Model" (ECM), while the long-run cointegration relationship in nonlinear money demand function and dynamic money demand function are respectively investigated in the framework of "Nonlinear Cointegration Least Squares" (NCLS) developed by Bae and De jong (2007) and Fully Modified OLS (FMOLS) developed by Pedroni (2000, 2001) and Philips ve Moon (2000) and Dynamic OLS (DOLS) developed by Kao ve Chiang (2000).

The money demand function has generally been considered as a linear function and estimated largely by vector error correction (VEC) and Dynamic Ordinary Least Squares (DOLS) methods. The purpose of this study is to estimate money demand function for Turkey both by these methods and Fully Modified OLS (FMOLS). We also compare coefficients of these different models. The distinguished aspect of the study from the relevant literature is that it estimates dynamic money demand function for Turkey using FMOLS method.

The rest of the paper is organized as follows. In section two money demand function is introduced. Data and econometric results are in section 3. Section four concludes the study.

2. Money Demand Function

Although there is a consensus that money demand function has a little role under Taylor-rule type monetary policy, it is still believed that money demand has a crucial importance for both macroeconomic model and monetary policy. In each country, monetary authorities continue to underline the role of the money demand function on monetary policy operations of the central banks (Bayer, 1998; Lutkepohl et al, 1999; Bae and De Jong, 2007). Studies on monetary policies indicate that monetary policy does not work only through the interest rate channel, but it gives useful information about portfolio allocations either. Many researcher accept that since money supply is largely controlled by the money authorities, money supply curve is drawn parallel to the axis of the nominal interest rate and vertically to the axis of the quantity of money (Papademos and Modigliani, 1990, p.402; Bae and De Jong, 2007) (A vertical line to the plane of interest rate and quantity of money). We conclude that the elasticity of the money supply to the nominal interest rate is zero. In the literature following Lucas (1988), Stock and Watson (1993), Ball (2001) and Bae and De Jon (2007), the long run money demand function is widely shown in the following form:

$$m_t=\beta_0+\beta_1 r_t+\mu_t \tag{1}$$

Where m_t denotes the logarithm of real money demand and r_t is the nominal interest rate. Besides the functional form (1), Allais (1947), Baumol (1952), Tobin (1956) and Bae and De Jon (2007) suggest a log - log model for money demand function to ascertain the relevant elasticities based on the inventory theoretic approach:

$$m_t=\beta_0+\beta_1 ln(r_t)+\mu_t \tag{2}$$

In this paper we assume validity of Keynesian liquidity preference theory, and consider only logarithmic functional form of money demand function developed by Allais (1947), Baumol (1952) and Tobin (1956) but extended by Miller and Orr (1966) and Bae and De Jon (2007), and includes both income elasticity and interest rate elasticity. Following Bae and De Jon (2007), we consider an individual having an income Y in the form of bonds. We are also assuming that the transaction cost for converting bond into cash is b, and that the real value of bonds converted into cash in each time is denoted by K. Then total transaction cost consisting of conversion cost and interest cost on money holding (K/2) over the timewill be denoted by the following formulation, in which the first term shows conversion cost and the second term is interest cost on holding money (Bae and De Jon, 2007).

$$\gamma=b\left(\frac{Y}{K}\right)+r\left(\frac{K}{2}\right) \tag{3}$$

Optimal real money balances is derived from minimizing the transaction cost with respect to K

$$\frac{M^d}{P}=\frac{K}{2}=\frac{1}{2}\left(\frac{2bY}{r}\right)^{1/2} \tag{4}$$

Where $\frac{M^d}{P}$indicates the real money balances. Taking the logarithm of the equation (4), we get equation (5) written below.

$$ln\, m_t= ln(\frac{M^d}{P})=\beta_0+\beta_1 ln(Y)+\beta_2 ln(r_t)+\mu_t \tag{5}$$

Where β_1 and β_2 are constant income and interest rate elasticitiesof money demand. Why we are dealing with logarithmic form of the money demand function in this study is that liquidity trap can be captured easily by this form. In the case of the liqiditiy trap, money demand becomes indefinite at a very low interest rate. Functional form (2) includes lidiqidty trap, because (2) allows the demand function increases to the infinity as the interest rates approaches to zero (Bae and De Jong: 4). Our expectataion about the signs of the coefficients of $\beta_1$and β_2 is positive and negative, respectively.

3. Data and Empirical Results

In this study we use the same variables as Bae and De Jong (2005), Ball (2011), Stock and Watson (1993) used in their papers, but we extended the variables up to year 2012. These variables are;

M1: Logarithmic form of the demand of real narrow money balances, equal to $\frac{M1^d}{P}$.

M2: Logarithmic form of the demand of real broad money balances, equal to $\frac{M2^d}{P}$.

y: Logarithmic form of the real gross national product, equal to GNP/d.

p: Logarithmic form of the price level (P), equal to GNP deflator.

r: Logarithmic form of the nominal interest rate, equal to average of twelve- months commercial paper rate.

All the data used ın this paper are delivered from the Central Bank of the Republic of Turkey (CBRT). Some basic descriptive statistics of the variables in logarithmic form which we employed in this study is presented in table 1, while the general trends of variables is shown in figure 1. Table 1 indicates that maximum volatility happens in narrow and broad money demand variables, and that the value between minimum and maximum is again valid for variable M1 equal to logarithm of real money balance.

Table 1. Descriptive statistics of the variables in logartimic form

	M1	***M2***	***y***	***P***	***r***
Observations	32	32	32	32	32
Mean	17.99646	19.53874	24.93311	3.518646	3.791020
Maximum	24.04672	25.41066	25.37596	4.926964	4.474948
Minimum	11.96622	13.16635	24.51147	1.665818	2.725890
Std. Dev.	4.221456	4.253382	0.274773	1.035389	0.566015

Source: CBRT electronic data service.

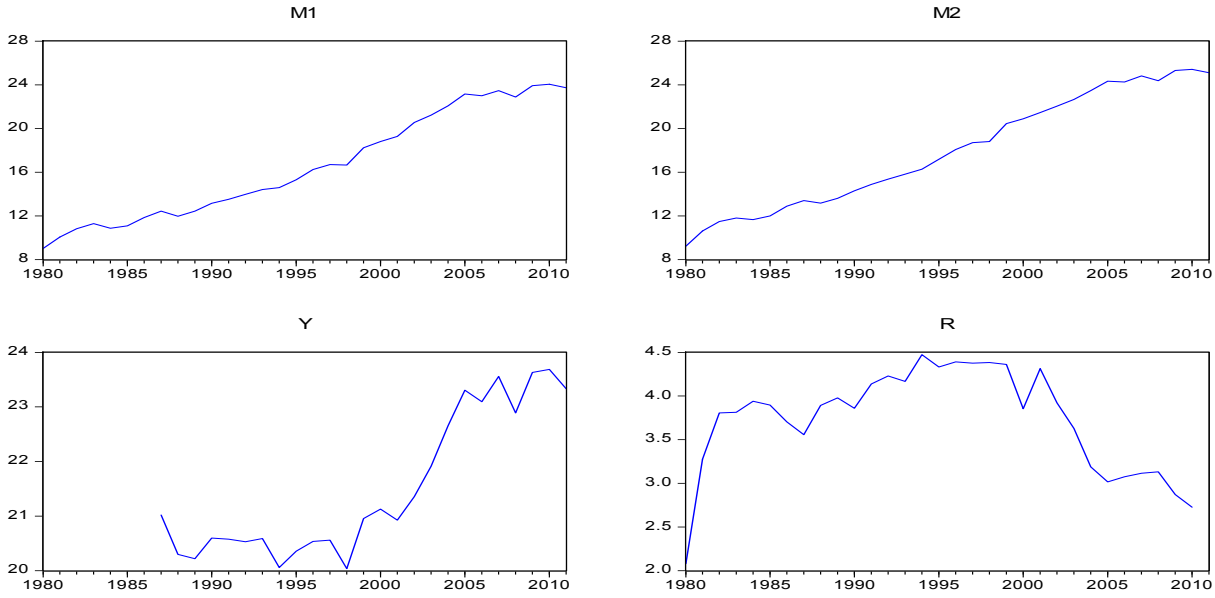

Figure 1. General trend of variables used in the study

Source: Author's drawings.

3.1 Unit Root Test Result

Before estimating equation (5) we will firstly investigate stationarity and level of integration of time series which we employ in the model. The integration degree of the series and the choice of appropriate cointegration method is important to make appropriate econometric analysis (Güloğlu and İvrendi, 2010: 9). Besides some potential problems of using non-stationary data we know that non-stationary time series also can cause spurious (non-sense) regression results, as noted by Granger and New bold (1974). For this purpose we conduct two unit root tests to the logarithmic variables of the model (5): Augmented Dickey fuller (ADF) test and Kwiatkowski-Phillips-Schmidt- Shin (KPSS) test (Kwiatkowski et al. 1992). The test results are presented in Table 2 and 3.The ADF and KPSS test results show that all the variables have unit root in their level values but become stationary in their first difference, i.e. they are integrated as I (1). Also this result can be seen from the figure 1 indicating that each variable has a non-stationary trend in level.

Table 2. ADF test results [a]

	Level			First Difference		
	τ(No intercept no trend)	τ_μ(Intercept)	τ_t (Intercept and Trend)	τ(No intercept no trend)	τ_μ(Intercept)	τ_t (Intercept and Trend
M1	4.51	-0.51	-2.42	-1.52	-5.65*	-5.54*
M2	-0.76	-2.72	-3.60**	-0.61	-5.61*	0.71
y	1.00	-0.29	-2.68	-5.34*	-5.76*	-5.61*
r	-0.00	-2.65	-1.62	-6.14*	-6.00*	-6.36*

[a] H_0: I(1) is tested against alternative hypothesis H_1: I(0). The order of the first difference terms is 3.

Notes: Lag lengths are selected automatically according to Akaike Info Criterion.

The critical values of test statistics ($\boldsymbol{\tau, \tau_\mu, \tau_t}$) are tabulated in Fuller (1976) and MacKinnon (1996).

* and ** show statistically significant at 1 % and 5 %respectively.

Table 3. KPSS unit roots test resultsa

	Level		First Difference	
	τ_μ(Intercept)	τ_t (Intercept and Trend)	τ_μ(Intercept)	τ_t (Intercept and Trend)
M1	0.74	0.21	0.11*	0.13**
M2	0.74	0.22	0.21*	0.13**
y	0.61**	0.75	0.27*	0.13*
r	0.21	0.19**	0.56*	0.8*

[a] H_0: I(0) is tested against alternative hypothesis H_1: I(1).

Notes: Critical values are taken from Kwiatkowski-Phillips-Schmidt-Shin (1992) Table 1. * and ** show statistically significant at 1% and 5% respectively.

Since all series are non-stationary, then there may be both short- run and long-run relationships between these variables. In order to examine the existence of a short-run relationship, we should check the relevant coefficients in the Vector Autoregressive (VAR) model. For this purpose we firstly apply a co-integration test to the data to check the existence of a long-run relationship between variables.

3.2 Co-integration Test Result

It is known that a linear combination of non-stationary time series could make a long run equilibrium point, namely they move cointegrated over the time. In this part we are using Johansen co-integration test to examine whether the variables are co-integrated with each other. If one or more linear combination of individually non-stationary series is stationary then these series may be co-integrated. This means that these series cannot move too far away from each other (Dickey, Jansen and Thorton, 1991:58). To apply Johansen test, we must determine lag length of unrestricted VAR model within five different lag selection criterions including likelihood Ratio (LR), Final Prediction Error Criterion (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ). The maximum lag number selected is 4. Lag order selection criteria results are shown in table 4. We also add three dummies (D94, D01 and D08) as exogenous variables to the VAR model to consider the unpredicted shock effects of three economic crises occurred in 1994, 2001 and 2008 respectively. The dummy variables D94, D01 and D08 are unity for year 1994, 2001 and 2008 and zero otherwise. According to table 4, most of the lag selection criterions suggest lag order as 2.

Table 4. Lag selection criteria results

Lag	LR	FPE	AIC	SC	HQ
0	0	NA	0.052289	5.562410	5.711770
1	1	116.7545*	8.85e-05*	-0.834748*	-0.237309*
2	2	9.563770	0.000113	-0.670423	0.375096
3	3	7.457716	0.000161	-0.516194	0.977404
4	4	2.098393	0.000463	0.084035	2.025713

* indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

We employ Johansen Test method to determine number of cointegrating vectors with two statistics: The trace and maximum eigenvalue statistics. The trace statistics tests the null hypothesis that the number of co-integrating vectors is less than or equal to r, where r is 0, 1 or 2 against general alternative, while the maximum eigenvalue statistics tests the null hypothesis that r=0, 1 or 2 against the alternative hypothesis indicating that r=1, 2, or 3. The critical values of the tests are tabulated from Johansen and Juselius (1990). Table 5 presents the results of Johansen Cointegration Test using the maximum eigenvalue and the trace tests. Both the maximum eigenvalue and trace tests results shown in table 4 suggest one co-integration relationship among three variables

Table 5. Tests results for co-integration rank

H_0	H_A	λ_i	λ_{max}	CV 95%	H_0	H_A	Trace	CV 95%
r=0	r=1	0.644078	21.69390	21.13162	r=0	r≥1	49.60239	29.79707
r≤1	r=2	0.504434	14.14317	14.26460	r≤1	r≥2	15.30849	15.49471
r≤2	r=3	0.465765	13.16532	3.841466	r≤2	r≥3	13.16532	3.841466

Critical values are tabulated from Table 1 of Osterwald and Lenum (1992). * shows significance level at 5%.

3.3 Estimation Results

We find that there is only one co-integrating vector between variables indicating that we can estimate long-run relationship between variables using vector error correction (VEC), DOLS and FMOLS techniques. For this purpose in this section, the long-run dynamics of money demand function of equation (5) is estimated by VEC, DOLS and FMOLS methods.

A VECM model with our variables and one lag is simply stated as follow:

$$d(m_t)=\theta_0+\beta_0*d(m_{t-1})+\beta_1*d(y_{t-1})+\beta_2*d(r_{t-1})+\beta_3*EC(-1)+\varepsilon_t \quad (6)$$

Where; m, r and y are at the first differenced variables, and m_t are equal to m_1 or m_2. $\theta_0$indicates constant coefficient and β_0, β_1 and β_2 shows short run causalities, while β_3 is the long run coefficient of the VEC model. *EC(-1)* is the one period lag residual of co-integrating vectors of the long run model given below:

$$m_t=\theta_0+\theta_1*r_t+\theta_2*y_t+\vartheta_t \quad (7)$$

Where *EC(-1)* indicates the adaptation rate to the long run equilibrium. It corrects disequilibrium and leads variables m, r and y of the system to converge to its long run equilibrium point. Hence, we expect that the sign of β_3 should be negative because the coefficient of β_3 shows what rate it corrects the previous period disequilibrium of the system.

VEC estimation result of the equation (6) with one lag is reported in Table 6. The coefficient of error correction term *EC(-1)* is -0.34 which is negative and significant as expected. It means that system corrects its previous period disequilibrium at a speed of approximately 34 percent yearly. In other saying, almost 34% of deviation from long run equilibrium is smoothed in one year. Moreover, this result provides evidence that income and nominal interest rate cause money demand in long run.

Table 6. Error correction model estimation result

Explanatory variables	VEC1: Dependent variable: m1		VEC2: Dependent variable: m2	
	Coefficient	Prob.	Coefficient	Prob.
$EC(-1)$	-0.345680*	0.0000	-0.081167*	0.0097
$d(m_{t-1})$	0.599926**	0.089	1.318553*	0.0027
$d(y_{t-1})$	0.873500*	0.059	1.733377*	0.0002
$d(r_{t-1})$	-0.992656*	0.0572	-1.033190*	0.0020
Constant	0.769424*	0.0000	-0.016065	0.9361
Co-integration equation: M1(-1) = 5.65*Y(-1) - 5.159*R(-1) + 122.02			Co-integration equation: M2(-1) = 6.46*Y(-1) -10.66*R(-1) - 159.61	

** indicates in order 10% and 5% significance level.

According to estimation result of co-integration equations (long-run relationship) under the table 6 there is a strong and significant long run relationship between *m, r* and *y*. It implies that a percentage increase in income is associated with a 5.65 percentage increase in M1 and 6.46 percentage increase in M2. Also, a percentage increase in nominal interest rate is associated with a 5.15 percentage decrease in M1 and 10.66 percentage decrease in M2. The signs of the short run coefficients are the same as in the long run except the constant term in VEC2 model. It is clearly seen that the short-run elasticities have values lower than the long run elasticities for both narrow and braod money demand models (VEC1 and VEC2 models).

Furthermore, The Stock-Watson's DOLS model is generally used in small samples and gives a robust result compared to alternative techniques. The presence of leads and lags for different variables eliminates the bias of simultaneity within a sample and DOLS estimates and provide better approach to normal distribution (Baba et al, 2013:23). DOLS model with dependent variable y_t and independent variable x_t is specified as below:

$$y_t=\varphi_0+\varphi x_t+\sum_{j=-m}^{n} d\Delta x_{t-j}+\varepsilon_t \tag{8}$$

Where n and m show *lag* and *lead* length, and φ indicates the long run effect of a change in x on y. The reason why lag and lead terms are included in DOLS model is that they have the role to make its stochastic error term independent of all past innovations in stochastic repressors (Baba et al, 2013:23). Equation (5) is specified in a DOLS framework as follows:

$$m_t=\theta_0+\theta_1 y_t+\theta_2 r_t+\sum_{k=-K_i}^{K_i}\omega_k\Delta y_t+\sum_{k=-K_i}^{K_i}\tau_k\Delta r_t+\varepsilon^*_t \tag{9}$$

Where $-K_i$ and K_i shows leads and lags. The optimal lag structure can be determined by using AIC (Akaike Information Criteria), SC (Schwarz Criteria) or using the values of $\sqrt{N}$ recommended by stock-Watson (1993) for DOLS approach, where N is number of observation. According to Stock-Watson's approach the optimal lag should be equal to $\sqrt{33}\cong 5.74$. Since we have limited observation, we prefer AIC and SC criteria to determine lag length. FMOLS and DOLS estimation result is presented in table 7 suggesting that in both FMOLS and OLS models which do not include trend model, the interest rate and real national product are negatively and positively related to narrow (M1) and broad (M2) money demand as the economic theory and many other empiric studies pre-supposed. In both models coefficients are significant at least at 5% percent error level. Estimation result of linear models contradicts with economic theory, so we take into consideration only estimation results of the models not including linear trend.

More specifically, the interpretation of coefficients estimated in table 7 is as follows: The DOLS (FMOLS) estimator shows that 1 percent increase in the nominal interest rates and real product, respectively decreases narrow money demand (M1) by 2.18 (2.38) and increases M1 by 1.24 (1.26) percent. However, when dependent variable is M2 then the DOLS (FMOLS) estimator indicates that 1 percent increase in the nominal interest rates and real product respectively decrease narrow money demand (M2) by 2.18 (2.38) and increases M2 by 1.24 (1.26) percent.

Table7. Co-integration estimation: DOLS and FMOLS estimation result based on econometric model

	Dependent Variable: M1				Dependent Variable M2			
	Trend: None		Trend: Linear		Trend: None		Trend: Linear	
Estimation Method	r	y	r	y	r	y	r	y
DOLS	-2.18**	1.24*	8.48*	6.33*	-1.71**	1.23*	10.85**	7.21**
FMOLS	-2.38*	1.26*	7.08*	5.70*	-1.96**	1.25*	8.60*	6.21*

Note: Leads and lags were set to 1 and 2 for DOLS estimators. **and * shows statistical significanceat 5 and 1 percent level.

Estimation results also suggest that the impact of interest rates on money demand is greater than that of the real product in Turkey. We conclude that the coefficients gained from long run estimation of money demand function by Johansen co-integration method is larger than coefficients estimated by FMOLS and DOLS techniques.

4. Conclusion

The main aim of this paper is to investigate the dynamic determinants of money demand function proposed by Bae and De Jon (2005) but based on Keynesian liquidity reference theory for Turkey covering the time period from 1980 to 2012. The long and short run coefficients of the money demand function is estimated by vector error correction, dynamic ordinary least squares (DOLS) and fully modified OLS (FMOLS) techniques.

The estimation result of the dynamic money demand function is consistent with the earlier empirical findings and suggests that there is a long-run relationship between money demand, real product and nominal interest rate as economic theory anticipates. But the long run-coefficients estimated from FMOLS and DOLS is smaller than that of the Johansen co-integration vectors. Nevertheless, real money demand in Turkey is positively related with real product and negatively related with nominal interest rates. Correction procedure is very high, and corrects nearly 34 percent of the biases from long run equilibrium in one year due to shocks in the short run.

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Note

Note 1. This study was presented in the 14th International Symposium on Econometrics Operation Research and Statistics in Bosnia Herzegovina, 24th May 2013.

International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Conditional Correlations between Stock Index, Investment Grade Yield, High Yield and Commodities (Gold and Oil) during Stable and Crisis Periods

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Received: June 7, 2013 Accepted: July 12, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p28 URL: http://dx.doi.org/10.5539/ijef.v5n9p28

Abstract

We analyzed the conditional correlation between the returns of five assets (S&P 500, investment grade bond, high-yield bond, crude oil and gold). The results obtained with the AGDCC model lead to several conclusions. The correlations between the assets retained are feeble during stable periods. In periods of financial crisis with sustained economic growth, adding gold, crude oil, high-yield bonds and investment-grade bonds in a portfolio can improve the benefit of this portfolio. However, investors should adjust their portfolio when concerns about the economic growth appear as crude oil is negatively correlated with the returns of the S&P 500 and the high-yield bond during crisis periods, but it is positively correlated with those assets' returns when the crisis is coupled with economic recession. Regarding the high yield bond, it losses less value than stock index during bear market and it appreciates as much as stock index during bull market. As for the gold, it is a strong safe haven during periods characterized by fears of recession, concerns regarding the credit markets, target rate cuts, as well as uncertainties regarding inflation rate. Thus, gold was not a safe haven during the Asian and the Russian crises, whereas it was a weak safe haven during the dot-com crisis and a strong safe haven during the subprime crisis. During these crises, due to the "flight-to-quality" gold value appreciated strongly compared to the other assets retained. Furthermore, with the aggravation of the economic and financial situation the negative impacts of the subprime crisis have spread from stock market and high-yield bonds to other financial markets (contagion), except to the gold market.

Keywords: conditional correlation, DCC Model, financial crisis, stock index, high-yield bond, investment-grade bond, crude oil, gold

1. Introduction

The benefits of portfolio diversification depend strongly on the correlation between the returns on the assets composing the portfolio. Lesser are correlated assets composing a portfolio, more effective is the risk reduction of loss of this portfolio and then better is the benefit of diversification. Correlations change over time in response to their fundamentals, and are mainly related to economic/monetary and financial integration as well as the economic and financial situation (Erb et al., 1994; Longin and Solnik, 1995; Goetzmann et al., 2005). Investors need constantly to determine the correlations across asset classes and readjust their portfolios in order to improve the trade-off between risk and returns, mainly during financial crises when the risk reduction of loss and the improvement of benefits of diversification are needed most.

The analysis of the benefit of a portfolio diversification is then based on the examination of the correlations across different assets' returns composing a portfolio. In the empirical literature, authors have mainly considered the interdependence between two asset classes, and particularly between government bonds and stock indices (Note 1). Few authors have been attracted by the correlation between stock index (or equities) and crude oil (Jones and Kaul, 1996; Faff and Brailsford, 1999; Sadorsky, 1999) or by the correlation between stock index (or equities) and gold (Jaffe, 1989; Johnson and Soenen, 1997; Davidson et al., 2003). In order to complete the existing studies,

we examine in this paper the correlation across five US assets; which are the high yield bond, the investment grade bond, the S&P 500, crude oil and gold. Compared to several authors who considered government bonds in

their studies only few authors, such Briere et al., (2008), Reilly et al., (2009), have retained high-yield bonds and investment-grade bonds. As we will see in this article adding these both bonds in a portfolio can improve the benefit of a portfolio.

High-yield bonds (HY bond), called junk bonds with credit ratings below BBB (S&P) or Baa3 (Moody's), are a combination of equity and riskless bonds. Empirically it is shown that correlation coefficients consistently show that straight HY bonds trade very much like stocks as pure debt instruments (Bookstaber and Jacob, 1986; Blume and Keim, 1991; Cornell and Green, 1991; Ramaswami, 1991; SEI Capital Markets Research, 1994; Shane, 1994). However, the correlation between HY bonds and equities (stock indices) tend to rise sharply when equities are characterized by negative returns due to the fact that much of the return of HY bonds is a result of default risk associated with equities. Nevertheless, the returns of HY bonds might decrease less than those of equities (or stock index) as HY bonds offer lower overall risk than equities/stock since bondholders are paid ahead of shareholders in case of bankruptcy. Furthermore, the "riskadjusted" returns of portfolios of HY bonds might be high compared to equities/stocks. Thus, the credit risk of these bonds is more compensated for by their higher yields. In sum, adding HY bonds in a portfolio might reduce losses in periods of crisis.

Compared to HY bonds, investment-grade bonds (IG) are less risky since their risks are more related to the interest rate risk like government bonds than to default risk like equities or HY bonds. Thus, IG bonds tend to evolve in the same direction than government bonds and then their correlations with other assets should present similar pattern than the correlations between government bonds and other assets. In general, the correlation between high-quality fixed income (government bond, investment grade bond) and equity is very feeble in normal times, while during equity market crashes stocks and high-quality tend to decouple due to the "flight-to-quality" from risky assets, such equities/stocks and HY, to less risky assets, such government bonds and IG bonds (Gulko, 2002; Stivers and Sun, 2002, Connolly et al., 2005; Cappiello et al., 2006; Andersson et al., 2008; Briere et al., 2008; Baele et al., 2010; Aslanidis and Christiansen, 2010). For instance, since the outbreak of the subprime crisis one could observe that IG bonds have risen when stock markets have rise and those bonds have been down slightly when stocks have decreased; which is important from a portfolio diversification perspective. Moreover, IG bonds have generally outperformed HG bonds and equities/stocks in periods of economic recession and underperformed HG bonds in periods of economic recovery (Weiner, 2005). In a typical recessionary cycle, the Central Bank reduces its target rates in order to stimulate the economy, the high-quality bond prices rise as a result of this reduction; therefore, IG bonds generate relatively strong returns during a recession. By contrast, as HY bonds are more correlated to equities, they have similar sensitivities to corporate earnings. As a result, HY bonds typically underperform IG bonds during an economic contraction. However, after recessionary periods, HY bonds have the potential for strong price appreciation as the economy begins to recover and corporate earnings improve. Thus, during episodes of great uncertainty in the economic and financial situations, IG bonds can be a weak safe haven and then reduce the losses and improve the benefits of a portfolio containing such bonds.

Regarding the correlation between equity returns (respectively bond yields) and commodity returns, authors have mainly considered the crude oil price as a commodity. Several authors have examined the long-run relation between crude oil and stock indices (Huang et al., 1996; Jones and Kaul, 1996; Ciner, 2001; Sadorsky, 1999, 2003; Nandha and Faff, 2007; Kilian and Park, 2009) and between crude oil and macroeconomic variables, such as gross domestic product, unemployment rate, inflation rate (Hamilton, 1983; Gisser and Goodwin, 1986; Mork, 1989; Lee et al., 1995; Daniel, 1997; Cunadua and Gracia, 2005). Most of these studies have shown that higher crude oil price influences negatively stock indices. Indeed, more expensive crude oil translates into higher transportation, production, and heating costs, which can have negative impact on corporate earnings. Furthermore, a higher fuel prices can also stir up concerns about inflation and impacts negatively consumers' spending. However, rising crude oil price can also be associated with a booming economy. Indeed, higher fuel prices could reflect stronger business performance and then a higher demand for fuel. Thus, the correlation between crude oil and stock market is not defined clearly (Pescatori and Mowry, 2008). Nevertheless, during economic recession periods this correlation might be positive as during these episodes crude oil price and stock indices should likely decline. During these periods one would probably observe a reallocation of funds towards assets such government bonds and IG bonds as they outperform crude oil, HY bonds and stock indices. This "flight-to-quality" is characterized by negative correlations between safer assets and risky assets.

The second commodity is gold. This commodity has attracted great attention from both academic and practical perspectives, mainly since the outbreak of the subprime crisis, as its price kept rising to record levels since 2007. This commodity price evolved differently during the subprime crisis compared to its behavior during financial crises occurred in the past. Furthermore, gold can be set apart from other commodities. Indeed, gold prices are

not correlated to exogenous variables (such as GDP, inflation and interest rates) that are subject to the business cycle, whereas returns on mainstream financial assets (stock returns and bond yield) and other commodity prices (such as aluminium, oil and zinc) are correlated to those exogenous variables (Lawrence, 2003). Moreover, returns on gold are not (or are slightly) correlated with returns on equity, corporate bonds (HY and IG bonds) and Treasury bonds than are returns on other commodities (Smith, 2002). Finally, gold is highly liquid, fungible and easily stored. For these reasons, gold plays an important role as a store of value or a good hedge, especially in times of political, economic and financial uncertainty. Thus, benefits of diversified portfolios with gold are higher than without gold (Jaffe, 1989; Chua et al., 1990; Johnson and Soenen, 1997; Davidson et al., 2003). However, according to Baur and Lucey (2010), gold was a hedge against stocks and a safe haven in extreme stock market conditions, but for only very short periods.

As the interdependence of financial markets is a serious concern for investors looking to diversify their portfolio, especially during financial crises, the purpose of this article is then to analyze the conditional correlations across different assets during calm and financial crises periods. The examined assets are the S&P 500, the high-yield bond, the investment-grade bond, the crude oil and the gold. We examine the conditional correlations between the S&P 500 return and the commodities returns on the period from 2 January 1997 to 31 August 2011. As we could not get data for the HY and the IG bonds in the period prior to 1 October 2005, the correlations across the five retained assets is analyzed on the period from 1 October 2005 to 31 August 2011. We do the former analysis in order to check whether the correlations between the commodity prices and the S&P 500 evolve in the same way during the different crises that occurred between 1997 and 2011 (the Asian crisis, the Russian crisis, the dot-com burst and the subprime crisis). Thus, we can check whether gold has been a safe haven during all these crises or only during some crises as shown by Coudert and Raymond-Feingold (2011).

Correlations are not observable and must be estimated. Multivariate GARCH (MGARCH) models are developed to study the dynamic correlations between financial time-series. However, general MGARCH models typically suffer the curse of the dimensionality problem in estimation as the number of time-series increases. In order to alleviate this latter problem, Engle (2002) proposes the Dynamic Conditional Correlation (DCC) mode. Cappiello et al., (2006) generalized the DCC model by taking into account the possibility of having asymmetric impacts of positive and negative innovations on the dynamics of the conditional correlations, which is called the asymmetric generalized DCC model (AG-DCC). The DCC model type enables us to detect possible changes in conditional correlations over time, which allows us to detect dynamic investor behaviour in response to news and innovations as well as their behaviour during calm and crisis periods in financial markets. Since their introduction, such models have been used in order to determine the correlation between assets' returns and then to optimize portfolio selection as well as to analyze the spillover/contagion effects and the "flight-to-quality" during financial crises (Corsetti et al., 2005; Boyer et al., 2006; Chiang et al., 2007). Indeed, according to Forbes and Rigobon (2002), there is a financial contagion from one country to another country when there is a significant increase in correlation after a shock to one country. Similarly, there is a financial contagion from one market to another one within a country when there is a significant rise in correlation after a shock to one market. By contrast, in case of "flight-to-quality" the conditional correlation between two asset classes decreases since the prices of those assets evolve in opposite directions (Briere et al., 2008; Baur and Lucey, 2010). In this study, we then investigate the dynamic conditional correlations between the selected assets through the DCC model types in order to examine their interdependence in normal time as well as to analyze the contagion and "flight-to-quality" effects across these assets during financial crisis.

This article is organized as follows. Data used in this article are presented and described statistically in section 2. The methodological design of our econometric analysis is set out in section 3. Section 4 presents the results obtained. Finally, we conclude in section 5.

2. Data

The aim of this article is to analyze the conditional correlations across five US assets' returns; these assets are the investment grade bond, the high-yield bond, the S&P 500, crude oil and gold. The S&P 500 index, the crude oil price and the gold price are extracted from Datastream and the investment grade bond price and the high yield bond price are retrieved from FINRA-Bloomberg. The S&P index level and both the commodity prices are daily and range from January 2 1997 to 31 August 2011, a period covering several financial crises (the Asian crisis, the Russian crisis, the dot-com burst and the subprime crisis) as well as expansionary and recessionary periods. As for the HY bond and IG bond prices, they are also daily and range from 1 October 2005 to 31 August 2011. We could not get data for these latter prices in the period prior to 1 October 2005. In this article, we first evaluate and analyze the conditional correlations between these five assets' returns in the period from 1 October 2005 to 31 August 2011. In a second step, the conditional correlations between the S&P 500 index and both the

commodities are considered. We do this latter analysis in order to check whether the correlation between the commodity prices and the S&P 500 evolves in the same way during the different crises that occurred between 1997 and 2011. It could be more efficient if we could do this analysis by taking into account also the HY and IG bond prices. However, as we outlined earlier, we could not get data on the period prior to October 2005.

The returns of these five assets are calculated as follows: rt = 100.ln(pt/pt−1), where pt is the price level on date t. Table 1 presents the descriptive statistics of these returns. According to the results of the ADF test and the Zivot & Andrew (1992) test, we can reject the null hypothesis of unit root for the first difference of the logarithm on any of these assets' prices/level. The results obtained with Box-Pierce, Ljung-Box and LM statistics reveal that the first difference of the logarithm of all these assets demonstrates significant serial correlation. Furthermore, the distribution of all assets' returns is asymmetric and has fat tails. Indeed, for all of them their skewness is significantly different from 0 and their kurtosis is different from 3. All the returns have negative skewness, implying that the left tail of the distribution is fatter than the right tail. This finding reveals that the distribution of the retained first difference of the logarithm of the assets' prices level is non-normal and asymmetric.

3. Dynamic Conditional Correlation Model

Let $r_t = [r_{1t}, r_{2t}, ..., r_{Nt}]$ denote an N_{x1} vector of N asset returns at time t, assumed to be conditionally normal.

$$E(r_t/I_{t-1}) = 0 \quad (1)$$

$$E(r_t r'_t/I_{t-1}) = H_t \quad (2)$$

Where H_t is an N_xN matrix with time varying conditional covariance and I_{t-1} is the information set at time $t-1$. As any covariance matrix is positive definite by definition, H_t can be decomposed as $H_t = D_tR_tD_t$, where D_t is an N_xN diagonal matrix with the square root of the conditional variances on the diagonal i.e. (D_t = *diag*($\sqrt{h1t}$, ..., $\sqrt{hnt}$). R_t is the N_xN time varying correlation matrix. Engle (2002) and Engle and Sheppard (2001) proposed to model the dynamic of this conditional correlation with the model named DCC (Dynamic Conditional Correlation model), which is presented in what follow (Note 2).

Table 1. Descriptive statistics(2005–2011)

	IG price	HY price	SP500	GOLD	OIL
Mean	0,000	-0,005	-0,001	0,091	0,020
Max.	4069	6806	10424	6841	16414
Min.	-2735	-9556	-13259	-7852	-12827
Mediane	0,002	0,020	0,073	0,076	0,069
stand error	0,262	0,670	1532	1377	2651
LB					
1	210.04**	519.19**	48.53**	11.45	104.4
10	246.28**	1075.84**	1091.02**	293.28	897.11
BP					
1	209.48**	517.79**	48.4**	11.41	104.12
10	245.56**	1071.43**	1084.31**	291.64	892.24
LM					
1	209.48**	517.81**	48.42**	11.42	104.12
10	222.84**	594.05**	396.31**	157.12	296.79
Zivot and Andrews					
model A	-24.5**	-14.26**	-31.06**	-27.16**	-20.69**
model B	-23.64**	-13.17**	-30.51**	-27.09**	-20.33**
model C	-24.5**	-14.26**	-31.05**	-27.16**	-20.68**
ADF					
model 0	-23.61**	-19.27**	-30.47**	-26.91**	-27.85**
model 1	-0.24**	-0.12**	-0.02**	2.51**	0.31**
model 2	-0.75**	-0.54**	-0.01**	0.24**	-0.02**
PP					
NT-t-stat	-32262	-28223	-45809	-38252	-38520
rho	0,174	0,300	-0,174	0,005	-0,002
WT-t-stat	-32266	-28219	-45793	-38241	-38507
rho	0,173	0,300	-0,174	0,005	-0,002

** and * indicate that the corresponding coefficient is statistically significant at the 5% and 10% level, respectively.

NT: No Trend and WT: With Trend.

$$R_t = [\rho_{ij,t}] = Q_t^{*,-1} \; Q_t \; Q_t^{*,-1} \tag{3}$$

With $Q_t = Q(1- a- b) + a\varepsilon_{t-1}\varepsilon'_{t-1} + bQ_{t-1}$.

Where a and b are scalar parameters. ε_t corresponds to a N_x1 vector with standardized residuals (ε_t = rit/ $\sqrt{\text{hijt}}$) and Q_t and Q are the covariance matrix of the standardized residuals and the unconditional covariance matrix of those standardized residuals, respectively. In this DCC model, it is assumed that positive and negative shocks have symmetric effects on the conditional correlations as well as all correlations are driven by the same dynamic pattern (a and b) which is hard to justify as the number of time series grows. In order to cope with this later limitation, a generalized form of the DCC model was proposed by Franses and Hafner (2003) with series specific parameters (G-DCC); a1, a2,...,aN and b1, b2,...,bN instead of a and b. Regarding the asymmetric effect of positive and negative shocks, Cappiello et al., (2006) proposed a scalar asymmetric DCC (ADCC) model as well as an asymmetric generalized DCC model (AGDCC), that allows conditional correlations to increase more when both returns are falling. In the AGDCC model, the covariance matrix of the standardized residuals (Q) can be expressed as follow (Note 3):$\overline{Q}$

$$Q_t = (\overline{Q} - A'\overline{Q}A - B'\overline{Q}B - G'\overline{N}G) + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'Q_{t-1}B + G'n_{t-1}n'_{t-1}G \tag{4}$$

Where A, B and G are *NxN* parameters matrices; these matrices contain series specific parameters (a_{ij} , ..., b_{ij} , ..., g_{ij} ...). $n_{t-1} = I[\boldsymbol{\varepsilon_t} < 0]$ $\boldsymbol{\varepsilon_t}$ and I[.] is a $Nx1$ dummy variable that takes the value one if $\boldsymbol{\varepsilon_t} < 0$. $\overline{\boldsymbol{N}}$ represents the unconditional covariance matrix of the negative standardized residuals and nt the conditional covariance matrix of negative standardized residuals.

When G = 0, the AG-DCC is reduced to the generalized DCC model (G-DCC). In the ADCC model the matrix A, B and G are supposed to be scalar: a, b and g. The latter parameter g is equal to 0 in the DCC model. In the AG-DCC model, a sufficient condition for Qt to be positive definite for all possible realizations is that the intercept, $\overline{Q} - A'\overline{Q}A - B'\overline{Q}B - G'\overline{Q}G$, is semi-definite and the initial covariance matrix Q0 is positive definite (Note 4).

4. Empirical Results

The estimation of the conditional correlations across assets' returns with the DCC model types necessitates first the choice for each series the model which best formalizes their dynamics, and then the evaluation, in the second step, of the conditional correlations by taking into account the results obtained in the first step. The results obtained for the models used in the first step as well as the results of the models considered in the second step are presented and discussed in what follows. After these discussions, the results regarding the conditional correlations are described.

4.1 Choice of the Models

4.1.1 Choice of the Univariate Volatility Model

As recommended by Cappiello et al., (2006), it is important to select first the model which best fits each series. As the most interesting aspect of asset returns variations is that these variations tend to cluster, GARCH-type models enable us to formalize this feature of those variations perfectly (Note 5). Moreover, GARCH type models have been used by several authors to determine the standardized residuals, which are used to evaluate the conditional correlation with DCC type models (Engle, 2001; Engle and Sheppard, 2002; Franses and Hafner, 2003; Cappiello et al., 2006). We evaluate the dynamic of each series with the following models: 1) GARCH model proposed by Bollerslev (1986), 2) Exponential GARCH model (EGARCH) proposed by Nelson (1991), and 3) Asymmetric GARCH model (GJR), proposed by Glosten et al., (1993). The specifications of these models are described in what follows: $\boldsymbol{\varepsilon}^2_{\boldsymbol{t}\text{-}1}$

$$h_t = \omega + \alpha\boldsymbol{\varepsilon}^2_{\boldsymbol{t}\text{-}1} + \beta h_{t-1} \tag{5}$$

$$h_t = \omega + \alpha\boldsymbol{\varepsilon}^2_{\boldsymbol{t}\text{-}1} + \lambda\boldsymbol{\varepsilon}^2_{\boldsymbol{t}\text{-}1}(I[\boldsymbol{\varepsilon}_{t-1} > 0]) + \beta h_{t-1} \tag{6}$$

$$ln(h_{t-1}) = \omega + \alpha\boldsymbol{\varepsilon}_{t-1} + \lambda(|\boldsymbol{\varepsilon}_{t-1}| - E(|\boldsymbol{\varepsilon}_{t-1}|)) + \beta ln(h_{t-1}) \tag{7}$$

Compared to the classical GARCH model (eq. 5), the EGARCH and GJR models take into account the sign of the shocks on the conditional volatility. In the EGARCH model (eq. 7), negative shocks have an impact ($\alpha-\lambda$) on the log of the conditional variance, whereas the effect of positive shocks is ($\alpha+\lambda$). In the GJR model (eq. 6), I[.] is an indicator function. In this model, negative shocks have an impact (α) on the conditional variance, whereas

the effect of positive shocks is (α + λ). Furthermore, in the EGARCH model, any conditions need to be put in order to guarantee the non-negativeness of the conditional variance. In the GARCH model, however, the conditions w > 0; α > 0andβ ≥ 0 should be held in order to guarantee this nonnegativeness. Similarly, in the GJR model, the following conditions are required: w > 0, (α + λ)/2 ≥ 0 and β > 0.

In order to select the specification that best fits for each series, we use the Bayesian Information Criterion (BIC). According to the BIC (Appendix I), the models selected for the S&P 500, the HY bond and crude oil include significant asymmetry in the sense that positive and negative shocks do not have the same effect on the conditional volatility of these assets. The EGARCH model fits well for the crude oil price and the GJR model for the HY bond and the S&P index. Regarding the IG bond return and the gold return, their volatilities are better modelled with a GARCH model, without asymmetry. As expected, our results suggest that the negative shocks tend to increase the conditional variance of the S&P 500 index return, the HY bond return and the crude oil return more than the positive shocks (Table 2). For instance, in the case of the S&P 500 index, the impact of a negative shocks is 0.16 (α), whereas the impact of a positive shock is 0.024 (= α + λ) (Table 2).

We also estimate the dynamics of the S&P 500 index, the gold and the crude oil with the three GARCH model types retained on the period from 2 January 1997 to 31 August 2011. In line with the results relative to the period from 2 October 2005 to 31 August 2011 described in the previous paragraph, Table A.1 in the Appendix reveals also that asymmetric GARCH model fits best for the dynamic of the S&P 500 and the crude oil. By contrast to the earlier results, the model selected for the gold return include also significant asymmetric.

4.1.2 Choice of the Dynamic Conditional Correlation Model

The dynamics of the correlation are formalized with four different specifications; 1) the classical DCC model, 2) the generalized DCC (GDCC) model, 3) the asymmetric DCC model (ADCC) and 4) the asymmetric generalized DCC model (AG-DCC), which are presented in section 3. Table 3 shows that all the estimated parameters of the DCC, GDCC, ADCC and AG-DCC models are significantly different from zero. According to the likelihood ratio test, the AG-DCC model fits better for the conditional correlation of our five series over the period from 2 October 2005 to 31 August 2011. Similar findings are obtained for the conditional correlations between the returns of the S&P 500 and the both commodities (gold and crude oil) over the period from 2 January 1997 to 31 August 2011. All the estimated parameters of the four DCC model types are significantly different from zero (Table 3), and the AG-DCC is the selected model.

Table 2. Univariate GARCH/EGARCH/GJR models (2005-2011)

	IG	HY	S&P 500	GOLD	OIL
ω	0.0021**	0.0027**	0.0204**	0.0156**	-0.087**
	(-5.79)	(-4.45)	(-4.28)	(-2.43)	(−7.10)
α	0.1358**	0.3387**	0.1663**	0.0576**	0.1435**
	(-15.46)	(-7.66)	(-7.26)	(-6.78)	(-8.4)
β	0.8161**	0.7448**	0.9127**	0.9356**	0.9842**
	(48.88)	(27.93)	(70.6)	(95.24)	(229.62)
λ		-0.1466**	-0.199**		-0.072**
		(-4.47)	(-7.18)		(-5.59)
Positif chocs effect		0.1921	-0.0236		0.0712
Negative chocs effect		0.3387	0.1663		0.2157

** and * indicate that the corresponding coefficient is statistically significant at the 5% and 10% level, respectively.

The dynamic conditional correlations, deduced from the AG-DCC model estimation, between the assets examined here are plotted in Figures 1-6. We first present and discuss the general trend of these conditional correlations in the next subsection. The behaviour of these conditional correlations during the subprime crisis and the other crises occurred since 1997 are presented and analyzed latter.

4.2 General Trend of the Conditional Correlations

Figure 2 reveals that the conditional correlation between the HY bond return and the S&P 500 return is similar to the correlation between the HY bond return and the IG bond return, except during financial crisis or during great uncertainty periods in financial markets. This finding is in line with the results obtained by Blume and Klein (1991), but it deviates from the results obtained by some authors such as Altman (1992), Fridson (1994) and Shane (1994), who showed that although the return of the HY bonds was correlated with those of the IG bonds

and Treasury bonds, the HY bond returns had a significantly stronger relationship to the returns on stocks. However, the conditional correlation between the returns of the HY bond and the S&P 500 is stronger on average than the correlation between the returns of the HY bond and the IG bond for the whole period examined, including stable and unstable periods (10/2005-08/2011). Indeed, the means of these correlation are 0.31 (HY/S&P 500) and 0.23 (HY/IG) for the whole period. In sum, if we do not distinguish between stable and unstable periods and then the average conditional correlation on the whole period of this study, our results are in agreement with the findings of Altman (1992), Fridson (1994) and Shane (1994). Another reason which could explain our finding is based on the credit rating of HY bonds. The difference between the credit rating of the HY bonds studied by these latter authors and the HY considered in this article can also explain our different findings during stable periods. Indeed, studies that examined the correlations of HY bonds with other assets found significant differences in the correlations among the three different credit rating classes of HY bonds. Specifically, the returns on Ba-rated (Moody's) or BB (S&P and Fitch) bonds are highly sensitive to changes in Treasury yields, while the returns on B (Moody's, S&P and Fitch) and Caarated (Moody's) or CCC (S&P and Fitch) bonds are less affected by Treasury interest rate changes, but highly correlated with the returns on common stocks (Reilly et al., 2009) (Note 6). In sum, the higher is the credit rating of a bond, the lesser is the correlation between this bond return and the stock return. Our results illustrate this fact and Figures 1 and 2 reveal that the average correlation between the IG bond return and the S&P 500 return is - 0.056 in a stable period (4/10/2005-31/12/2005), whereas the average correlation between the returns of the HY bond and the S&P 500 is 0.261. Indeed, the IG bond is higher quality and less risky than the HY corporate bond and is closer to the government bond than to the stock index.

Table 3. DCC, ADCC, GDCC and AGDCC models

	a2	b2	a2	b2	g2
10/2005-08/2011					
IG	0.0053**	0.9619**	0.0027**	0.9511**	0.0145**
	(-3.24)	(-73.52)	(-2.48)	(-84.83)	(-2.67)
HY	0.0087**	0.981**	0.0021**	0.9937**	0.0156**
	(-4.85)	(-120.26)	(-3.18)	(-765.36)	(-5.77)
SP	0.0188**	0.967**	0.0142**	0.9621**	0.0105**
	(-5.73)	(-164.48)	(-6)	(-194.71)	(-3.44)
GOLD	0.0062**	0.992**	0.0094**	0.9928**	0.0085**
	(-4.56)	(-206.75)	(-5.4)	(-303.79)	(-3.13)
OIL	0.0645**	0.9288**	0.0493**	0.09449**	0.0156**
	(−5.85)	(−99.76)	(−7.19)	(−167.36)	(−3.30)
Scalar Model	0.0151**	0.9680**	0.0133**	0.9682**	0.0052**
	(−21.43)	(−425.63)	(−13.64)	(−418.6)	(−3.22)
01/1997-08/2011					
SP	0.009**	0.984**	0.010**	0.951**	0.069**
	(−8.18)	(-274.37)	(-4.6)	(-164.19)	(-6.67)
GOLD	0.004**	0.989**	0.013**	0.955**	0.004**
	(−4.91)	(-238.63)	(-3.84)	(-93.52)	(−2.17)
OIL	0.087**	0.936**	0.030**	0.979**	0.009**
	(−10.00)	(-147.96)	(-5.97)	(-213.73)	(-5.35)
Scalar Model	0.017**	0.976**	0.015**	0.977**	0.003**
	(−18.86)	(-694.43)	(-13.1)	(-710.81)	(-2.18)

** and * indicate that the corresponding coefficient is statistically significant at the 5% and 10% level, respectively.

In line with the findings of several authors, our results suggest that the conditional correlation between the returns of the S&P 500 and the crude oil is negative, except during periods marketed by uncertainty in the financial markets and concerns about economic growth (Figure 4). Thus, higher crude oil price impacts negatively the corporate earnings through its effect on the transportation, production, and heating costs. Due to the fact that the risk associated with the HY bond is mainly related to the stock market, the prices of these bonds depend strongly on the condition of the stock market. This fact can explain our result (Figure 4) revealing that the conditional correlations between the HY bond return and the crude oil return present a similar pattern to the correlations between the S&P 500 return and the crude oil return until the summer 2008.

In the same line, the conditional correlation between the IG bond return and the crude oil return was most of the time negative and remained in the range [0;−0.1], except for some very short periods (Figure 4). This finding, which is in line with our expectation, can be explained by the fact that the IG bonds are high-quality assets like Treasury bonds and their risk depends mainly on the interest rate risk as Treasury bonds. If crude oil prices rally strongly, that is a negative for the Treasury bond prices as well as for the IG bonds, due to notions that inflationary pressures could reignite and become problematic for the economy and then cause an increase of the interest rates, which would negatively affect the prices of the T-bonds and IG bonds. By contrast, when the oil price is in a downtrend the prices of IG bonds and government bonds should increase as the decline of the oil price influence negatively the future inflation rate. This latter situation can also occurred during economic recession episodes as we described in the introduction. In sum, in a portfolio containing the S&P 500 index (or another stock index) and/or HY bonds and/or crude oil, the introduction of IG bonds in this portfolio can be efficient as these IG bonds are not or slightly correlated with the former assets and commodity.

As expected, the return of the gold was feebly correlated with the returns of the S&P 500, the HY bond and the IG bond, except during some financial crises (Figure 3). This finding can be explained by the fact that gold does not depend on exogenous variables like the latter assets (Lawrence, 2003). Furthermore, the conditional correlations between the gold return and the S&P 500 return evolved closely to the correlation between the return of the HY bond and the gold. Regarding the correlation between the returns of the IG bond and gold, it presented similar pattern than the correlations SP500/gold and HY/gold during stable periods, but not during crisis period (Figure 3). Regarding the relation with crude oil, the conditional correlation between the gold return and the crude oil return was relatively low and oscillated around 0.10 until the end of 2004 (see Figure 6). Thereafter, this correlation has been on an upward trend.

In sum, the retained assets are feebly correlated in stable periods. Thus, a portfolio containing these assets could be efficient in stable periods. It is important now to determine how the conditional correlations amongst the examined assets' returns move during financial crises. In the next subsection, we will present and discuss our results about these correlations during the subprime crises and compare our findings with the results obtained during the other past crises.

4.3 During the Subprime Crises

With the aggravation of the economic and financial situation the negative impacts of the subprime crisis have spread from stock market and HY bonds to other financial markets, such IG bonds and crude oil, within the USA as well as to foreign markets (financial crisis contagion). Furthermore, the "flight-to-quality" from risky assets to riskless assets has accentuated when this crisis has deepened. The contagion of this crisis and the "flight-to-quality" are detailed in what follow.

In summer 2007, the world economy entered into a significant global adjustment caused by the outbreak of the subprime crisis. Investors started to realize the seriousness of this crisis only in October 2007 when some financial institutions started to reveal enormous losses and the US government proposed a "super fund" of $100 billion to purchase mortgage-backed assets whose market value plunged strongly. Furthermore, the Fed's chairman, Ben Bernanke, and the Treasury Secretary, Hank Paulson, expressed alarm about the dangers that resulted from the bursting housing bubble. Investors then started to reallocate their funds towards less risky assets such as Treasury bonds, IG bonds and gold, which explains the increase of the IG bond price, the decline of the stock index level and the HY bond price after a period of hesitation (July-October 2007). These observations can explain our results, suggesting a decrease of the conditional correlation between the IG bond return and the S&P 500 return (respectively the HY bond return) and a oscillation of the correlation between the S&P 500 return and the HY bond return around 0.38 in the period from October 2007 to January 2008 (Figures 1 and 2). This finding is in agreement with the results obtained by several authors such as Gulko (2002), Connolly et al., (2005), Andersson et al., (2008) and Aslanidis and Christiansen (2010), who found that the correlation between government bond returns (riskless assets) and stock index returns (risky asset) decreased sharply during a crisis period. These findings illustrated the "flight-to-quality".

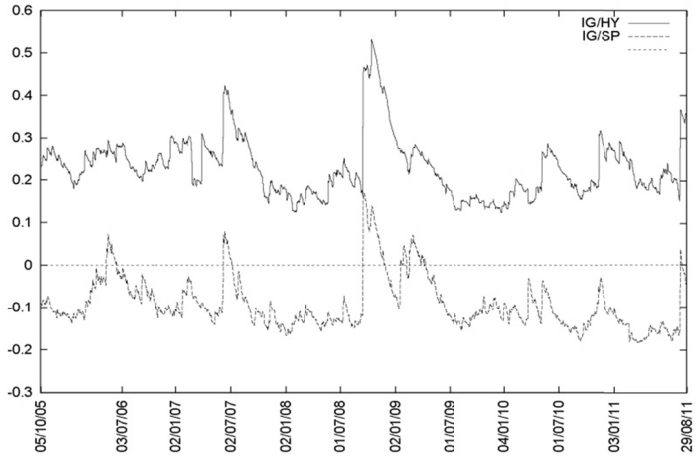

Figure 1. Conditional correlations between IG/HY and IG/SP500

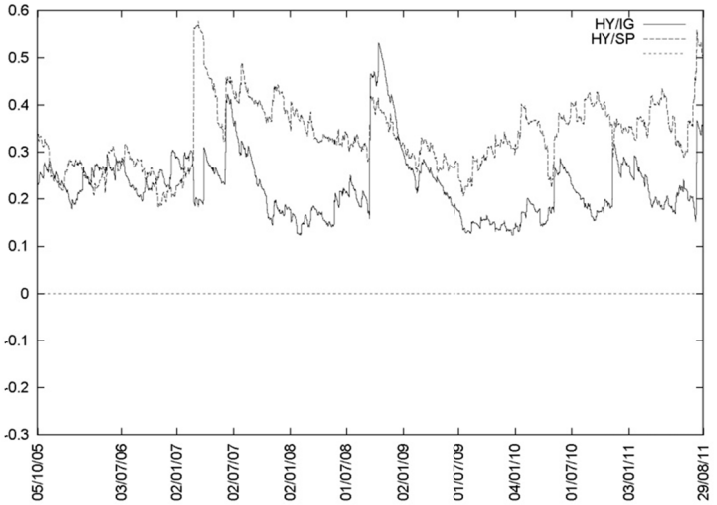

Figure 2. Conditional correlations between HY/IG; HY/SP500

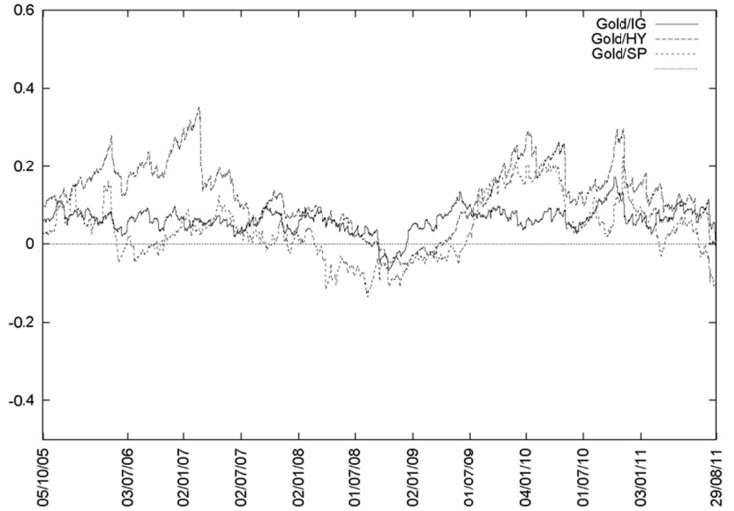

Figure 3. Conditional correlations between Gold/IG; Gold/HY and Gold/SP500

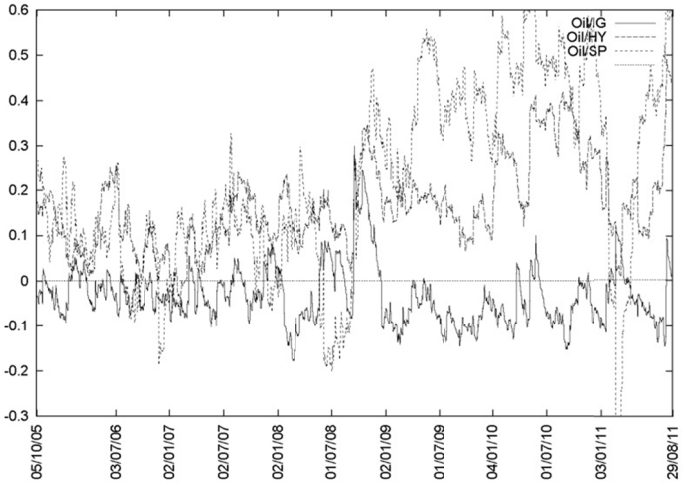

Figure 4. Conditional correlations between Oil/IG; Oil/HY and Oil/SP500

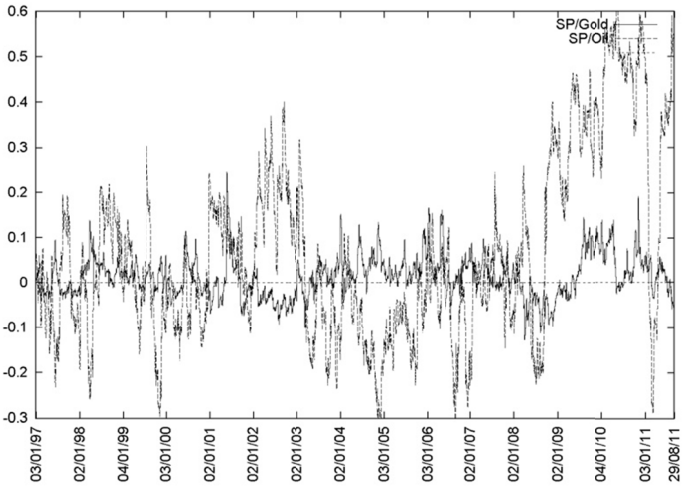

Figure 5. Conditional correlations between SP500/Gold and SP500/Oil

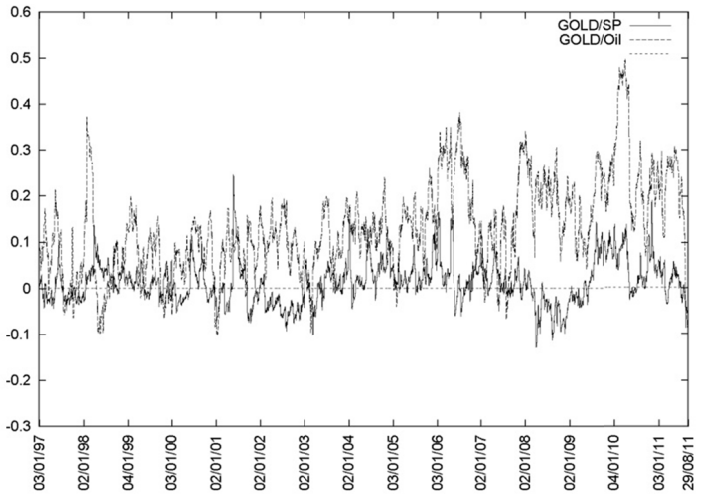

Figure 6. Conditional correlations between Gold/SP500 and Gold/Oil

During the first phase of the subprime crisis, the commodity prices examined presented similar patterns to the IG bond price and different patterns from the S&P 500 return and the HY bond return. Both these commodity prices rose, by 52 per cent (gold) and 57 per cent (crude oil) from June 2007 to March 2008. This observation is in agreement with the hike in the conditional correlation between these two commodities' returns on this period (Figure 6). Similarly, the conditional correlations between these commodity prices returns and the IG bond return were also slightly up, except during a few short periods (Figures 3 and 4). By contrast, the conditional correlations between the S&P 500 return and the returns of these both commodities decreased in the first phase of the subprime crisis (Figure 5). Similarly, the correlations between the HY bond return and both the commodities' returns also declined (Figures 3 and 4).

At the beginning of 2008 the crisis had become sufficiently severe to threaten the stability of the financial system; several institutions, such Bear Stearns, began going bankrupt or announced the reduced value of their assets. Thus, uncertainty on markets and risk premium associated with equities rose. Investors then sold more of their equities/stocks as well as corporate bonds (IG and HY bonds) in order to invest in gold and government bonds ("flight-to-quality"). All the assets examined here, except gold, lost value during the first months of 2008 and then their conditional correlations increased (Figures 1, 2 and 6). These observations illustrated the transmission of the negative effects of this crisis towards other assets (IG bonds) and then can be considered as a contagion. However, due to its higher quality, the IG bond lost only 1.90 per cent compared to the loss of the HY bond and the S&P 500, which went down by 8.60 per cent and 11 per cent, respectively, on the period from 2 January to 14 March 2008. By contrast, due to the "flightto- quality" gold price went up by 18.50 per cent, then the correlations between this commodity return and the returns of the other examined assets stayed stable or declined until the uncertainty alleviated in the middle of March 2008 (Figures 3 and 6). During the middle of March, the sale of Bear Stearns to JP Morgan Chase and the measures (Term Auction Facility, Term Securities Lending Facility and Primary Dealer Credit Facility) introduced by the Fed helped to alleviate uncertainty on the markets and then enabled assets' price levels to revive.

The financial markets plummeted again and more severely during summer 2008 as the financial crisis spread around the world and economic growth started to decline. The situation worsened more in September when uncertainty on the markets rose further due to the panic that resulted from the takeover by the US Federal of Fannie Mae and Freddie Mac on 7 September, the sale of Merrill Lynch to Bank of America on 14 September and the collapse of Lehman Brothers on 15 September. With the bankruptcy of Lehman Brothers, the financial crisis entered a new very severe phase marked by several failures of financial institutions and the plunge of stock markets around the world. Compared to the period summer 2007 - August 2008, this crisis affected more markets and the "flight-to-quality" was more pronounced during this deepest time of this crisis (September-November 2008) as nearly all investors fled into the safety of US Treasury bonds, gold, and the US dollar (perceived as the world's reserve currency). Thus, the S&P 500 index level, the crude oil price, the HY bond price and the IG bond price plummeted. For instance, on the period 15 September - 15 October 2008, the S&P 500, the HY bond, the IG bond and the crude oil lost 27.20 per cent, 22.70 per cent, 5.74 per cent and 18.70 per cent, respectively, of their values. The downward movements in these prices and in the S&P 500 level are in agreement with the sharp hike in the conditional correlations of these assets' returns in the period September Ű October 2008, as shown in Figures 1-6. By contrast, as the gold was considered safe assets, its price went up by 8.67 per cent on the period from 15 September to 15 October 2008 due to the "flight-to-quality", and then its correlation with the other assets went down (Figures 3 and 6). These latter correlations declined so deeply to attain a negative value; finding which is in line with the results obtained by Baur and Lucey (2010), Baur and McDermott (2010) and Coudert and Raymon-Feingold (2011).

The measures (Note 7) adopted by the Fed and other central banks during the deepest time (September - October 2008) of this crisis started to ease the pressure and to revive financial markets towards the end of 2008. However, a further shift towards riskless assets occurred again from the beginning of January until the middle of March 2009, when some problems, such as the agreement of the Danish parliament on a financial package, caused panic and uncertainty. During this period, equities/stock indexes around the world plunged again (Note 8). The S&P 500 index, the HY bond price, the IG bond price and the crude oil price dropped by 18.62 per cent, 15 per cent, 6 percent and 6 percent, respectively, over the period from 2 January to 15 March 2009. By contrast, due to the "flight-to-quality" the gold price appreciated more than 15 per cent in this period. In order to contain these collapses and reduce pressure on the markets, several central banks proposed measures. For instance, in March 2009 the Fed introduced the Quantitative Easing method to inject funds into the economy by creating new money and then using it to purchase assets (government bonds and mortgage-related assets) in order to lower borrowing costs and thereby stimulate the economy (Note 9). These measures enabled uncertainty to be reduced

and restored confidence in the markets as well as reviving the stock markets. In sum, the "flight-to-quality" in the period January - March 2009 can explain our results (Figures 3 and 6) which reveal a decrease of the conditional correlation between the gold return and the four other assets' returns. These declines in correlations were less intense than the declines seen during the deepest period of the subprime crisis (September - October 2008).

Finally, August 2011 was also characterized by a "flight-to-quality" as uncertainty rose sharply in August, caused by the US debt-ceiling crisis. Although the legislation to increase the debtceiling was signed on 2 August 2011, on 5 August, for the first time in the country's history, the US government bond was downgraded by the credit-rating agency Standard & Poor's due to the growing US budget deficit. This new provoked the plunge of the US stock market as well as markets around the world. Investors fearing the prospects of the US economic recovery and the ongoing Eurozone debt crisis sought safety mainly in US government bonds and gold. Thus, the S&P 500 and the crude oil lost 11.07 per cent and 9.60 per cent, respectively, of their values during the period from 3 August to 10 August 2011, whereas gold price went up by 6.16 per cent. As for the prices of HY bonds and IG bonds, they also decreased, but less than the S&P 500 index and the crude oil price. Indeed, the HY bond price went down by and 3.72 per cent and the IG bond price by 1.06 per cent. This "flight-to-quality" can then explain our finding revealing a hike in the conditional correlation between the S&P 500 return and the HY bond return (respectively the returns of the crude oil and the IG bond) at the beginning of August 2011 (Figures 1, 2, 4 and 5). By contrast, the conditional correlation between the return on gold and the four other retained assets' returns went down in this period (Figures 3 and 6).

In sum, our finding point out that gold was a safe haven during the subprime crisis. Portfolios containing gold during this crisis should have been more efficient than without. Furthermore, adding IG bonds in a portfolio during crisis period could improve the efficiency of this portfolio as the returns of IG bonds are feebly correlated with the returns of the S&P 500, the crude oil and the gold. Furthermore, the IG bond prices lost less value than the S&P 500, the HY bonds and the crude oil. These findings are valuable for the subprime crisis, it is important to check whether these assets were a safe haven during the past financial crises. In the next subsection, we will present and discuss only the case of the correlations amongst the gold, the S&P 500 and the crude oil during the past crises episodes.

4.4 Conditional Correlations and Other Financial Crises

The conditional correlation between the gold return and the S&P 500 return is not negative for every crisis episode (Coudert and Raymond-Feingold, 2011) and gold price does not increase for every crisis episode. Indeed, Figures 3 and 5 reveal that the correlation between the S&P 500 return and the gold return was slightly negative for a very short period during the Asian crisis. The decline of this correlation is due to the appreciation of the S&P 500 index and the very slight loss of the gold price. This crisis broke out on July 2nd 1997, when the Thai government was forced to float the Baht, and spread to some other Asian countries, such as Malaysia (August 1997), Indonesia (August 1997) and Hong-Kong (October 1997) due to the flight of speculators from Asian countries presenting similar weakness (financial crisis contagion). Investors reallocated their funds towards the USA, the European countries and some healthy emerging countries. Then, in these countries assets prices went up since investors preferred to reallocate their funds in the stock market instead of riskless assets, such gold, as the US economic growth was sustained and the inflation rate was close to the target fixed by the Fed in 1997. Indeed, it is mainly during periods marked by fears of recession, uncertainties regarding the credit markets, Fed rate cuts, a falling dollar, as well as inflationary concerns that gold is preferred.

Regarding the crude oil price, after a decline on the outbreak of the Asian crisis, it evolved in almost the same direction as the S&P index until the beginning of October 1997, but with lesser intensity. Thereafter, this commodity price was on a downward trend. The common trend of the S&P 500 index and the crude oil price, even with different intensity, is in agreement with our finding regarding the rise of the conditional correlation between this stock index return and this commodity return in the period from July to October 1997 (Figures 3 and 4). Thereafter, the crude oil price moved in the opposite direction to the S&P 500 index and then their correlation went down.

A similar scheme reappeared during the Russian crisis. During this crisis, the gold price and the crude oil price moved in almost the same direction. The prices of both these commodities declined very slightly until mid-August 1998 (crude oil) / the end of August 1998 (gold), increased strongly until the end of September 1998 and then went down slightly until March 1999. These observations explain our results revealing an increase of the conditional correlations between the returns of these both commodities in the period from June 1998 to March 1999 (Figures 4 and 5). Like these commodity prices, the S&P 500 level went down from 20 July 1998 to

the end of August 1998. After a couple of days of hesitation, this stock index rose after 4 September 1998 until mid-1999. The evolution of these assets' returns from summer 1998 to the end of this year can explain our results (Figure 3) which reveal a downward trend of the conditional correlations between the S&P 500 return and the crude oil return as well as between this stock index return and the gold return in the period from early September 1998 to March 1999. In sum, similarly to the Asian crisis episode, the correlation between the S&P 500 return and the gold return declined slightly during the Russian crisis due mainly to the appreciation of the stock index and the slight loss of value of the gold price.

In line with the results obtained during the Asian and the Russian crises, the conditional correlation between the S&P 500 index return and the gold price return was also on a downward trend during the dot-com crisis (2000-2002) (Figures 3 and 5). During the first months of this crisis, the downward trend of this correlation resulted from the slight increase of the stock index level and the slight decline of the gold price, whereas after August 2000 both these returns changed their direction. Indeed, at the outbreak of this crisis both the commodity prices and the S&P 500 index lost value from March to May 2000 and thereafter, they evolved on different paths. The S&P 500 index was on a slight upward trend until the end of August and then on a downward trend until October 2002, except that this index rose sharply during some very short periods, such as March-May 2001 and in September 2001. As for the gold price, it was on a slight downward trend from March 2000 to March 2001 and then was on an upward trend until the beginning of 2003. As expected, the gold price started to rise when fears of recession, concerns about the inflation rate and uncertainty in the financial markets were strong. Indeed, the US economy was on recession from March to November 2001 according to the National Bureau of Economic Research. Furthermore, In the USA, the inflation rate in 2000 and 2001 was above the target fixed by the Fed. Indeed, in 2000 the inflation rate reached 3.38 per cent, the highest level since 1992 and in 2001 this rate was 2.83 percent.

In sum, gold is a safe haven mainly during periods marketed by fears of recession, concerns about the inflation rate and strong uncertainty in the financial markets.

5. Conclusion

In this paper, we analyzed the conditional correlations across five U.S. assets' returns. These assets correspond to the high-yield bond, the investment-grade bond, the S&P 500, the crude oil and the gold. We used four Dynamic Conditional Correlation (DCC) models; the scalar DCC model (DCC), the asymmetric DCC (ADCC) model, the generalized DCC model (GDCC) and the generalized asymmetric DCC model (AGDCC). The results obtained with the AG-DCC model outperform the results obtained with the three other models. The results obtained with the AG-DCC lead to several substantial conclusions; which are described in what follow.

During stable periods, the HY bond return is correlated with the S&P 500 return as much as with the IG bond return; whereas during unstable periods, the former return is more correlated with the S&P 500 return than with the IG bond return. This finding is mainly explained by the credit risk component in the HY bond; a factor shared with equity returns and which is important during unstable periods. However, during crisis episodes, such during the subprime crisis, the HY bond losses less value than the S&P 500. Furthermore, during bull market, the HY bond price goes up as much as the stock index level. For instance, on the period from March 2009 to March 2010, the S&P 500 level increased by 55.12 per cent and the HY bond price by 42.85 per cent. Thus, by replacing some portion of stock index by HY bonds in a portfolio we can improve the efficiency of this portfolio.

The interdependence between the HY bond return and the crude oil return presents similar pattern than the interdependence between the S&P index return and this commodity return due to the common factor between the HY bond and the S&P 500. These interdependences are close to zero and sometimes slightly negative during stable periods. Similarly, the price of the IG bond is also slightly correlated negatively with the price of the crude oil in normal time, since a hike of the crude oil price influences positively the inflation rate, which has negative impact on the prices of the IG bonds and government bonds. During bear market and then uncertainty in the financial markets, the conditional correlations between the returns of the crude oil and the S&P 500 and between the returns of the crude oil price and the HY bond decrease due to the decline of the S&P 500 level and the HY bond price. If this latter financial situation is coupled with economic recession then the conditional correlation between the returns of the S&P 500 (respectively the HY bond) and the crude oil goes down since the price of the crude oil presents similar downward pattern than the S&P 500 level and the HY bond price. Thus, adding crude oil, stock index or HY bonds in a portfolio could benefit in stable and unstable periods, except during periods marketed by concerns about the economic growth.

Similarly to the crude oil, the gold return is feebly or negatively correlated with the returns of the both retained bonds and the S&P 500 in normal time since the former commodity does not depend on the same exogenous

variables like the other assets. Furthermore, during financial crises the conditional correlation between the gold return and the return of the other retained assets is often negative. Precisely, the conditional correlation between risky assetsŠ returns (for example the S&P 500) and the gold return declined during the Asian crisis, the Russian crisis and during the first part of the Dot-com crisis due to the slight decline of the gold price and the appreciation of the S&P 500 index. By contrast, during the second part of the dot-com crisis and during the subprime crisis the conditional correlation between risky asset returns and gold return went also down, but due to the appreciation of the gold and the decline of the S&P 500 index level. Precisely, the gold price rose sharply during the subprime crisis, whereas during the second part of the Dot-com crisis, this price went up slightly. Furthermore, during these latter crises, the US economy was on a recession, inflation rates was high, concerns regarding the credit markets were important (during the subprime crisis). Thus, as stated by Coudert and Raymond-Feingold (2011) and confirmed by our results, gold is safe haven on average and not for every crisis episode or every country. During some crisis episode, this commodity is not used as safe haven, such during the Asian crisis, the Russian crisis and the first part of the dot-com crisis. During some crisis period, gold is a weak safe haven, such during the second part of the dot-com crisis and it can also be a strong safe haven during some crisis episode, such during the subprime crisis.

In sum, the statement that correlations across different asset classes decrease in times of crises, then creating potential for diversification through asset allocation (Smith, 2002; Hunter and Simon, 2004) is valuable for the correlation between riskless assets (such as government bonds or gold) and risky assets (such as equities, highyield bond).

Finally, the subprime crisis affected negatively first the stock market and the HY bonds and impacted negatively other assets (IG bonds and crude oil) when this crisis deepened and concerns about the economic growth appeared. This transmission of the negative effects of this crisis from one market to another market within the same country represents a contagion of this crisis. In sum, with the aggravation of the economic and financial situation the negative impacts of the subprime crisis have transmitted to other financial markets within the USA as well as to foreign markets (financial crisis "contagion"). Our results display in Figures 1-6 reveal also that the "flight-to-quality" from risky assets, such the S&P 500 and the HY bond, to riskless assets, such government bond, IG bond and gold, has accentuated when the subprime crisis has deepened.

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Notes

Note 1. See for example, Hartmann et al., (2001), Gulko, (2002), Stivers and Sun (2002), De Goeij and Marquering (2004), Connolly et al., (2005), Cappiello et al., (2006), Andersson et al., (2008), Baur and Lucey (2009), Baele et al., (2010) and Aslanidis and Christiansen (2010).

Note 2. A similar model was proposed by Tse and Tsui (2002), but the model proposed by Engle has been more popular.

Note 3. The ADCC model can be express as follow: $Q_t = (\overline{Q} - a^2\overline{Q} - b^2\overline{Q} - g^2\overline{Q}) + a^2\varepsilon_{t-1}\varepsilon'_{t-1} + b^2Q_{t-1} + g^2n_{t-1}n'_{t-1}$, where a, b and g are scalar parameters.

Note 4. In the DCC model, a sufficient condition for Q_t to be positive definite for all possible realizations is that the scalar parameters a and b are nonnegative and satisfy $a + b < 1$.

Note 5. See Bollerslev et al., (1992) for an excellent survey of the literature.

Note 6. The results obtained by Reilly et al., (2009) illustrated these relations. These authors found that the correlation between Treasury bonds and Baa bonds has been estimated at 0.68, as compared to correlations between Treasuries and HY bonds that fall to about 0.18 in the case of Ba bonds, 0.03 for Brated bonds, and -0.09 for Caa-rated bonds. By contrast, Reilly et al., found that the correlation between the S&P 500 and the high-quality bond is lower (0.206, and barely significant in a statistical sense) than the correlation between HY bonds and the S&P 500 (0.57 and statistically significant).

Note 7. In the USA, the Emergency Economic Stabilization Act of 2008 was introduced, which contained the Troubled Assets Relief Program, proposed by the Secretary of the Treasury, Henry Paulson, on 19 September, aiming to permit the US government to purchase illiquid assets (toxic assets) from financial institutions for $700 billion.

Note 8. For instance, in the UK British banking shares collapsed strongly, mainly on Monday 19 January 2009 (known as Blue Monday).

Note 9. In March the Bank of England announced the Asset Purchase Facility in order to purchase assets financed by issuing central bank reserves.

Appendix

Appendix I. BIC

	IG	HY	S&P 500	GOLD	OIL
10/2005-08/2011					
GARCH	-568.84	1132.62	4645.61	5033.68	6793.17
GJR	-541.86	1128.41	4628.8	5068.73	6789.45
EGARCH	-520.15	1134.11	4633.18	5072.21	6769.22
01/97-08/2011					
GARCH			11126.05	10345.89	16909.32
GJR			11011.43	10318.98	16904.55
EGARCH			10996.07	10366.02	16916.6

International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Stock Market Risk Premiums, Business Confidence and Consumer Confidence: Dynamic Effects and Variance Decomposition

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Received: December 29, 2012 Accepted: June 11, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p45 URL: http://dx.doi.org/10.5539/ijef.v5n9p45

Abstract

This study is set up to assess the dynamic effects of business confidence and consumer confidence on stock market risk premiums and to determine the relative importance of business confidence and consumer confidence in forecasting the variability of stock market risk premiums though a variance decomposition. The results show that the response of stock market risk premiums becomes positive immediately following the shocks to business confidence and consumer confidence. Based on the variance decomposition analysis, the variability of stock market risk premiums is 95% due to its own shock and the rest is due to the shocks to business confidence (1%) and consumer confidence (4%) for the 3-month horizon. For the 6-month horizon, the variability of stock market risk premiums is 93% due to its own shock, 2% due to business confidence shock and 5% due to consumer confidence shock. The forecast error of stock market risk premiums is 90% due to its own shock and the rest is due to the shocks to business confidence (4%) and consumer confidence (6%) for the 12-month horizon. The results from the OLS time-series regression show that business confidence and consumer confidence jointly explain around 7.42% of the variation of stock market risk premiums.

Keywords: business confidence, consumer confidence, stock market risk premiums

1. Introduction

Gross investment by businesses and private consumption by consumers are vital to a country's overall economic health and sustainable growth in addition to government spending and net exports. Consumer confidence is significantly linked to future real GDP growth rate and the probability of the economy entering into a recession (Howrey, 2001). When businesses and consumers hesitate to invest and spend, the economy can slip into a recession (Bernanke, 1983). For example, an argument by Romer (1990) suggests that consumer confidence is linked to the late October 1929 stock market crash. This argument is echoed by Otoo's (1999) study which shows a correlation between stock prices and consumer sentiment. Blanchard (1993) finds a high connection between the early 1990s recession and consumption shocks. Fisher and Statman (2003) empirically show that stock market returns are highly correlated with consumer confidence. In addition, Cevik, Korkmaz and Atukeren (2012) examine the effect of business confidence on stock returns and find that the ISM manufacturing index, a proxy for business confidence, has an effect on the regime-switching probabilities during the bull and bear periods of the U.S. stock market. Jansen and Nahuis (2003) find that changes in sentiment and stock returns are highly correlated; similar evidence is reported in a study conducted by (Lemmon & Portniaguina, 2006). Furthermore, Chen (2011) shows that lower consumer confidence has a significant impact on stock market performance during the bear-market periods.

Up to this point, very little is known about the dynamic effects of business and consumer confidence on stock market risk premiums. Consequently, it is the objective of this study to assess the dynamics effects of business confidence and consumer confidence on stock market risk premiums and to determine the relative importance of business confidence and consumer confidence in forecasting the variability of stock market risk premiums though a variance decomposition. This study is warranted because empirical evidence of the joint effect of business and consumer confidence on stock market risk premiums is little known in the current literature. Finally, this study also provides important implication for stock market valuation, investment and risk management.

2. Method and Data

This study employs the vector autoregressive analysis framework, a system of equation 1, 2 and 3, to assess the dynamic effects of business confidence and consumer confidence on stock market risk premiums and to determine the relative importance of business confidence and consumer confidence in forecasting the variability of stock market risk premiums though a variance decomposition. In addition, a joint analysis of the effect of business confidence and consumer confidence on stock market premiums is conducted using the OLS time series regression (Equation 4).

$$R_{mt} - R_{ft} = \alpha + \sum_{i=1}^{p} \phi_i (R_{mt-i} - R_{ft-i}) + \sum_{i=1}^{p} \lambda_i \Delta BC_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta CC_{t-i} + \varepsilon_t \quad (1)$$

$$\Delta BC_t = \alpha + \sum_{i=1}^{p} \phi_i (R_{mt-i} - R_{ft-i}) + \sum_{i=1}^{p} \lambda_i \Delta BC_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta CC_{t-i} + \varepsilon_t \quad (2)$$

$$\Delta CC_t = \alpha + \sum_{i=1}^{p} \phi_i (R_{mt-i} - R_{ft-i}) + \sum_{i=1}^{p} \lambda_i \Delta BC_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta CC_{t-i} + \varepsilon_t \quad (3)$$

$$R_{mt} - R_{ft} = \alpha + \beta \Delta BC_t + \gamma \Delta CC_t + \varepsilon_t \quad (4)$$

Where:

R_{mt} = return on the stock market index in month *t*.

R_{ft} = the return on a thirty day T-bill in month *t*.

R_{mt-i} = return on the stock market index in month *t-i*.

R_{ft-i} = the return on a thirty day T-bill in month *t-i*.

ΔBC_t = change in the index of business confidence by taking the first difference; that is the value of business confidence index in month *t* less month *t*-1.

ΔCC_t = change in the index of consumer confidence by taking the first difference; that is the value of consumer confidence index in month *t* less month *t*-1.

ΔBC_{t-i} = change in the index of business confidence in month *t-i*.

ΔCC_{t-i} = change in the index of consumer confidence in month *t-i*.

Monthly changes of the U.S. business and consumer confidence indices from 1978:M2 to 2012:M5 are obtained from the Global Financial Data database. These business and consumer confidence indices are constructed by the Organization for Economic Co-operation and Development (OECD). Readers are strongly encouraged to access the OECD's website located at http://stats.oecd.org/ to read about how those indices are constructed in details. The monthly excess returns on CRSP value-weighted index from1978:M2 to 2012:M5 obtained from Kenneth R. French data library located at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/ data_library.html.

3. Results

Table 1 and 2 provide a summary of descriptive statistics and correlations among the variables. As shown in Figure 1 and 2, the results show that the response of stock market risk premiums becomes positive immediately following the shocks to business confidence and consumer confidence. As shown in Table 3, the variability of stock market risk premiums is 95% due to its own shock and the rest is due to the shocks to business confidence (1%) and consumer confidence (4%) for the 3-month horizon. For the 6-month horizon, the variability of stock market risk premiums is 93% due to its own shock, 2% due to business confidence shock and 5% due to consumer confidence shock. The forecast error of stock market risk premiums is 90% due to its own shock and the rest is due to the shocks to business confidence (4%) and consumer confidence (6%) for the 12-month horizon.

As shown in Table 5, the results show that an average of 102 basis points (β = 1.02824, t = 2.71) increase in stock market risk premiums is associated with one unit increase in the change of business confidence holding consumer confidence constant. Likewise, as a result of one unit increase in the change of consumer confidence, stock market premiums experience an average increase of 184 basis points (γ = 1.84661, t = 3.82) when business confidence is held constant. Business confidence and consumer confidence jointly explain around 7.42% of the variation of stock market risk premiums.

Table 1. Descriptive statistics

Variables	Mean	Standard Deviation	# of Obs
R_{mt}- R_{ft}	0.5791262	4.631675	412
ΔBC	-0.0046478	.6182492	412
ΔCC	-0.0016845	.4845916	412

Table 2. Correlations

	R_{mt}- R_{ft}	ΔBC	ΔCC
R_{mt}- R_{ft}	1		
ΔBC	0.2031	1	
ΔCC	0.2400	0.3406	1

Table 3. Variance decomposition of stock market risk premiums, business confidence and consumer confidence

Horizon (In Months)	*Rm-Rf*	S.E	ΔBC	S.E	ΔCC	S.E
3	0.95	0.021	0.01	0.010	0.04	0.019
6	0.93	0.024	0.02	0.014	0.05	0.028
9	0.92	0.025	0.03	0.016	0.05	0.019
12	0.90	0.027	0.04	0.018	0.06	0.021

Order of VAR: Rm-Rf, ΔBC, ΔCC.

Table 4. Granger causality wald tests

Regressors	Dependent Variables		
	Rm-Rf	ΔBC	ΔCC
Rm-Rf	0.000	0.265	0.023
ΔBC	0.051	0.000	0.000
ΔCC	0.002	0.000	0.000

The p-values for F-statistics for joint tests on lags are reported here.

Table 5. OLS time-series regression results

	Coefficient	**Std. Err.**	***t***	**Sig.**
Constant	0.58701	0.22009	2.67	0.000
ΔBC_t	1.02824	0.37909	2.71	0.007
ΔCC_t	1.84661	0.48365	3.82	0.000
R-Square	0.0742			
Adj. R-Square	0.0697			
F(2, 409)	16.40			0.000

Number of observation = 412; Durbin-Watson d-statistic (3, 412) = 1.976973.

Table 6. Durbin's alternative test for autocorrelation

lags(p)	chi2	df	Prob > chi2
1	0.031	1	0.8604

Null Hypothesis: no serial correlation.

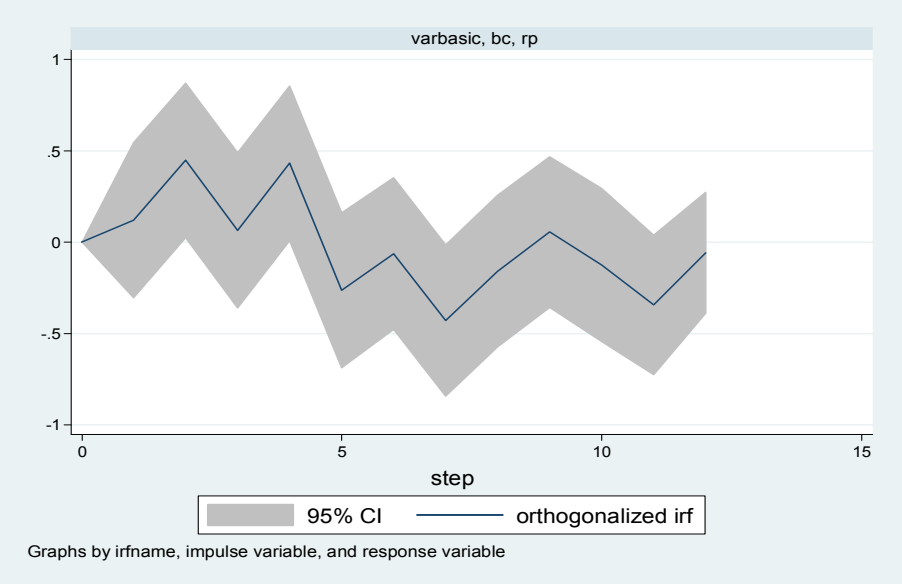

Figure 1. The orthogonal impulse response functions (OIRF) of stock market risk premiums to business confidence shock

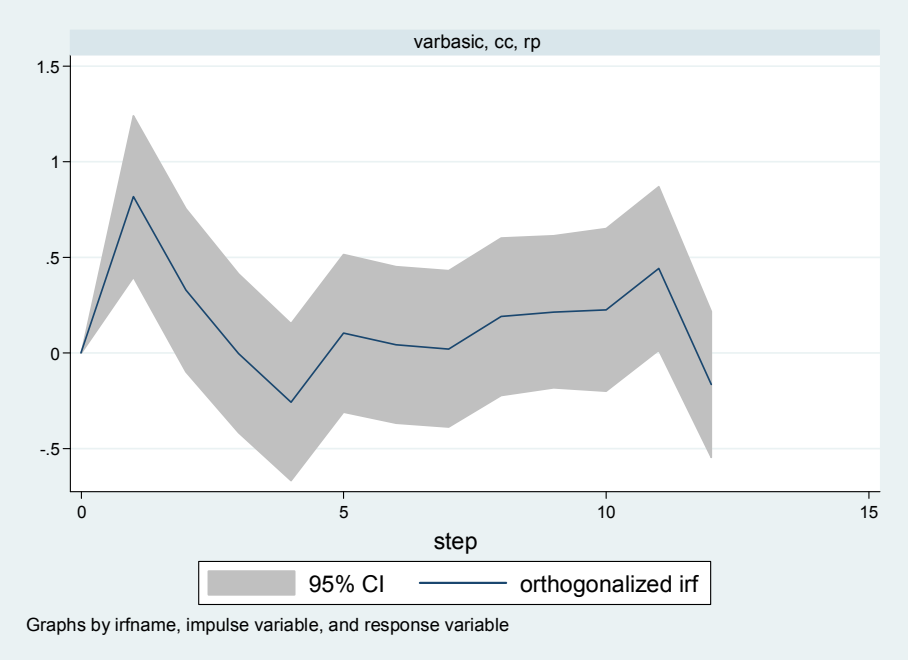

Figure 2. The orthogonal impulse response functions (OIRF) of stock market risk premiums to consumer confidence shock

4. Conclusion

Because very little is known about the effect of business and consumer confidence on stock market risk premiums; consequently, the problem of this study to assess the dynamics effects of business confidence and consumer confidence on stock market risk premiums and to determine the relative importance of business confidence and consumer confidence in forecasting the variability of stock market risk premiums though a variance decomposition. The results show that the response of stock market risk premiums becomes positive immediately following the shocks to business confidence and consumer confidence. Based on the variance

decomposition analysis, the variability of stock market risk premiums is 95% due to its own shock and the rest is due to the shocks to business confidence (1%) and consumer confidence (4%) for the 3-month horizon. For the 6-month horizon, the variability of stock market risk premiums is 93% due to its own shock, 2% due to business confidence shock and 5% due to consumer confidence shock. The forecast error of stock market risk premiums is 90% due to its own shock and the rest is due to the shocks to business confidence (4%) and consumer confidence (6%) for the 12-month horizon. The results from the OLS time-series regression show that business confidence and consumer confidence jointly explain around 7.42% of the variation of stock market risk premiums.

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International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

The Bargaining Power in Taiwan Interbank Overnight Market

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Received: June 18, 2013 Accepted: July 22, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p50 URL: http://dx.doi.org/10.5539/ijef.v5n9p50

Abstract

The rate corridor regime, relying on lending and deposit facilities to set ceilings and floors for interbank overnight rates, has been practiced by many central banks. This paper modifies the theoretical model proposed by Bech and Klee (2011) to discuss the seller's bargaining power in Taiwan interbank overnight market under rate corridor system. We apply two-limit Tobit model to estimate the bargaining power. The empirical results show that the repo rate, policy indicator and index for reserves concentration have significantly positive relationship with seller's bargaining power. Meanwhile, the results imply that the interbank overnight rates rise with these three variables. The conclusions could be clearly observed from the predictions on the paths of the interbank overnight rate under various scenarios.

Keywords: interbank overnight market, bargaining power, Tobit Model

1. Introduction

The operating procedures of monetary policy involve instruments (tools), operating targets, intermediate targets, and policy goals. Central Banks manipulate the instruments to achieve a specified value of an operating target. In recent years, the interest rate on interbank overnight loans has been widely used as the primary operating target for monetary policy because it is the most immediate source of regulating banks' liquidity. For example, the Fed has announced a federal funds rate target at each Federal Open Market Committee meeting since February 1994. The European Central Bank sets a target for the overnight cash rate which is similar to the federal funds rate. Therefore, the whole market participants keep close watch on the announcement of the interbank overnight rate because it affects interest rates throughout the economy.

The central banks can use their monopoly power over the supply of currency and reserves to influence the interbank overnight rate. The basic reserves market model could be used to examine the responses of the reserves quantities and interbank overnight rate under alternative instruments. Much literature discusses a rate corridor regime for interbank overnight market which has been practiced in Australia, New Zealand, Sweden and Switzerland. Some features of this regime have been described in Whitesell (2006) and Mishkin (2013). Operationally, the discount rate is set at a premium above the target rate, while the interest rate paid on the reserve balances (deposit rate) is set at a spread below the target rate. The discount rate functions as a ceiling and the deposit rate as a floor for the interbank overnight rate. As the reserve demand fluctuates, the interbank overnight rate will stay between these two limits.

The financial crisis of 2007-2009 led the Fed to adopt the corridor system. The authority to pay interest rate on reserve balances had been granted by Congress in 2006 but was not effective until October 2011. The financial crisis induced the Fed to implement this power on October 6, 2008. However, the effective federal funds rate did not stay above the floor of the corridor. Lavoie (2010) explains this phenomenon by the fact that not all the participants in the federal funds are eligible to receive interest payments on their reserve balances. The government-sponsored enterprises (GSEs) and foreign institutions get nothing on their reserve balances. This creates a segmented market where these institutions lack bargaining power and are being forced to lend at a rate below the floor. Moreover, Bech and Klee (2011) develop a bargaining model to explore the behavior of the federal funds rate. They use information on observed rates to calibrate the bargaining power of the different participants. The theoretical model proposed by Bech and Klee would provide us an available framework to analyze Taiwan interbank overnight market.

Taiwan interbank overnight market, as called interbank call loans market, was established in April 1980. Originally, the participants were restricted to those institutions, like the domestic banks and local branch of foreign banks, which were required to hold reserve balances. To expand the size of transactions, investment and trust companies (ITC) and bills finance companies (BFC) that were not required to hold reserve balances had been allowed to join the interbank overnight market since 1991. Figure 1 shows the transactions by institutions. The domestic banks are the most important traders in the market. ITC and BFC seem to usually stand in the position of borrowing. However, the amount of transactions by ITC and BFC is not large.

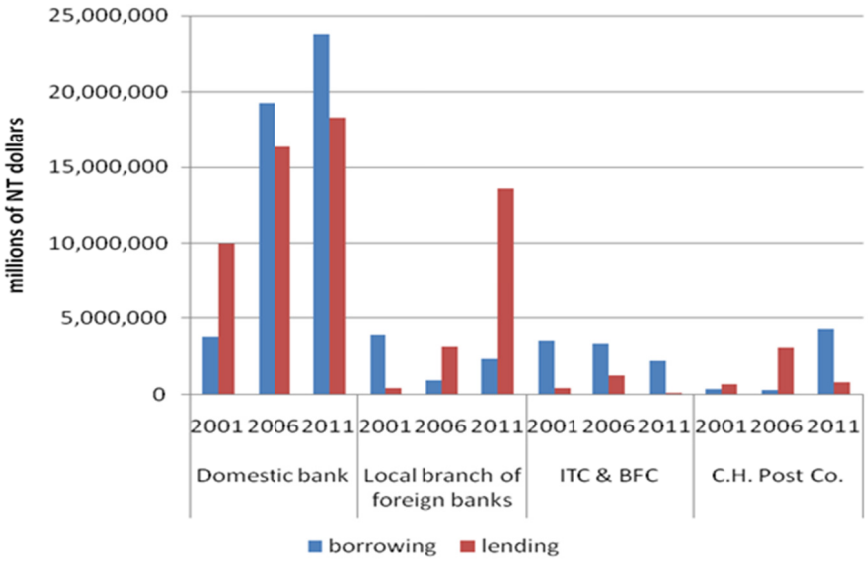

Figure 1. Interbank overnight transactions by institutions

Source: Central Bank of R.O.C (Taiwan), Financial Statistics Monthly.

As most other countries, banks in Taiwan could borrow at the discount window offered by the central bank or get the liquidity from other banks. However, the central bank of Taiwan set the discount rate as the floor of the target rate before 2003. To be correspondent with the corridor scheme of other countries, the interbank overnight rate has been allowed to be lower than the discount rate since 2003. This feature is illustrated in Figure 2. Additionally, the interbank overnight rate does not really stay within the corridor.

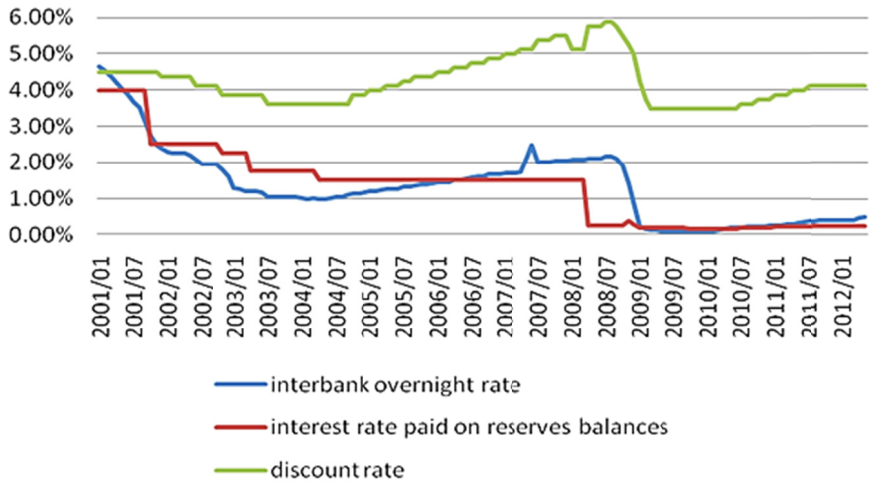

Figure 2. Taiwan interbank overnight rates

Source: Central Bank of R.O.C (Taiwan), Financial Statistics Monthly.

Bech and Klee (2011) propose a model with heterogeneous participants in markets and banking. However, the roles of ITC and BFC in Taiwan are not as significant as that of GSEs in the United States. Therefore, this paper will not deal with the problem of heterogeneity in the theoretical model. Instead, we use the share variables in the econometric model to investigate the influence of ITC and BFC on the bargaining power in Taiwan interbank overnight market. This paper is organized as follows. We describe the bargaining model and its implications in Section 2. Then we will calibrate the model to Taiwan interbank overnight market data and back out the bargaining power of the market participants in Section 3. We also predict the interbank overnight rate under various scenarios in this section. The conclusions are in Section 4.

2. The Model

2.1 Theoretical Model

The economy consists a central bank and a set of profit-maximizing and risk-neutral agents that buy and sell overnight funds in the interbank overnight market. According to the definition of Nash, a bargaining problem with two agents could be expressed as a pair (*F, d*), where *F* is the set of feasible agreements, and *d* indicates the threat point. Bech and Klee define a bargaining model where the utility of the agents is equal to the interest income. Following the argument of Binmore et al. (1986), the Nash solution could be written as

$$r^*(F,d) = \arg\max_{d \le f} (f^{buyer} - d^{buyer})^{1-\beta} (f^{seller} - d^{seller})^{\beta} \tag{1}$$

where r^* is the equilibrium interbank overnight rate in this bargaining model, (f^{buyer}, f^{seller}) denote the interest rate paid by the buyer (borrower) and the interest rate received by the seller (lender) respectively, and (d^{buyer}, d^{seller}) indicate the highest rate at which the buyer is willing to borrow money and the lowest interest at which the seller is willing to lend fund. Moreover, $\beta \in [0, 1]$ is the bargaining power of the seller, and then 1-β is the bargaining power of the buyer. The final solution implies that the buyer pays the seller the interest r. It means that (f^{buyer}, f^{seller})=(-*r*, *r*). The threat point should satisfy the conditions that $d^{buyer} \le f^{buyer} = -r$ and $d^{seller} \le f^{seller} = r$. The Nash solution in equation (1) could be rewritten as

$$r^* = \arg\max_{d^{seller} \le r \le -d^{buyer}} (-r - d^{buyer})^{1-\beta} (r - d^{seller})^{\beta} \tag{2}$$

Setting the first-order condition of equation (2) being zero yields the solution of *r* as

$$r^* = d^{seller} + \beta(-d^{buyer} - d^{seller}) = -d^{buyer} - (1-\beta)(-d^{buyer} - d^{seller}) \tag{3}$$

In the model of Bech and Klee, there are two segmented markets and the effective federal funds rate is the weighted average rate yielding from the bargaining problem in each market. However, the separation of Taiwan interbank overnight market is not significant because of the little amount of transactions by ITC or BFC. Therefore, we will directly use equation (3) to discuss the behavior of Taiwan interbank overnight rate.

Suppose the interest rate paid on reserve balances is r_{ioer}, it is clear that the seller will not lend to other bank if the interbank overnight rate is lower than r_{ioer}. It implies that $d^{seller} = r_{ioer}$. Let r_{sdw} denote the discount rate, and it is known the buyer will not borrow money from other bank if the interbank overnight rate is higher than r_{sdw}. It means that $d^{buyer} = -r_{sdw}$. The surplus can be divided between two parties is the interest rate difference r_{sdw} - r_{ioer}. Therefore equation (3) can be expressed as

$$r^* = r_{ioer} + \beta(r_{sdw} - r_{ioer}) = r_{sdw} - (1-\beta)(r_{sdw} - r_{ioer}), \tag{4}$$

We discuss the implications derived from equation (4). First, an increase in the seller's bargaining power (β) will raise the interbank overnight rate. It implies the seller could ask for a higher interest payment if his bargaining power increases. The positive relationship will be magnified when the surplus that could be divided between two parties is larger. This property is observed by differentiating equation (4) with respect to β.

$$\partial r^* / \partial \beta = r_{sdw} - r_{ioer} \ge 0, \tag{5}$$

Secondly, we analyze the impact of interest rate paid on reserve balances by the following differentiating equation.

$$\partial r^* / \partial r_{ioer} = 1 - \beta \ge 0 \tag{6}$$

The interbank overnight rate moves in the same direction with the interest rate paid on reserve balances.

Intuitively, an increase in the interest rate paid on reserve balances will raise the threat point of the seller. Thus the buyer should pay more interest to get the fund. Moreover, the magnitude of this positive relationship depends on the size of borrower's bargaining power.

Finally, an increase in the discount rate will make the interbank overnight rate be higher. The reason is that the demand for interbank loan will increase when the cost of alternative source of fund (discount window) is higher. Then it pushes up the interbank overnight rate. The extent of this positive relationship is relevant to the seller's bargaining power and could be shown by the following equation.

$$\partial r^* / \partial r_{sdw} = \beta \geq 0 , \tag{7}$$

2.2 Econometric Model

By rearranging equation (4), the seller's bargaining power could be expressed as

$$\hat{\beta} = \frac{r^* - r_{ioer}}{r_{sdw} - r_{ioer}} \tag{8}$$

Because the interbank overnight rate has been allowed to be lower than the discount rate since 2003, we will use the interest rate data available by the Central Bank of R.O.C. (Taiwan) to construct the values of seller's bargaining power (β) for Taiwan from January 2003 to May 2012. The time series is shown in Figure 3. Obviously, the values of seller's bargaining power (β) do not stay between zero and one at all times. We will focus on those observations that the values of seller's bargaining power keep within the reasonable ranges. Instead of the fractional response model used by Bech and Klee, we will apply Tobit model to investigate the behavior of bargaining power in Taiwan interbank overnight market.

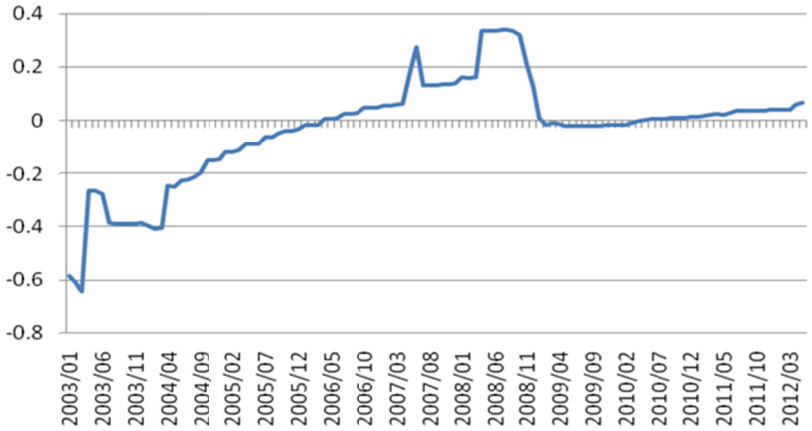

Figure 3. Seller's bargaining power (β)

We consider a regression model in which the dependent variable is continuous and recorded in only some of the ranges. The two-limit Tobit model provides a framework for us to estimate the bargaining power when it will be truncated at both high and low values. The model is defined as follows:

$$\beta_t^* = \boldsymbol{\gamma}' \mathbf{x_t} + u_t \tag{8}$$

where β_t^* is the latent variable, γ is a $k \times 1$ vector of parameters, x is a $k \times 1$ vector of explanatory variables, and u_t are disturbances that are independently and normally distributed, with mean zero and a common variance σ^2. Let the seller's bargaining power (β_t) be the observed dependent variable,

$$\beta_t = \begin{cases} 0 & \text{if} \quad \beta_t^* \leq 0 \\ \beta_t^* & \text{if} \quad 0 < \beta_t^* < 1 \\ 1 & \text{if} \quad \beta_t^* \geq 1 \end{cases} \tag{9}$$

The likelihood function is given by

$$L(\gamma, \sigma \mid \beta_t, \mathbf{x}_t) = \prod_{\beta_t = 0} \Psi\left(\frac{-\gamma' \mathbf{x}_t}{\sigma}\right) \prod_{\beta_t = \beta_t^*} \Psi\left(\frac{\beta_t - \gamma' \mathbf{x}_t}{\sigma}\right) \prod_{\beta_t = 1} \left[1 - \Psi\left(\frac{1 - \gamma' \mathbf{x}_t}{\sigma}\right)\right] \quad (10)$$

Two-stage estimation procedure could be used to obtain the maximum-likelihood estimates of γ and σ^2. The more detail discussion about this model could be seen in Maddala (1983).

3. Empirical Results

3.1 Determinants of Bargaining Power

Basing on the settings of Bech and Klee, we specify six variables that may be the important factors in determining the bargaining power. The first variable, ***Balances***, denotes the logarithm of total level of reserve balances held by the financial institutions. The higher level of reserve balances implies there is not much demand for reserves. It is expected to reduce the seller's bargaining power.

The second variable, ***HHI***, indicates the Herfindahl-Hirschman index which measures the concentration of the reserve balances. This index is computed as the square sum of reserve share for the largest 29 financial institutions in Taiwan. Intuitively, if the reserves are held by a few participants (a higher HHI), the structure of the market is near monopoly. It will strengthen the seller's bargaining power.

The third variable, ***Repo***, is the repurchase agreement rate on government bonds secondary market (1-30 days). It is known the repo market and the interbank overnight market are substitutes. A higher repo rate provides the seller with alternative investment opportunity. It increases the seller's bargaining power.

The forth variable, ***NPL***, is the non-performing loans ratio of all financial institutions. It measures the health state of the banking sector. Increases in counterparty risk will lead to worse information asymmetry. Moreover, banks are not willing to lend because they prefer to keep liquidity for precautionary reasons. For example, Afonso *et al*. (2011) suggest the importance of liquidity hoarding and counterparty risk in the U.S. interbank overnight market during financial crisis of 2008. Thus a higher non-performing loans ratio reduces interbank lending and the seller's bargaining power might be lower.

The fifth variable, ***Policy***, describes the monetary policy environment. We set a dummy variable that equals 1 if the rate paid on reserve balances changes at the later month. The expectation about future monetary policy will affect the motive for bank to hold reserves.

The sixth variable is not included in the study of Bech and Klee. We consider the ratios of the amount of borrowing (lending) by BFC and ITC to total borrowing (lending) which are denoted by $\boldsymbol{BFC^b}$ ($\boldsymbol{BFC^l}$) and $\boldsymbol{ITC^b}$ ($\boldsymbol{ITC^l}$), respectively. These share variables capture the influence of those heterogeneous participants over the bargaining power.

The data set is obtained from the Central Bank of R.O.C (Taiwan), *Financial Statistics Monthly,* and the databank provided by Taiwan Economic Journal (TEJ). The sample period ranges from January 2003 to May 2012, with a total 111 monthly observations. The descriptive statistics for the variables involved in this study are presented in Table 1.

Table 1. Descriptive statistics

Variable	Mean	Std. Dev.	Maximum	Minimum
Balances	6.0737	0.0766	6.1900	5.9400
HHI	0.1523	0.0582	0.2586	0.0231
Repo	0.0095	0.0056	0.0211	0.0013
NPL	2.4274	1.7428	6.8400	0.4200
Policy	0.1171	0.3230	1.0000	0.0000
$\boldsymbol{BFC^b}$	0.0010	0.0018	0.0064	0.0000
$\boldsymbol{BFC^l}$	0.0082	0.0010	0.0381	0.0000
$\boldsymbol{ITC^b}$	0.1413	0.0763	0.3432	0.0433
$\boldsymbol{ITC^l}$	0.0199	0.0149	0.0769	0.0004

3.2 Empirical Results

We use two-limit Tobit model described in equation (8) and (9) to estimate the seller's bargaining power. The independent variables include the factors mentioned in section 3.1. We exclude the influence of heterogeneous participants in Model 1. Then add the share variables relevant to the transaction of BFC and ITC in Model 2, 3, 4.

The empirical results are presented in Table 2. ***Repo*** and ***Policy*** are two significant variables that are positively related to seller's bargaining power. A higher repo rate tends to push up seller's bargaining power as expected. Bech and Klee find the same evidence for GSEs that are significant sellers in Federal Funds market. Moreover, anticipation of the change in rate paid on reserve balances will stimulate the seller's bargaining power. The concentration index (***HHI***) is positively related to seller's bargaining power. It is consistent with our expectation. The total level of reserve balances (***Balances***) and the health state of the banking sector (***NPL***) do not significantly determine bargaining power except in Model 1. The coefficient on ***NPL*** is insignificantly negative. We explain this result with two effects. The first effect is noted previously that counterparty risk makes seller reduce lending and it raises seller's bargaining power. The second effect is that the injection of liquidity by central bank in the worse financial state causes the decrease in seller's bargaining power. These two effects move in the opposite directions and then the total effect is indefinite.

The coefficients on lending share of BFC are significant negative in Model 2 and Model 4. In addition, the influence of ITC is insignificant. BFC need not hold reserves and they lend fund under consideration of benefit. If BFC participate the selling market more aggressively, it will reduce the other seller's bargaining power. By contrast, this effect does not be found when BFC act as borrowers in the market. It is worth noting that BFC, like other banks, could borrow at the discount window offered by the central bank. Therefore, the borrowing decisions for BFC are similar to other banks.

Table 2. Estimation for seller's bargaining power with two-limit Tobit Model

Dependent variable: seller's bargaining power

Independent variables	Model 1	Model 2	Model 3	Model 4
Balances	0.9172	0.3869	0.3331	0.2767
	(1.72)*	(0.83)	(0.54)	(0.49)
HHI	0.2514	0.7357	0.5412	0.7628
	(0.60)	(2.01)**	(1.32)*	(2.05)**
Repo	28.4326	26.3012	31.0454	27.3549
	(9.70)***	(10.32)***	(10.50)***	(9.46)***
NPL	-0.0715	-0.0534	-0.0667	-0.0505
	(-1.71)*	(-1.54)	(-1.47)	(-1.28)
Policy	0.0700	0.0446	0.0606	0.0449
	(2.94)***	(2.16)**	(2.62)***	(2.13)**
BFC^b		-35.7521		-80.4513
		(-0.25)		(-0.52)
BFC^l		-5.8211		-4.9660
		(-4.11)***		(-2.75)***
ITC^b			-0.1960	-0.1155
			(-0.71)	(-0.45)
ITC^l			-3.2061	-0.9999
			(-2.27)**	(-0.63)
Constant	-5.7982	-2.6094	-2.2349	-1.9292
	(-1.75)*	(-0.90)	(-0.59)	(-0.56)
Log likelihood	74.3070	81.7969	77.4090	82.1069

Notes: *t* values are given in parentheses. ***, **,* indicate significance at 1%, 5%, 10% statistical level, especively.

3.3 Prediction of Interbank Overnight Rate

Central bank can change the interest rate paid on reserve balances to alter the rate corridor. In this section, we intend to predict the interbank overnight rate under different setting for interest rate paid on reserve balances. From Table 2, the log likelihood ratio for Model 4 is the highest among all models. Therefore, we apply the coefficients estimated by Model 4 to perform this predicting exercise. All the independent variables involved in the regression are assumed to stay in their mean level as shown in Table 1. The discount rate is set at mean level (4.25%). Especially, we plot the implied interbank overnight rate with different assumptions for BFC lending share. In the low (high) scenario, the BFC lending share is assumed to be the average level minus (plus) one standard deviation.

Figure 3 illustrates the fact that higher interbank overnight rates are associated with higher interest rates

paid on reserve balances. Moreover, a higher BFC lending share results in a lower interbank overnight rate because it implies a lower seller's bargaining power. A further point to be noted is that the interbank overnight rates with different assumptions for BFC lending share will converge to the same level as the interest rate paid on reserve balances increases.

Figure 4 to Figure 6 show the effects of different level of total reserve balances, different degree of index of reserve concentration and different value of repo rate on the interbank overnight rate, respectively. The positively sloped paths suggest that the interbank overnight rates rise with these three variables. The negative relationship between non-performing loans ratio and interbank overnight rate is observed in Figure 7.

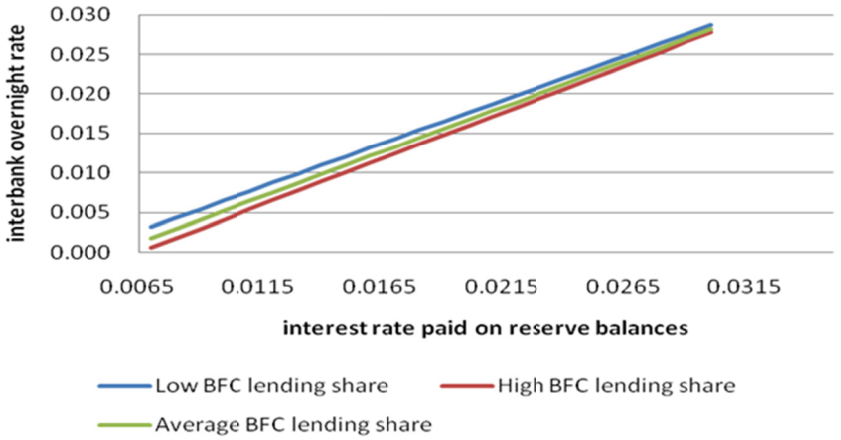

Figure 3. Prediction of interbank overnight rate—by interest rate paid on reserve balances

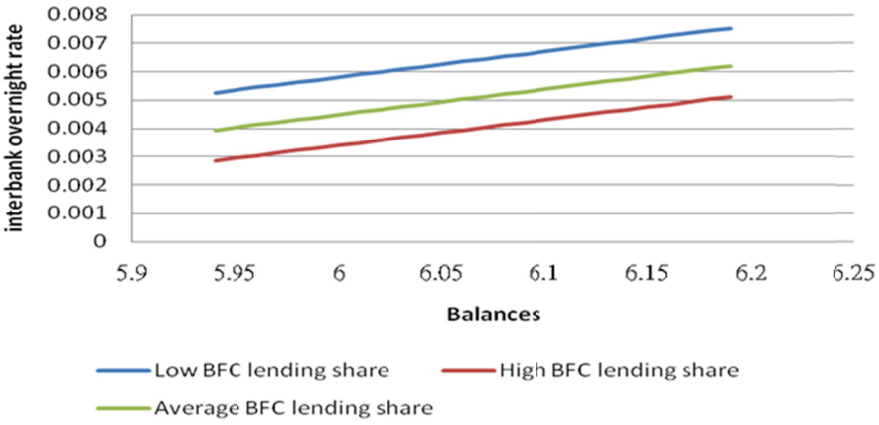

Figure 4. Prediction of interbank overnight rate—by total level of reserve balances

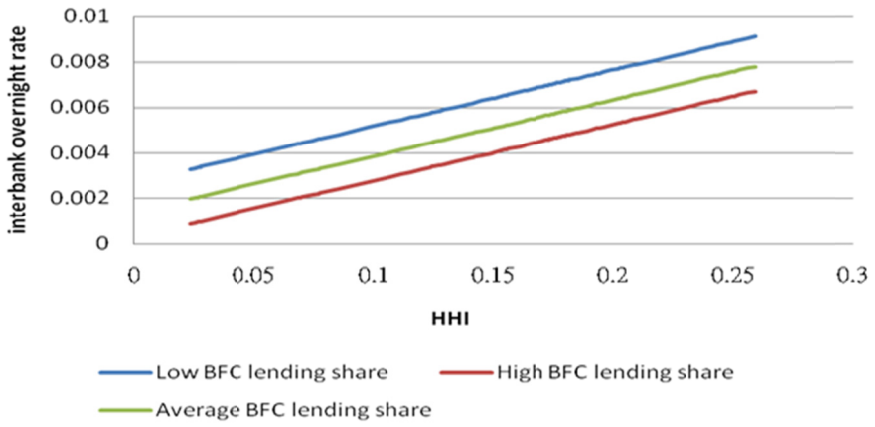

Figure 5. Prediction of interbank overnight rate—by index of reserves concentration

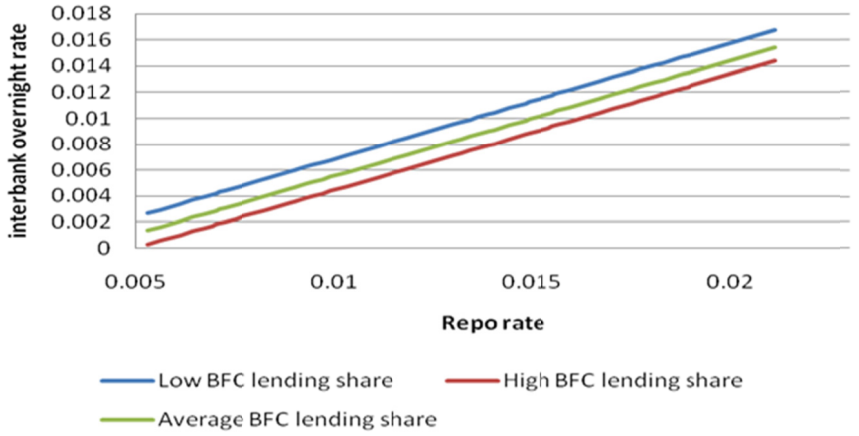

Figure 6. Prediction of interbank overnight rate—by repo rate

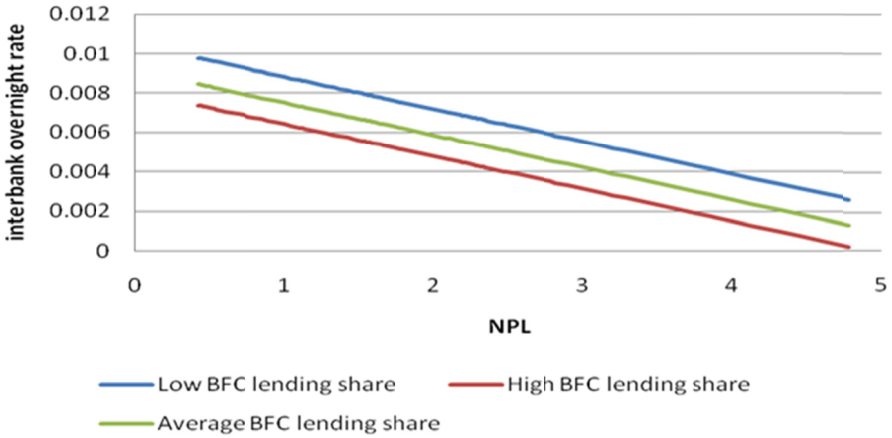

Figure 7. Prediction of interbank overnight rate—by non-performing loans ratio

4. Conclusions

This paper modifies the theoretical model proposed by Bech and Klee to investigate the seller's bargaining power in Taiwan interbank overnight market under rate corridor system. We apply two-limit Tobit model to estimate the bargaining power and evaluate the impacts on interbank overnight rate under various scenarios. The empirical results show that the repo rate, policy indicator and index for reserves concentration have

significantly positive relationship with seller's bargaining power. Meanwhile, the results also imply that the interbank overnight rates rise with these three variables. The predictions on the paths of the interbank overnight rate under different scenarios make our conclusions more clear.

This issue could be extended to focus on other Asian countries where central banks play important roles in stabilizing the financial system. Especially, it is interesting to investigate the dynamics of interbank overnight rates during financial crisis. Because the manipulations of reserves schemes are different among Asian countries, the theoretical model used in this paper could be modified to fit each economy. It may help us to look more closely at the behavior of central banks.

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International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971XE-ISSN 1916-9728
Published by Canadian Center of Science and Education

Thirlwall's Law: The Case of Turkey, 1987–2011

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Received: August 2, 2013 Accepted: August 6, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p59 URL: http://dx.doi.org/10.5539/ijef.v5n9p59

Abstract

This study applies Thirlwall's law to Turkish economy from 1987:Q1 to 2011:Q4 period using Autoregressive Distributed Lag (ARDL) model and Kalman Filter method. Turkish economy has balance of payments deficits for last three decades. According to Thirlwall's law this deficits constrains countries' growth rates and therefore when countries long term growth rates are analyzed the demand side of the economy and the balance of payment performance must be taken into account. The hypothesis of Thirwall's law is tested by various forms of the model. The finding implies that balance of constraint growth model is not valid for Turkey.

Keywords: balance of payments constrained growth, weak form, strong form, Kalman filter method

1. Introduction

Thirlwall's law or balance of payments constrained growth model provides a different viewpoint to growth theory from orthodox economic (classical and neoclassical) approach. The orthodox theory, as Say Law emphasizes, is a supply determined model and the balance of payments is self equilibrating, and growth is determined by the growth of factor inputs and technical progress. According to Thirlwall (1979), this approach cannot explain why growth rates are different between countries and he stressed that as distinct from orthodox theory, countries growth of income are demand-determined and specially in a global world (or in an open economy) demand is constrained by balance of payments. Therefore it is impossible to understand differences in the long-run economic growth of countries without reference to the balance of payments (McCombie&Thirlwall, 2004).

The aim of the paper is to investigate the empirical validity of Thirlwall's law for Turkish economy 1987:Q1 to 2011:Q4 period. The paper follows several studies which use ARDL model, but on the other hand our paper is different from previous studies, as we add Kalman filter method together with ARDL model. The paper consists of six sections. In first section we will analyze original model (Thirlwall, 1979; Thirlwall & Hussian, 1982). Moreover in this section the criticisms and contributions to the model (Elliott & Rhodd, 1999; Moreno-Brid. 2003; McGregor & Swales, 1985) are included. In the second section previous studies will be summarized in terms of findings and method. Next, Thirlwall's law will be tested in the context of Turkey. Section 4 gives empirical results and finally conclusion.

2. Theoretical Model

In this model beginning proposition is that no country can grow faster than that rate consistent with balance of payments equilibrium on current account unless it can finance ever-growing deficits, which in general it cannot (Thirwall, 2011). In this direction in his pioneering paper/study Thirlwall (1979) analyzed growth experience of major developed countries and he showed that the growth rates of these countries approximates to the rate of growth of exports divided by the income elasticity of demand for imports. This result is known as Thirlwall's law in the literature.

The simplest way to model growth within a balance of payments constrained framework, to start with the balance of payments equilibrium condition; specify export and import demand functions, since import growth is a function of domestic income growth, solve the model for the growth rate consistent with long-run balance of payments equilibrium (Thirlwall, 2011)

Current account equilibrium is given by:

$$P_d X = P_f ME \tag{1}$$

where X is exports, $M$is imports, $P_d$is the domestic price of exports; P_f is the foreign price of imports, $E$is the exchange rate measured as the domestic price of foreign currency.

Export and import demand functions are specified as multiplicative with constant elasticities giving:

$$X = a(P_d / P_f E)^{\eta} Z^{\varepsilon} \quad \eta < 0, \varepsilon > 0 \tag{2}$$

$$M = b(P_f E / P_d)^{\psi} Y^{\pi} \quad \psi < 0, \pi > 0 \tag{3}$$

where η is the price elasticity of demand for exports, ε is the income elasticity of demand for exports; ψ is the price elasticity of demand for imports; π is the income elasticity of demand for imports, $Z$is the level of world income and Y is domestic income.

Taking logarithms of equations (2) and (3), differentiating with respect to time, substituting the growth of exports and imports into equation (1) in growth rate form, and solving for the growth of income, gives:

$$y_B = \left[(1 + \eta + \psi)(p_d - p_f - e) + \varepsilon(z) \right] / \pi \tag{4}$$

where the lower-case letters represent rates of growth of the variables (Thirlwall, 2011:16).

If relative prices in international trade or real exchange rates are constant, equation (4) reduces to:

$$y_B^{*} = \varepsilon(z) / \pi \tag{5}$$

Since we don't have information on $\varepsilon(z)$ for all countries it can be assumed that$\varepsilon(z) = x$,

$$y_B^{**} = x / \pi \tag{6}$$

Perraton (2003) termed equation (5) strong form of the Thirlwall's law and equation (6) weak form of the law. Because if the parameter ε has not been estimated, using equation (6), then export growth (x) must include the effect of relative price changes as well as the effect of world income growth which weakens somewhat the argument that the balance of payments is always brought into equilibrium by domestic income changes. The model is best tested, therefore, using the "strong" version if robust estimates can be made of ε (Thirlwall, 2011).

According to this schema differences in growth rates are predominantly caused by international differences in the values of ε and π which reflect all aspects of non-price competitiveness- factors which change relatively slowly over time (Arestis&McCombie, 2006). Non-price competitiveness reflects such supply-side characteristics as quality, after-sales service, the effectiveness of distribution networks, and so on. Consequently, while this approach stresses the importance of the growth of demand for exports in the growth process, this is a function of what may be termed a country's supply characteristics (McCombie, 1997).

Thirlwall's law or balance of payments constrained growth model has been extended and modified in the course of time. Specifically, Thirlwall and Hussian (1982) taking consideration of developing countries growth experience extended the model to include capital inflows**.** Therefore, capital flows included model can be regarded as developing country version of the Thirlwall's law.

By definition, including capital flows the overall balance of payment can be written like as following:

$$P_d X + C = P_f ME \tag{7}$$

which is a simple extension of equation (1) where $C > 0$ represents positive capital inflows, $C>0$ representes capital outflows. Taking rates of change of the variables in equation (7), and using expressions for the rate of growth of exports and imports from equations (2) and (3), gives the growth rate consistent with overall balance of payments (ob) of:

$$y_{ob} = \left[(1 + \theta\eta + \psi)(p_d - p_f - e) + \theta\varepsilon(z) + (1 - \theta)(c - p_d) \right] / \pi \tag{8}$$

where θ is the share of export receipts in total receipts to pay the import bill; c is the growth of nominal capital

inflows, so that (c-p_d) is the growth of real capital inflows (Thirlwall, 2011).
Again if we make the assumption that relative prices measured in a common currency remain unchanged over the long term equation (8) reduces to:

$$y^*_{ob} = \left[\theta x + (1-\theta)(c - p_d)\right]/\pi \quad (9)$$

In other words, the growth rate consistent with the overall balance of payments is the weighted sum of the growth of exports and real capital flows divided by income elasticity of demand for imports. If there were no capital flows [i.e.$\theta = 0$ and $(c - p_d) = 0$], then equation (9) would collapse to the simple rule in equation (6) that $y = x/\pi$ (Thirlwall, 2011).

Later, in addition to capital flows Elliott and Rhodd (1999) included debt and debt service components. Moreno-Brid (2003) also included interest payments on debt to the model**.** Even if the growth of interest payments is quite high and debt service ratio is also high, it stil makes little difference to the predicted growth rate. In other words export growth dominates (Thirwall, 2011).

Thirlwall law's empirical validation is sought by different econometric tests. First of all, model is tested using Spearman's rank correlation by Thirlwall (1979). According to McGregor and Swales (1985), the use of this nonparametric test is very weak and it would seem more reasonable to test Equation (6) directly using regression analysis. In the light of criticims made by McGregor and Swales (1985) the law is usually tested as follows: firstly trade functions are estimated in order to obtain the corresponding elasticities; secondly, the income growth rate consistent with external equilibrium is calculated as Equation (6); and, finally, a regression is made of the growth rate of income consistent with external equilibrium on the actual growth rate (Alonso, 1999).

McGregor and Swales (1985), argue that for these regressions to be consistent with the theory, the constant term should be zero and the regression coefficient unity (Thirwall, 1986). The problem with this test, however, is that it requires a full set of countries for the whole world in which deficits and surpluses cancel out. If the only countries taken are predomiantly deficit countries, the constant would exceed zero, and the slope is likely to differ from unity, and the hypothesis that growth is the balance of payments constrained would be rejected because of inappropriate sample choice (Thirlwall, 2011).

The second parametric test suggested by McCombie (1989), is to take each country separately and to estimate the income elasticity of demand for imports (π^*) that would equate actual growth rate and balance of payments constrained growth rate, and to compare this estimate (π^*) with the estimated π from the time-series regression analysis for the country under consideration. If π^*does not differ significantly fromπ, then actual growth rate and balance of payments constrained growth rate will not differ significantly either (McCombie & Thirlwall, 2004).

Thirlwall (2011) emphasizes that the econometric methods which are used in studies have become much more sophisticated and the tests of the model have become more rigorous. But the most notable shift of all has been towards the use of cointegration techniques to establish long-run relationships between levels of variables. Alonso (1999), which is one of the earliest works in this direction, used cointegration techniques for an individual country to estimate π^*taking levels of variables in the export and import demand functions. The level of income consistent with balance of payments equilibrium is then calculated and the actual growth of income is regressed on this "equilibrium" level of income. If the constant is not significantly different from zero and the regression coefficient is not significantly different from unity, this indicates parallel evolution of two series (Thirlwall, 2011).

3. Literature Review

Thirlwall's law is tested for both a single country such as; Atesoglu (1993), Hieke (1997), León-Ledesma (1999), YongbokJeon (2009) and country groups Thirlwall and Hussain (1982), Andersen (1993), Perraton (2003) and Bagnai (2010).

Table 1. Summary of recent literature review for Thirlwall's Law

Author(s)	Countries and Period	Method	Result
Thirlwall and Hussain (1982)	20 Developing Countries (1950s to 1970s)	OLS	Capital inflows have enabled to countries to grow slightly faster than Thirlwall's expression.
Bairam and Dempster (1991)	11 Asian Countries (1965-85)	OLS	When India and Japan are excluded form sample, the economic growth is determined by Thirwall's law.
Atesoglu (1993)	USA (1955-70, 1975-90)	OLS, two stage least squares method	Thirlwall's law can explain a satisfactory account of the variations in long-term economic growth of USA economy.
Atesoglu (1993-94)	Canada (1961-76, 1977-91)	OLS	The growth in exports has been a significant and important source of Canadian economic growth but capital inflows don't appear to play an important role in the economic growth.
Andersen (1993)	16 industrial countries	Engle Granger co-integration anlaysis	There is a close relationship between the actual growth rate and the balance of payments equilibrium growth rate in the long run and even a 1:1 ratio is only obtained when Japan is excluded.
Hieke (1997)	USA (1950-1990) quarterly data	Co-integration anlaysis and OLS	According to the paper the post-World War II period U.S. economy supports Thirlwall's law when the data are subdivided into the periods 1950-66 and 1967-90.
León-Ledesma (1999)	Spain (1965-1993)	Two Stage Least Squares	Spanish economy's growth rate has been very close to the estimated balance-of-payments equilibrium growth rate.
Elliott and Rhodd (1999)	20 Developing Countries (1950s to 1970s)	OLS	When debt service is included, the balance of payments constrained model can predict better growth rate for 13 of the 20 countries.
López and Cruz (2000)	4 Latin America Countries (1965-1996)	Johansen cointegration test and VAR Analysis	Thirlwall's law is relevant for these countries in that output growth closely tracks export growth in the long run and moreover, higher exports tend to cause higher output.
Moreno-Brid and Pérez (1999)	5 Central American countries (1950-1996)	Johansen cointegration test	The balance of payments constrained growth model holds for Costa Rica, Guatemala and Nicaragua, but for El Salvador and Honduras the balance of payments constrained growth rate is below than the actual rate.
Alonso (1999)	Spain (1960-1994)	Johansen cointegration test and VAR Analysis	The results confirm the existance of the external restriction in Spanish case furthermore, prices play a minor role in external adjustment.
Perraton and Turner (1999)	15 industrial countries (1957-1995)	SURE Technique	When the observations are weighted according to the relative shares in total GDP then there is a strong relationship between the predictions of Thirlwall's law and actual growth rates.
Perraton (2003)	51 developing countries (1973-95)	Error correction technique	For 27 countries the balance of payments constraint model countries is a good predictor of actual growth performance, particularly when the effect of terms of trade changes on import capacity are allowed for.
Kvedaras (2005)	10 CEE countries (1995-2004) quarterly data	Conditional Error Correction Model	The balance of payments constraint model captures well the disparity of growth rates of the income in 8 countries except Bulgaria and Hungary.
Pacheco-López and Thirlwall(2006)	17 Latin American countries (1977-2002)	McCombie (1989) test and rolling regression analyses	The balance of payments equilibrium growth rate is a good predictor of the growth performance in 9 of 17 countries.
Jeon (2009)	China (1979-2002)	ARDL-UECM and bounds testing	Thirlwall's law holds in China and there is a demand-oriented economic growth inChina.
Gouvea and Lima (2010)	A sample of Latin American and Asian countries	Johansen cointegration analysis and vector-error-correction	The original version of Thirlwall's law was hold for all sample countries except South Korea, and the multisectoral Thirlwall's law version was found to hold for all of them.
Felipe et. Al (2010)	Pakistan (1980-2007)	ARDL model	According to the findings Pakistan's actual growth is above itsbalance-of-payments constrained growth rate and the difference was covered by net inward capital flows.
Bagnai (2010)	22 OECD Countries (1960-2006)	Engle-Granger cointegration test and OLS	There is cointegration in 16 out of 22 countries. The findings support Thirlwall's law only in the second half of the sample.
Samimi et al. (2011)	Iran (1951- 2007)	ARDL Bounds Testing	Empirical results show that the Thirlwall's law has been rejected in Iran.
Grullón (2011)	Dominican Republic (1960-84 and 1985-2005)	ECM-based bounds testing	According to the findings, throughout the inward-oriented industrialization the balance of payments constrained growth rate of income exceed that outward-directed industrialization. This is determined by import-export income demand elasticity differentials.

4. Data and Empirical Results

The sample period covers quarterly data from 1987:1 to 2011:4 to test the weak and the strong form of Thirlwall's Law. The raw data have been collected from International Financial Statistics (IMF-IFS). Turkey's

export volume index, import volume index, export price index and import price index, real GDP index, terms of trade and world's real GDP index and export price index variables are used.

First of all, following export and import demand functions are created in Model (1) and Model (2) respectively (Houthakker& Magee, 1969: 112).

$$M_t = \beta_0 + \beta_1 Y_t + \beta_2 tt_t + \varepsilon_{1t} \quad (10)$$

$$X_t = \alpha_0 + \alpha_1 Z_t + \alpha_2 P_t + \varepsilon_{2t} \quad (11)$$

$\boldsymbol{\beta_0}$ and $\boldsymbol{\alpha_0}$are the constant terms; $\boldsymbol{\beta_1, \beta_2, \alpha_1, \alpha_2}$ are the slope terms; $\boldsymbol{\varepsilon_{1t}}$, $\boldsymbol{\varepsilon_{2t}}$are the error terms; m_t is the real import volume (LIMSA); $\boldsymbol{Y_t}$real GDP (LGDPSA), $\boldsymbol{tt_t}$ is the terms of trade (LTTSA), $\boldsymbol{X_t}$is the real export volume (LEXSA); $\boldsymbol{Z_t}$is the world's real GDP (LWGDPSA) and P_t is the rate of Turkey's export price index over worlds export price index (LPTSA).

The raw data are taken into natural logarithm and seasonally adjusted via Tramo-Seats method. Lee – Strazicich (2003) unit root test is used to examine whether the variables are stationary or not. Test results are given in Table 1.

Table 2. Lee-Strazicichunit root results

Series	(t-statistics) Values	Structural Breaks	
		1st Break	2nd Break
(LNIMSA)	-5,21 (1)	1995:4	2003:2
	-7,45 (3)*	1989:4	1999:2
(LNGDPSA)	-5,33 (7)	2000:4	2007:4
	-9,49 (0)*	1993:2	2008:1
(LNTTSA)	-5,44(3)	1990:3	2000:4
	-7,27 (3)*	1989:3	1991:1
(LNEXSA)	-4,37 (0)	2000:1	2006:4
	-13,94 (0)*	1997:2	1999:1
(LNWGDPSA)	-4,66 (3)	1991:4	2005:3
	-7,47 (0)*	1990:4	2008:2
(LNPTSA)	-6,07 (3)	2001:1	2008:1

1) Lag lengths are in paranthesis. There is no autocorellation for these lags.

2) Critical values for Lee&Strazicich test are taken from Lee and Strazicich (2003, 1084), i.e they are -5.59, -5.74, -5.71.

3) (*) indicates the results after first difference.

As to Table 1, it is identified that LPSA is I(0) and other variables are I(1). Therefore, we use ARDL model to get the long run relationship. So we get the following equations:

$$\Delta LNIMSA_t = \beta_0 + \beta_1 d1 + \beta_2 d2 + \beta_3 d3 + \beta_4 d4 + \sum_{i=1}^{m} \beta_{5i} \Delta LNIMSA_{t-i} + \sum_{i=0}^{m} \beta_{6i} \Delta LNGDPSA_{t-i} + \sum_{i=0}^{m} \beta_{7i} \Delta LNTTSA_{t-i} + \beta_8 LNIMSA_{t-1} + \beta_9 LNGDPSA_{t-1} + \beta_{10} LNTTSA_{t-1} + \varepsilon_{t1} \quad (12)$$

$$\Delta LNEXSA_t = \alpha_0 + \alpha_1 d1 + \alpha_2 d2 + \alpha_3 d3 + \alpha_4 d4 + \sum_{i=1}^{m} \alpha_{5i} \Delta LNEXSA_{t-i} + \sum_{i=0}^{m} \alpha_{6i} \Delta LNWGDPSA_{t-i} + \sum_{i=0}^{m} \alpha_{7i} \Delta LNPTSA_{t-i} + \alpha_8 LNEXSA_{t-1} + \alpha_9 LNWGDPSA_{t-1} + \alpha_{10} LNPTSA_{t-1} + \varepsilon_{t2} \quad (13)$$

Here crisis dummies are d1, d2, d3 and d4 are for the years 1989, 1994, 2001 and 2008 respectively. To establish the cointegration relation we have $\boldsymbol{H_0}$: $\boldsymbol{\beta_8 = \beta_9 = \beta_{10}}$= 0 and $\boldsymbol{H_0}$: $\boldsymbol{\alpha_8 = \alpha_9 = \alpha_{10}}$= 0 for Model (3) and Model (4) respectively. Calculated F –statistics is compared with the critical values in the Pesaran (et.al.,) (2001). If the calculated F-statistics is bigger than the upper bound value, it will be determined to have a long run relationship, i.ecointegration. Prior to determining cointegration for the equations lag lengths are found by Schwarz Information Criteria. These results are given in Table 2.

Table 3. Determining lag lengths

0	Model 3 (SIC)	Model 3 (BG)	Model 4 (SIC)	Model 4 (BG)
1	-2,45*	1,61 (0,2045)	-3,14*	3,01 (0,0546)
2	-2,35	0,02 (0,9746)	-3,12	0,54 (0,5836)
3	-2.24	0,35 (0,7005)	-3,04	0,53 (0,5871)

1) m, SIC, BG show lag lengths, Schwarz Information Criteria value, Breusch-Godfrey autocorrelation test F value, respectively. Probability values are in parenthesis.

2) There is no autocorrelation at the 5 % significance level.

3) * shows the fitting lag length.

Lag length is 1(one) for Model (3) and 1(one) for Model (4). As to results in Table 3, since calculated F statistics for Model 3 and Model 4 are bigger than the upper bound critical values there exist at least one long run relation between the variables in Model 3 and Model 4.

Table 4.Cointegrationresults

Cointegration Result (for Model 3)			
(k)	F- Statistics value	Critical Values	
		Lower Bound	Upper Bound
2	5,98	3,79	4,85
Cointegration Result (for Model 4)			
(k)	F- Statistics value	Critical Values	
		Lower Bound	Lower Bound
2	9,47	3,79	4,85

1) Critical values at the 5 % significance level are taken from Pesaran, Shin and Smith (2001, 300 (Table CI (iii)).

2) (k);indicates the number of independent variables in the Model (3) and Model (4).

Because of the existence of the cointegration relation, there will be no spurious regression. Thus, the variables at the level in the Model 1 and Model 2 are used to observe $\beta_1$and α_1 via Kalman Filter method for each models. The results are given in the Graph 1 and Graph 2.

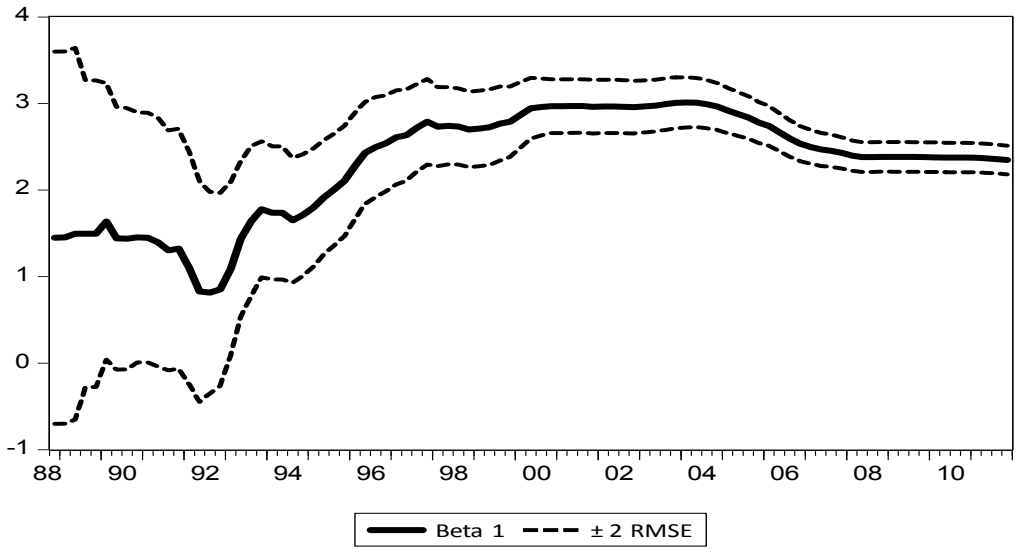

Figure 1. Kalmanfilter result (Model 1)

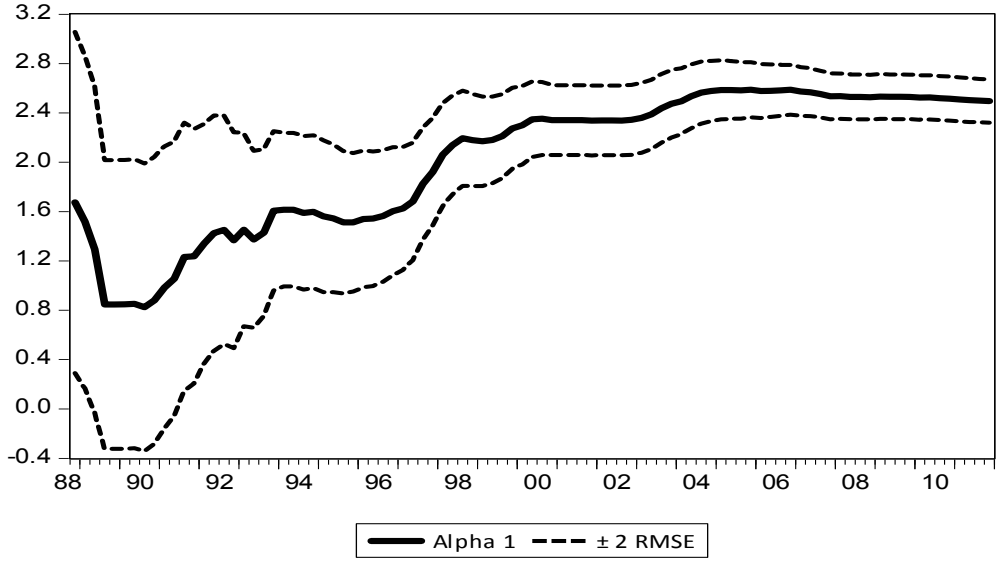

Figure 2. Kalmanfilter result (Model 2)

After getting β_1 and α_1 coefficients via Kalman Filter method, following Perraton (2003), to test the weak form of Thirlwall Law Model (5) is created.

$$\Delta G_t = \alpha_0 + \alpha_1 \Delta A_t + \varepsilon_t \tag{14}$$

In the Model (5), α_0 is the constant term, α_1 is the slope coefficient, ΔG_t is the predicted growth rate, ΔA_t is the nominal growth rate and ε_t is the error term. ΔG_t is calculated as dividing the real export growth rate by income elasticity of import (β_1).

Then, data belongs to ΔG_t variable is examined for the unit root via Lee –Strazicich (2003) unit root test. The result is given in Table(4).

Table 5. Lee-Strazicichunit root test result

Series	(t-statistics) Values	Structural Breaks	
		1st Break	2nd Break
ΔG_t	-9,78 (8)	1991:3	1998:4

1) Lag lengths are in paranthesis. There is no autocorellation for these lags.

2) Critical values for Lee&Strazicich test are taken from Lee and Strazicich (2003, 1084),i.e they are -5.59, -5.74, -5.71.

3) (*) indicates the results after first difference.

Since ΔG_t is stationary, Model (5) is estimated by OLS and α_0=0, α_1=1 hypothesis is tested via Wald Test. As to results in Table (5), null hypothesis is rejected at the 5 % significance level.

Table 6. Test results of weak form of Thirlwall Law

Variables	Coefficients	Probability Values
Constant term	0,006	0,006*
ΔA_t	0,194	0,033*
AR(1)	-0,280	0,006*
	Descriptive tests	
$R^2 = 0{,}14$, Breusch-Godfrey autocorrelation F statistics value = 0,91 (0,405) Wald Test F statistics value = 40,07 (0,000)		

1) Probability values are in parenthesis.

2) * indicates the variables that is significant at the 5 % significance level.

So it is concluded that weak form of Thirlwall Law is not valid for Turkey. To test the strong form of Thirlwall Law Model (5) is created.

$$\Delta P_t = \alpha_0 + \alpha_1 \Delta A_t + \varepsilon_t \tag{15}$$

In the Model (6), $\alpha_0$is the constant term, α_1 is the slope coefficient, ΔP_t is the predicted growth rate, ΔA_t is the nominal growth rate and ε_t is the error term. ΔP_t is calculated as dividing income elasticity of export (α_1) multiplying with world's real growth rate by income elasticity of import (β_1).

Then, data belongs to ΔP_t variable is examined for the unit root via Lee –Strazicich (2003) unit root test. The result is given in Table (6).

Table 7. Lee-Strazicichunit root test result

Series	(t-statistics) Values	Structural Breaks	
		1st Break	**2nd Break**
ΔP_t	-7,95 (7)	2007:2	2008:4

1) Lag lengths are in paranthesis. There is no autocorellation for these lags.

2) Critical values for Lee&Strazicich test are taken from Lee and Strazicich (2003, 1084),i.e they are -5.59, -5.74, -5.71.

3) (*) indicates the results after first difference.

Table 8. Test results of strong form of Thirlwall Law

Variables	Coefficients	Probability Values
Constant term	0,006	0,000*
ΔA_t	0,033	0,012*
AR(1)	0,533	0,000
	Descriptive tests	
$R^2 = 0{,}13$, Breusch-Godfrey autocorrelation F statistics value = 1,65 (0,197) Wald Test F statistics value = 2784,86 (0,000)		

1) Probability values are in parenthesis.

2) * indicates the variables that is significant at the 5 % significance level.

Since ΔP_t is stationary, Model (6) is estimated by OLS andα_0=0, α_1=1hypothesis is tested via Wald Test. As to results in Table (7), null hypothesis is rejected at the 5 % significance level. Therefore, it is concluded that strong form of Thirlwall Law is not valid for Turkey.

5. Conclusion

Thirlwall's law or balance of payment constraint growth model is modified in the course of the time. During this time this model's empirical validation is different empirical methods. The aim of this study is to test the validity of the Thirlwall's law for Turkey, for the period 1987-2011. After analyzing original model and its modifications

and literature review, this studies empirical analysis is divided in two paths. Firstly the weak form of the Thirlwall Law and then strong form of the Thirlwall Law is tested by Kalman filter method together with ARDL method. This method is totally different from the other studies done in the literature dealing with Thirlwall's Law. Kalman Filter approach has a key role since it gives the income elasticities of export and import for each year that we analyzed. Getting these values help us to observe the accurate testing results. As to results, it is stated that neither weak form nor strong form of the Thirlwall Law is valid for the period 1987-2011 in Turkey. For the further studies, instead of world's data different country group's data (EU countries, Asian countries and etc.) may be taken into consideration. Moreover, instead of total export and total import values, specific sector (automotive, textile and etc.) values may be taken into consideration.

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International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

The Impact of the Global Financial Crisis on the Integration of the Chinese and Indonesian Stock Markets

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Received: April 21, 2013 Accepted: June 8, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p69 URL: http://dx.doi.org/10.5539/ijef.v5n9p69

Abstract

The study investigates the integration of Chinese stock market with Indonesian stock market after the 2008 global financial crisis, by considering volatility spillover between the two countries. The study also considers the volatility spillovers effects of Japan and the U.S on Indonesian and Chinese stock markets. Exponential generalized autoregressive conditional heteroskedasticity model is employed for analyzing data series covering January 4, 2002 to December 20, 2011. The results indicate that Indonesian and Chinese stock markets have bidirectional return spillover effects before and after the 2008 global financial crisis. The results of volatility spillover effects provide evidence that Chinese stock market has unidirectional effect on Indonesia stock market after the financial crisis. We also found evidence of volatility spillover effect of the Japanese stock market on Indonesian stock market before and after the crisis, but we do not find volatility spillover evidence from the U.S to Indonesian stock market after the financial crisis. This finding indicates that besides Japan, China has increased its influence on Indonesian stock market after the global financial crisis, whereas the U.S has become less influential than before the crisis. This strong integration of the Chinese stock market in Indonesia market implies limited gains for portfolio diversification from the international portfolio investors.

Keywords: stock market, integration, spillover, volatility

1. Introduction

Chinese economy has, of recently, been playing an important role in the Asian region as well as across the globe following the impressive growth and large economic size. The economy overtook Japan and became second largest to United States (U.S) in 2010 (IMF, 2011). This made the Chinese stock market to equally take an important role in the world equity markets. Moreover, after the 2008 global financial crisis, the Chinese stock market became a large recipient of world investments, thereby, expanding its links with the Asian stock markets among world emerging stock markets (Kang, Kim and Yoon 2011). The impressive growth of the Chinese economy also opened up economic opportunities for Indonesian investors in terms of trade and investment. According to Chandra and Lontoh (2011) study, China became Indonesian's second largest trading partner behind Japan after overtaking the U.S in 2010. Similarly, Indonesian economy became China's fourth largest trading partner in the Asian region in 2010. This recent increase of trade ties between China and Indonesia has also deepened the investment relations between the two countries; as such Indonesian and Chinese stock markets have become important targets by investors of the two countries for their portfolio diversification. Besides that, the Indonesian stock market has for the past few years been one of the targeted markets in Asia by international portfolio managers including Chinese portfolio investors for investment following the impressive growth of the Indonesian economy (Hung and Cheung, 1995).

Given these recent economic developments between China and Indonesian, it is important to analyze whether the recent global financial crisis has played a role in China's economic integration with Indonesia. Particularly, it is worth investigating on whether the Indonesian financial market is sourcing new market information from the Chinese stock market taking into account that China is now the world's second largest economy and the largest in Asia. The underlying question is whether the Chinese financial market has become powerful in distributing and sourcing market information from other Asian markets, and in particular Indonesia, as the economy is growing its global importance. Currently, there are few studies that have analyzed the influence of Chinese stock

market on other stock markets within or outside the Asian region despite the significant role the Chinese economy is playing across the globe, and on Indonesian financial market in particular (Kang and Yoon, 2011; Kang, Kim and Yoon, 2011). The few studies present have only included Indonesia and China as part of their broader sample when analyzing stock market integration in the Asian region (Janakiramanan and Lamba, 1998; Ng, 2002; Gee and Karim, 2010; Joshi, 2011). This study, therefore, aims at examining the integration of the Indonesian and Chinese stock markets before and after the 2008 global financial crisis taking into account that China became Indonesia's world's second largest trading partner after this period. The study also considers volatility spillover effects from Japan and U.S stock markets to Indonesia and China as Japan still remains Indonesia's and China's largest trading partner while U.S is still the largest economy in the world.

Investigating and understanding the integration of the Indonesian stock market with Chinese stock market is important and interesting for a number of reasons. First, the Chinese economy has been growing impressively for the past 30 years, thereby becoming the world second largest economy after the U.S. in 2010; in turn, the Chinese stock market became one of the major world stock markets in terms of market capitalization and investments inflow (World Exchange, 2012). Considering these developments in the Chinese stock market, it is important to analyze and understand how the market is interacting with other markets in the world and particularly within the Asian region, such as Indonesian stock market. Secondly, it is believed that regional integration is strong when countries share common cultural aspects, business conditions and trade policies (Gebka and Serwa, 2007). China shares these characteristics with most regional counterparts, including Indonesia, such that the analysis of the volatility spillover effects within the Asian region should also be taking into account spillovers from China as one of the major stock market operating within the region. Thirdly, China is now the world's second-largest economy and the largest in Asia and a key trading partner of Indonesia indicating that the Chinese economy is now playing a key important role in Indonesian economy. Fourthly, the Chinese stock market is ranked among the five major world stock markets; indicating that the market is powerful in distributing and sourcing new market information in the region and also across the globe (World Exchanges, 2012). It is, therefore, interesting to know whether Indonesian stock market has developed a strong link with Chinese stock market taking into account the growing importance of the Chinese economy, especially after the 2008 global financial crisis, and also evidence provided by pre-crisis empirical literature which suggests that the Indonesian stock market was isolated from other Asian stock markets (Palac-McMiken, 1997; Roca et al, 1998; Janakiramanan and Lamba, 1998; Ibrahim, 2005). Such strong linkage between Chinese and Indonesian economies may have impact on financial markets thereby reducing their insulation as such any financial instability from one stock market may easily be transmitted to the other stock market, subsequently decreasing the benefits from portfolio diversification. Therefore, analysis of the Indonesian and Chinese stock market integration provides international portfolio managers with powerful information for the portfolio diversification and hedging strategies, and also policy makers to formulate appropriate policies when dealing with adverse economic events within the region.

However, it should also be noted that the Japanese stock market remains one of the most important international market across the globe and has strong economic ties with most economies within the Asian region. According to World Exchanges (2012), the Japanese stock market is ranked third among the top major world stock markets; hence, discussion of integration between Indonesia and China stock markets should take into account their co-movements with Japan as it provides important information to portfolio managers. In addition, studies have shown that the U.S stock market is influential in the Asian stock markets; however, after the global financial crisis, some studies indicate that the U.S influence in the Asian stock markets is becoming less dominant (Kang, Kim, Yoon, 2011). For these reasons, inclusion of Japan and the U.S stock markets when examining the integration of the Asian regional stock markets after the global financial crisis becomes indispensable. This analysis will contribute to the literature on the role that Chinese economy is playing on Indonesian economy. The rest of the paper is structured as follows: Section 2 provides a brief overview of literature related to stock markets in the Asian region. Section 3 provides methodology and Section 4 describes the data and empirical results. Section 5 concludes the paper.

2. Literature Review

The literature on stock market integration for both developed and developing countries is vast. Earlier studies show that national stock markets had lower interactions among themselves which suggested potential gains in international portfolio diversification (Grubel, 1968; Levy and Sarnat, 1970 and Solnik, 1974). Later after 1987 stock market crash, studies found evidence of increased interaction in international stock markets, especially in stocks traded actively on the major financial centers (Goldstein and Michael, 1993). More studies by Arshanapalli et al. (1995); Francis et al. (2002); Yang et al. (2003); Ibrahim (2005) Yu et al. (2007) and Majid et

al. (2008) followed and confirmed the cointegration of the stock markets after 1987 crisis.

On the Asian region, most studies have concentrated on analyzing the integration of emerging stock markets of the Asean countries (Indonesia, Malaysia, Philippines, Singapore and Thailand) either among themselves or with the Japanese and the U.S stock markets and most of them focus on the period before or after 1997 Asian financial crisis. Earlier regional studies show that the Indonesian stock market was isolated from the Asean stock markets and integrated to the U.S and the Japanese stock markets. For instance, Palac-McMiken (1997) found that all Asean stock markets are linked to each other with exception of Indonesia. Moreover, Roca et al (1998) study found that there were short-run linkages among the Asean stock markets except with Indonesia. Further, Janakiramanan and Lamba (1998) study provide evidence that the Indonesian stock market was not linked to other regional Asian markets. In 2005, Ibrahim also analyzed the international linkages of the Indonesian stock market with Asean markets before and after 1997 Asian financial crisis by using cointegration approach and vector autoregressive (VAR) model. The results found no cointegration evidence between the Indonesian stock market and the other Asean stock markets, including the Japanese and the U.S stock markets for both periods. The results, further, indicated that the Indonesian stock market was responsive to Japanese and the U.S stock markets but was segmented from Asean stock markets after the crisis.

In contrast, McCauley et al. (2002) investigated the East Asian bond and loan market integration in the post crisis period of 1999-2002. The study results provide evidence of integration of both bond and loan market during this period. Ratanapakon and Sharma (2002) examined the short-run and long-run relationships of the Asian regional stock prices during the pre and post Asian financial crisis. The results indicate the degree of linkages between the stock markets during and after the crisis. In 2004, Hsin examined the same market which was investigated by Engle and Susmel (1993) and found regional transmission effects are stronger than international effects especially for Europe and Asia. Similar results were found by Gebka and Serwa (2007) who investigated stock markets of the Central and Eastern Europe, Latin America and South East Asian. Worthington and Higgs (2004) also investigated the transmission of equity returns and volatility for the three Asian developed stock markets of Hong Kong, Japan and Singapore and six Asian emerging stock markets of Indonesia, Korea, Malaysia, Philippines, Taiwan and Thailand by using weekly returns for the period between January 1, 1988 and October 6, 2000. MGARCH-BEKK model was employed to identify the source and magnitude of spillover effects. The results suggest that there was no homogenous mean return spillover effects from developed to emerging markets. Moreover, the volatility spillover were higher from own market volatility than cross market volatilities indicating weak integration. Gee and Karim (2010) also investigated return and volatility spillover effects among the five Asian stock markets and their interaction with the U.S and Japan after the Asian crisis. They employed exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model using daily observations from March 1, 1999 to December 31, 2007 to investigate the intraregional and interregional spillover effects. Their results show that the returns of the Asean-5 stock markets highly depend on own past returns. The results further indicate that the Asean-5 stock markets are more influenced by the U.S stock market as compared to the Japanese stock market. The results also show evidence of intra-regional linkage among the Asean-5 stock markets.

In 1997, Liu and Pang examined the Japanese and the U.S equity markets influence on the four Asian markets and the study found that the return and volatility spillovers from the U.S. market are more influential in transmitting information in the four countries. Michelfelder and Pandya (2005) support Liu and Pang (1997) results after finding that the U.S market has dominant influence in the Asian region comparing to the Japanese stock market. However, Ghosh et al (1999) using cointegration theory investigated the influence of the Japanese and the U.S stock markets on the Asian-Pacific stock markets. The results show that Indonesia, Philippines and Singapore stock markets co-move with the Japanese market, while Hong Kong, India, Korea and Malaysia co-move with the U.S stock market. Ng (2000) collaborates this finding after investigating return and volatility spillover effects between Japan, the U.S and Asian stock markets using generalized autoregressive conditional heteroskedasticity (GARCH) model. The results show that Japan and U.S have unidirectional volatility spillover effects on the Asian stock markets. In 2002, Johnson and Soenen investigated the degree of integration of 12 Asian-Pacific stock markets with Japan. The results indicate that there is high integration between Australia, China, Hong Kong and New Zealand and the Japanese stock market. Mulyadi and Anwar (2012) also investigated the volatility spillovers between Indonesia, U.S and Japan capital markets from January 1, 2004 to December 31, 2008. The study employed GARCH (1,1) model for the analysis and the results indicate bidirectional volatility spillover between Indonesia and Japan stock markets, while the U.S has unidirectional volatility spillover effect on the Indonesian stock market. The results suggest that volatility spillover is not just one way from developed stock market to emerging market but can also be a two way system.

On the other hand, literature shows few studies that have investigated the interaction of the Chinese stock market with regional Asian counterparts. The few studies presented mainly focus on the co-movements and return spillovers within Mainland China and fewer on return and volatility spillover effects between China and the regional Asian stock markets. For instance, Laurence, Cai and Qian (1997) examined the causal relationship among the Chinese stock markets and the results show a strong causal relationship from the Shanghai B-share to other Chinese markets whereas there was feedback causal relationship between Shanghai A- and Shenzhen B-share markets. However, Kim and Shin (2000) study found Shanghai A-share market leading the Shenzhen B-share market before 1996, but such relationship was found to be disappearing or reversing after 1996. Chan, Lo and Cheung (1999) also found that there was a lead-lag stock market return transmission among the Chinese stock markets of Shanghai and Shenzhen and also with stock markets from Hong Kong and Taiwan.

In 1998, Chakravarty, Sarkar and Wu analyzed cross return correlations among the Chinese stock indices (A- and B-share) with those from Hong Kong, Japan, and the U.S and results provide evidence of bivariate cross return correlations among the Chinese market, and also with market indices from Hong Kong, Japan, and the U.S. However, Greenewold, Tang and Wu (2004) study found that the Mainland China stock markets are relatively isolated from regional markets of Hong Kong and Taiwan. Furthermore, Cheng and Glascock (2005) found that the Chinese stock markets are not cointegrated among themselves or with Japan and the U.S markets. Li (2007) also analyzed the linkages between Shanghai and Shenzhen stock markets within China with Hong Kong's Heng Seng and the U.S S&P500 market using Multivariate GARCH-BEKK (MGARCH-BEKK) model (named after Baba, Engle, Kraft and Kroner)for daily observations between January 4, 2000 and August 17, 2007. The study results indicate weak integration between Heng Seng and the two China stock markets (Shanghai and Shenzhen) as there was unidirectional volatility spillovers from Heng Seng to the two Mainland Chinese stock markets. The results further indicate no evidence of volatility spillovers between the Chinese and the United States stock markets suggesting that the two markets are not integrated. In 2009, Yi explored the information transmission among the Chinese, Japanese and Korean stock markets. The results indicate no evidence of volatility spillovers between China and Korean stock markets. Kang and Yoon (2011) also investigated the volatility spillovers effects among five Asian stock markets of China, Hong Kong, Korea, Singapore and Taiwan and how the 2008 global financial crisis influenced return and volatility transmission among the markets. They employed a VAR (1)-bivariate GARCH-BEKK model using daily series between January 2, 2006 and January 31, 2011. Their results show that China has stronger linkages with the other four Asian stock markets after the 2008 global financial crisis; suggesting that the stock market integration within the region has been intensified.

Kang, Kim and Yoon (2011) also examined the volatility spillover effect between Chinese and Korean stock markets after global crisis using VAR (1)-bivariate GARCH-BEKK model. The study data covered the period from January 2, 2006 to September 30, 2010. The study results indicate bi-directional volatility spillover effect before the crisis and uni-directional effect from the Chinese to Korean stock markets after the crisis. The findings suggest dominance of the Chinese stock market over the Korean stock market after the global financial crisis. Joshi (2011) also examined the return and volatility spillover among India, Hong Kong, Japan, China, Jakarta and Korea stock markets using multivariate GARCH-BEKK model from January 2, 2007 to February 29, 2010. The study findings show that most of the stock markets have bi-directional return, shock and volatility spillover effects. The results further indicate that cross-market spillover are lower than own volatility spillover suggesting weak integration of the Asian stock markets.

Thus, the examined literature suggests stock market dependency among some Asian countries. Besides, the literature has shown that Asian stock markets are also integrated with developed countries stock markets. However, the literature also indicates that it is difficult to decide about strict segmentation or perfect integration among the markets. On the Asian region, literature review suggests availability of few studies that focus on integration of the Indonesian stock markets with China despite strong economic ties the two countries share in terms of trade and investment besides sharing of similar cultural aspects. The few available pre-Asian financial crisis studies suggest that the Indonesian stock market is isolated from other Asian stock markets. On the other hand, the post 1997 Asian financial crisis studies suggest that the Asian stock market are intensifying their integration among themselves and also with Japanese and the U.S and stock markets. However, there is need to investigate further on the Asian stock market integration with China after 2008 global financial crisis when the Chinese economy became world's second largest and largest in the Asian region.

3. Methodology

One of the interesting features of financial time series data is that 'bad' news has more pronounced effect on volatility than 'good' news. As a result, current return volatility has a strong negative correlation with the future return volatility (Sheu and Cheng, 2011). This asymmetric response is often called 'leverage effect'. It is

important, therefore, to have a model that can capture such leverage effects in the time series data. Autoregressive Conditional Heteroskedasticity (ARCH) model is perhaps the most popular as it pertains to financial time series data. ARCH models were introduced by Engle (1982) and later generalized as GARCH (Generalized ARCH) by Bollerslev (1986) and Taylor (1986). Multivariate Exponential GARCH (EGARCH) model as proposed by Nelson (1991) and Threshold GARCH (TGARCH) model as proposed by Glosten, Jaganathan and Runkle (1993) are two relevant models that reflect the leverage effect.

The multivariate EGARCH model is adopted in this analysis of volatility spillovers effects of Indonesian, Chinese, Japanese and the U.S. stock markets. The model is important as it captures the contemporaneous correction between the stock prices. The model is also able to improve the efficiency and the power of the tests for the volatility spillovers across the countries (Koutmos and Booth, 1995). The EGARCH modeling is also important in our analysis as it copes with the situation of asymmetry in the volatility transmission mechanism as the effect of stock market volatility in the given market is divided into local market and cross market innovations (Gee and Karim, 2010). The model also captures the asymmetric effect of bad and good news on the conditional variance and hence allowing the evaluation of bad and good news generated in the domestic stock market to the next trading market (see Koutmos and Booth, 1995; Gee and Karim, 2010; Rafaget and Muhammed, 2012). Moreover, EGARCH models allow inclusion of dummy or explanatory variables in the conditional mean and variance equations depending on the study objectives (Kanas, 2000; Miyakoshi, 2002; Olowe, 2009; Rafaget and Muhammed, 2012).

The specification of EGARCH model used in this analysis is expressed as:

$$R_{i,t} = \alpha_{i,0} + \sum_{k=1}^{n} \beta_{i,k} \varepsilon_{k,t-1} + \varepsilon_{i,t} \quad \text{for } i,k = 1,2,\ldots, n \text{ and } i \neq k \tag{1}$$

$$\varepsilon_{i,t} / \Omega_{t-1} \sim iid \qquad N(0, h_t) \tag{2}$$

where equation (1) is the mean equation containing dependant variable returns ($R_{i,t}$) for index i at time t which depends on $\alpha_{i,0}$ standing for drift term; $\beta_{i,k}$ for $i=k$ is for spillovers across markets and $\beta_{i,k}\ \varepsilon_{k,t-1}$ is for autocorrelation in the returns resulting from non-synchronous trading (Hamao et al, 1990). This conditional mean equation is the first empirical analysis step. Equation 2 is a mathematical expression for error term which is independently and identically distributed with mean zero and constant variance.

Following, Koutmos and Booth (1995), Antoniou et al (2003) and Gee and Karim (2010), we model the conditional variance of the EGARCH as:

$$\sigma^2_{i,t} = \exp[\ \alpha_{i,0} + \sum_{k=1}^{n} \alpha_{i,k} f_k(z_{k,t-1}) + \delta_i \ln(\sigma^2_{i,t-1})] \quad \text{for } i,k = 1,2,\ldots, n \text{ and } i \neq k \tag{3}$$

In this equation (3) $\sigma^2_{i,t}$ is the traditional variance in market i and k expressed as an exponential function of the past standard innovation $(Z_{k,t-1}=\varepsilon_{k,t-1}/\sigma_{k,t-1})$ from own market and cross markets. The coefficient $\alpha_{i,k}$ for $i, k=1, 2,\ldots, n$ and $i \neq k$ is a volatility spillovers across markets and a positive and significant $\alpha_{i,k}$ together with a negative δ_k means that negative news of market i has a greater effect on the volatility of market k as compared to the positive news. The persistence in volatility is given by δ_i where unconditional variance is finite if $\delta_i<1$ and does not exist if $\delta_{i=1}$ and in such a case conditional variance is believed to have followed an integrated process of order one. Asymmetric transmission shock from one market to other market is expressed in equation (4) where relative asymmetry is measured by covariance $\sigma_{i,k,t} = \rho_{i,k}\sigma_{i,k}\sigma_{i,t}$ for $i, k=1, 2,\ldots, n$ and $i \neq k$.

$$f_k(z_{k,t-1}) = \left(|z_{k,t-1}| - E\left(|z_{k,t-1}|\right) + \gamma_k z_{k,t-1}\right) \quad \text{for } k = 1,2,\ldots, n \tag{4}$$

In equation (4), asymmetry is estimated by partial derivative and can be derived as

$$\partial f_k(z_{k,t}) / \partial z_{k,t} = 1 + \gamma_k \quad \text{if } z_k > 0$$

$$\partial f_k(z_{k,t}) / \partial z_{k,t} = -1 + \gamma_k \quad \text{if } z_k < 0 \tag{5}$$

Asymmetry is said to be present if γ_k is negative and significant in equation (4) above. The term $|z_{k,t}|$-$E(|z_{k,t}|)$ measures the magnitude of the impact. If $\alpha_{i,k}$ in equation (3) is assumed to be positive, the effect of $z_{k,t}$ on σ^2 will be negative if the magnitude of $z_{k,t}$ is smaller than its expected value $E(|z_{k,t}|)$. The magnitude effect of $z_{k,t}$ is

reinforced or offset depending on the sign of the innovation, whereas the relative importance of the leverage effect is measured by $|-1+\gamma_k|/(1+\gamma_k)$ ratio.

Assuming there is normal conditional joint distribution of the returns of all the stocks markets; the multivariate EGARCH model estimated using a maximizing log likelihood function is expressed as:

$$L(\varphi) = -0.5(NT)\ln(2\pi) - 0.5\sum_{i=1}^{T}\left(\ln|H_t| + \varepsilon_t' H_t^{-1}\varepsilon_t\right) \quad (6)$$

where φ is the parameter vector to be estimated; N is number of the equations; T is the number of observations in the sample; H_t is N x N time-varying conditional variance covariance matrix and ε_t is the vector of innovations at time t.

4. Data and Preliminary Analysis

The study uses daily closing indices of Jakarta Composite Index (JCI) of Indonesia; Shanghai Stock Exchange (SSE) of China, Nikkei 225 (N225) of Japan, and Standard and Poor's 500 Stock Index (S&P500) of the U.S from January 4, 2002 to December 30, 2011. This period is selected to account for market tranquility after the Asian Crisis in 1997 which devastated the Indonesian's economy and September 11, 2001 attack of the U.S which had adverse effect on world stock markets. The daily closing indices of the stock market index have been chosen due to the nature of the stock transaction on a daily basis. The day to day transaction is able to capture the movement of the stock index in comparison with the monthly data. It is not an absolute judgment that the daily data is the best but it is relatively better to some extent. The daily data represents the movement of the daily stock index fluctuations which could not been captured clearly by the monthly index. The stock returns in this analysis are expressed as first differences of natural logarithm index of prices:

$$R_t = lnP_t - lnP_{t-1} \quad (7)$$

where R_t represents stock return at time t, ln stands for natural logarithm, P_t represents the closing stock market index at time t and P_{t-1} is stock market index at time $t-1$.

The data series is drawn from the Bloomberg Information Network. In order to examine the impact of 2008 global financial crisis, our full sample is divided into two sub-samples of pre-crisis period covering January 4, 2002 to August 30, 2008 and post-crisis period covering September 16, 2008 to December 30, 2011. The periods were chosen with consideration of the evidence that September 15, 2008 was known as the day when Lehman Brothers declared their bankruptcy.

Figure 1 shows the time plot of the price series of the four stock markets for the whole sample period. All the stock markets exhibit a decline in the price series around 2007. The series also depict similar movement and are trending upwards from around 2009. Figure 2 presents the returns of the share price indices during the sample period, the indices show that large (small) volatilities are followed by large (small) volatilities indicating volatility clustering characteristics in the four markets.

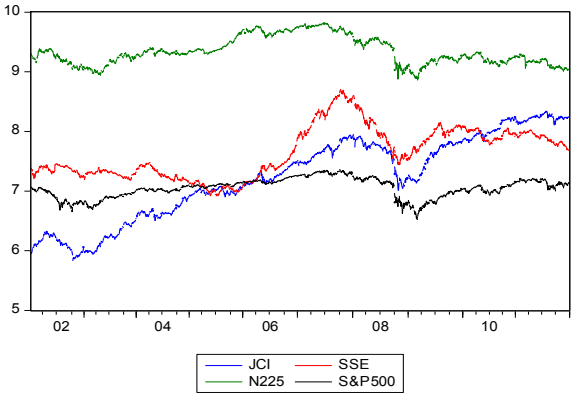

Figure 1. Stock price indices from 2002 to 2011

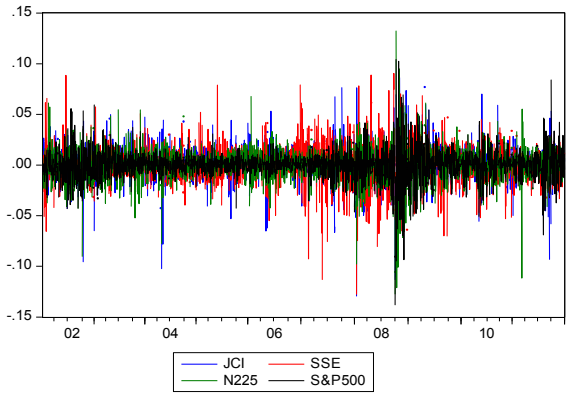

Figure 2. Stock market returns of the share price indices

Table 1 presents the descriptive statistics of the returns for our data series before and after the 2008 global financial crisis. The table shows that all the mean returns for the countries under study are positive before the crisis with the Indonesian stock market earning higher returns. In the post-crisis period, Indonesia has positive mean returns where China, Japan and the U.S have negative stock returns. The standard deviations in the pre-crisis period ranges from 1.1 percent in U.S to 1.8 percent in China indicating that Chinese market was most volatile during this period. The post crisis standard deviations range from 1.88 percent in Indonesia to 2.1 percent in Japan indicating that Indonesia was least volatile as compared to China, Japan and U.S. This analysis suggests that emerging countries offer higher returns than developed markets; however, the markets are characterized by higher volatilities.

The values of skewness show that the return series are skewed negatively demonstrating that asymmetry prevails in all the stock returns. The kurtosis values of stock returns for both periods are greater than 3 indicating thicker tails and a higher peak than a normal distribution. The Jarque-Bera (JB) statistics are highly significant at 1 percent level indicating rejection of normal distribution for all returns. The Ljung-Box (LB) Q test statistics with 36 lags rejects the null hypothesis of no serial correlation at 1 percent significance level. Similarly, the Ljung-Box Q^2 (36) confirms the presence of serial correlation of squared returns as the null hypothesis of no serial correlation is rejected at 1 percent significance level. The four return series are heteroscedastic as evidenced by the significance of ARCH effects with 12 lags as shown in Table 1 indicating that the variance of residuals are not constant, but time varying, and therefore, we cannot assume that $u \sim N(0, \sigma^2)$ as in the ARMA model. This, then, favours the GARCH model which deals with ARCH/GARCH features. Table 2 reports the correlation matrix results of the four countries under investigation. The results show that the returns in both periods are positively correlated with each other. The results also indicate that the degree of correlation became stronger in the period after the crisis as compared to period before the crisis. The matrix further highlights that in both periods there exist a highest correlation between the Indonesian and the Japanese stock markets.

Table 1. Summary of statistics for daily market returns

	Pre-Crisis Period				*Post-Crisis Period*			
	JCI	SSE	N225	S&P500	JCI	SSE	N225	S&P500
Mean	0.0010	0.0006	0.0020	0.0001	0.0006	-0.0060	-0.0007	-0.0001
Std. Dev.	0.016	0.018	0.015	0.011	0.018	0.019	0.021	0.020
Skewness	-0.949	-0.302	-0.437	-0.127	-0.419	-0.154	-0.685	-0.499
Kurtosis	10.76	8.544	6.8212	6.013	9.139	5.433	10.935	9.745
J-B	3539.56	1725.17	852.21	506.96	1204.48	188.68	2034.63	1458.86
Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LB(36)	38.013	52.269**	50.328*	57.628**	41.533	33.218	63.368**	34.95
LB^2(36)	163.83**	226.37**	187.64**	1279.8**	378.85**	291.91**	1167.7**	1008.6**
ARCH(12)	11.350**	6.252**	6.815**	20.915**	13.212**	4.964**	45.064**	22.197**

Note: ** and * indicate significance at 10% and 5% levels.

Table 2. Correlation matrix for the stock market returns

	JCI	SSE	N225	S&P500
Pre-Crisis Period				
JCI	1.00000			
SSE	0.18371	1.00000		
N225	0.42149	0.18486	1.00000	
S&P500	0.09259	0.02103	0.17796	1.00000
Post Crisis Period				
JCI	1.00000			
SSE	0.35050	1.00000		
N225	0.57388	0.35695	1.00000	
S&P500	0.30375	0.12113	0.29082	1.00000

5. Empirical Results

Table 3 presents results of the exponential GARCH (EGARCH) model for the mean and volatility spillover equations for the pre-crisis and post-crisis period based on the maximum likelihood estimation. The mean spillover equation results for Indonesia show that during the pre-crisis, the current stock returns are predicted by the past stock returns as the coefficient β_{11} is significant at 1 percent level. The results also indicate that during the period, there was cross-market return spillover influence from China and Japan stock markets to Indonesian stock market as evidenced by the significance of β_{12} and β_{13} coefficients at 1 percent level. However, we found that the U.S stock market has no influence on the Indonesian stock market return as the coefficient β_{14} is not significant. The post crisis period results show that apart from the own past innovations effect, the Indonesian stock market returns are also affected by the return spillovers from the Chinese, Japanese and the U.S stock markets.

The mean spillover equation results for the Chinese stock market show that the current mean returns are not predicted by own market return either in pre-crisis or post-crisis period as the coefficient β_{22} is insignificant at 1 percent level in both periods. Our results corroborate findings of Chang (2010), Kang and Yoon (2011) and Joshi (2011) on the influence of the Chinese stock market in Asian countries. The results also indicate that Chinese stock returns are not influenced by the U.S stock market returns in both pre and post-crisis periods; however, there are cross-market return spillover effects from Indonesia and Japan to the Chinese stock market during these periods. The statistical significance of β_{12} and β_{21} at 1 percent level suggest that the Indonesian and Chinese stock markets have bidirectional return spillover effects between them before and after the crisis. Further, the results indicate that the Japanese stock market is more influential in the regional Asian countries after the 1997 Asian financial crisis. Thus, the improvement in the Japanese return earnings led to upward adjustments of earnings in Indonesia and China.

The results of volatility spillover equations indicate that the current stock market volatility in the Japanese and the U.S markets have effects on the future volatility of the Indonesian stock market before the 2008 financial crisis. In the period after crisis, we found evidence of significant transmission of volatility from the Chinese and the Japanese stock markets to Indonesian stock market; though, there are no cross-market volatility spillovers from the U.S to the Indonesian market as the coefficient α_{14} is found to be statistically insignificant at either 1 percent or 5 percent level. On the Chinese market, we found cross market volatility spillover effects from the Japanese market in the pre-crisis period, but we do not find the volatility spillover effects from Indonesia and the U.S stock market. In the post-crisis, the coefficients of the past innovations for Indonesia, Japan and the U.S stock markets are insignificant indicating that the past stock markets volatilities shocks do not have effects on the current volatilities of the Chinese stock market. This suggests that the Chinese stock market has a weak linkage with international stock markets despite the rapid economic growth.

The insignificance of α_{12} and significance α_{21} at 1 percent level after the crisis suggests that the Chinese stock market has unidirectional volatility spillover effects on the Indonesian stock market after the 2008 global financial crisis. This indicates that news about shocks in the Chinese stock market affects the volatility of the Indonesian stock market. On the contrary, the U.S stock market has less influence on the Indonesian market during the post-crisis as shown by the insignificance of α_{14} at 1 percent level. The results indicate that the Indonesian stock market is integrating more with the Chinese and the Japanese stock markets than the U.S stock market in the aftermath of the 2008 global financial crisis. The findings are consistent with previous studies of Kang and Yoon (2011) and Kang, Kim and Yoon (2011) who found an increase of the Chinese stock market influence on the Asian regional economies after the 2008 global financial crisis.

The values of the parameters (δ_i) for the persistence of volatility for both Indonesia and China are highly significant in both periods indicating that volatility persistence takes a long time to die out. We calculated the half-life of a shock by using $\ln(0.5)/\ln(\delta_i)$ formula. The calculated half-life values for Indonesia are 1.52 days and 12.39 days in pre and post-crisis period respectively, suggesting that the market adjustment from the cross market shocks was relatively efficient before than after the crisis. The stock market efficiency in the pre-crisis period may be attributed to the tranquility of major stock markets across the globe during this period. On the other hand, the Chinese market has half-life values of 49.88 days before the financial crisis and 41.92 days after the crisis, indicating that volatility was taking long time to decay during the period before the crisis. The Chinese efficiency estimates are consistent with the fact that Chinese stock market remain less integrated from the international markets, hence, the previous day own market information is a good predictor of next day's market transactions. The findings are consistent with Johansson and Ljungwall (2009) and Wang (2010) who found that the Chinese stock markets have a weaker interaction with the international markets before the 2008 global financial crisis. However, the decrease in the number of days after the global financial crisis suggests the intensification of integration of the Chinese market with other markets.

The asymmetry parameters (γ_i) are negative and only significant for Indonesia for both pre and post-crisis periods. The negative sign indicates that bad news have more pronounced effect than good news. We compute asymmetry ratio for both countries using $|-1+\gamma_i|/|1+\gamma_i|$ formula. The results demonstrate that the bad news impact is 1.64 times larger than the good news impact in Indonesia during the period before the crisis and 1.2 times after the crisis. For China, the negative news impact is 1.01 times as big as the positive news impact during the pre-crisis period and 1.04 times in the post-crisis period. The findings are consistent with the finance theory as the investors' reaction to bad news tends to be more pronounced than the good news.

The p-value of Q-statistics up to 36 lags are all insignificant indicating that the conditional mean equations are correctly specified and provide an adequate description of the data series as there is no autocorrelation problems.

Table 3. Return and volatility spillovers models

	JCI (*i =1*)	SSE (*i =2*)	JCI (*i =1*)	SSE (*i =2*)
	Pre-Crisis Period		***Post-Crisis Period***	
Price spillover parameters				
β_{i0}	0.001[0.0004]**	0.0001[0.0004]	0.001[0.0004]**	-0.001[0.001]
β_{i1}	0.111[0.032]**	0.088 [0.027]**	-0.007[0.008]**	0.296[0.041]**
β_{i2}	0.056[0.015]**	-0.026 [0.028]	0.179[0.025]**	0.020[0.040]
β_{i3}	0.372[0.019]**	0.093 [0.028]**	0.397[0.022]**	0.167[0.039]**
β_{i4}	0.012 [0.024]	0.015 [0.034]	0.139[0.022]**	0.008[0.029]
Volatility spillover parameters				
α_{i0}	-3.422 [0.408]**	-0.234[0.046]**	0.677[0.119]**	-0.209[0.057]**
α_{i1}	0.426 [0.052]**	1.369[0.860]	0.261[0.042]**	-2.134[1.283]
α_{i2}	0.891 [1.149]	0.161[0.019]**	-5.352[1.484]**	0.101[0.022]**
α_{i3}	-7.761 [1.880]**	-4.231[0.967]**	-4.977[1.418]**	2.362[1.662]
α_{i4}	6.761 [1.843]**	2.483[1.515]	0.894[1.692]	-1.270[1.644]
Other parameters				
δ_i	0.6432 [0.046]**	0.9862[0.005]**	0.9456[0.012]**	0.9836[0.005]**
Half-life	1.52	49.88	12.39	41.92
γ_i	-0.2437 [0.032]**	-0.002[0.009]	-0.0844[0.023]**	-0.0201[0.013]
Relative asymmetry	1.64	1.01	1.18	1.04
Diagnostic tests				
Q (36) statistic	30.089 (0.704)	42.777 (0.172)	42.805 (0.143)	28.893 (0.716)
Q^2 (36) statistic	24.432 (0.910)	20.805 (0.973)	34.526 (0.443)	31.787 (0.577)

Note: (i) *i =1, 2, 3* and *4* which stands for JCI, SSE, N225 and S&P500 (ii) Values in [ ] are standard errors and (iii) p-Values are reported in ( ) (iv) ** and * indicate significance at 1% and 5% levels respectively.

6. Conclusion

The study examines the integration of the Indonesian and Chinese stock markets. In particular, we investigate return and volatility spillover effects between the two stock markets before and after the 2008 global financial crisis using the exponential GARCH (EGARCH) model. The analysis also takes into account return and

volatility spillovers effects from the Japanese and the U.S stock markets. The inclusion of the Japanese and the U.S stock markets was to determine their level of influence in the Indonesian stock market in the aftermath of global financial crisis.

The empirical results have shown that Indonesia and China have bidirectional return spillover effects before and after the crisis. We also found strong cross-market return spillover effects from Japan to Indonesia and China in both periods. However, our results have revealed that the Chinese stock market returns are not influenced by the U.S stock market. The volatility spillover results provide no evidence of volatility spillover effect from China to Indonesia during the pre-crisis period, but such volatility spillover evidence is found after the crisis. The results also show less dominance of the U.S stock market in influencing Indonesian stock market in the post-crisis period than before the crisis. On the part of China, our results have shown that the Chinese stock market is not influenced by return and volatility spillovers from Indonesia, Japan and the U.S in the post-crisis period suggesting less influence of international stock markets on the Chinese stock market. Our volatility transmission results imply that besides Japan, China is becoming one important source of market information for Indonesia after the global crisis. On the contrary, we found less dominance of the U.S stock market on Indonesian and Chinese stock markets after the global financial crisis than before it.

Our results have clearly shown that the Chinese stock market has increased its linkages with the Indonesia market after the global financial crisis indicating the important role the global financial crisis has played in integrating the two economies. This increased integration of the Chinese and Indonesian stock markets implies that portfolio diversification using these two markets has limited gains for portfolio investors as the Indonesian market is no longer insulated from Chinese stock market shocks. Thus, portfolio investment decisions in the Indonesian stock market, and possibly other regional Asian stock markets, should be taking into consideration the volatilities signals from Chinese stock market. The results also provide important information for development of hedging strategies to the portfolio investors in the two countries as well as policymakers when formulating policies for safeguarding their financial markets.

Acknowledgements

We are grateful to Professor Charles Mataya for his guidance and invaluable assistance in coming up with this research paper.

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International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971XE-ISSN 1916-9728
Published by Canadian Center of Science and Education

The P-Star Model of Inflation and Its Performance for the Kenyan Economy

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Received: June 11, 2013 Accepted: June 10, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p82 URL: http://dx.doi.org/10.5539/ijef.v5n9p82

Abstract

The aim of this study was to extend the P-Star methodology by applying an alternative approach to the derivation of the foreign price gap; to estimate the P-Star model using Kenyan data over the period from 1960 to 2011 and finally, to compare the forecasting performance of the P-Star model with alternative inflation models. The results from the estimated P-Star model show that the domestic price gap has highly significant positive effects on inflation in Kenya with the implied result that a 1 per cent increase in domestic price gap leads in the subsequent period to an increase in inflation by 0.5 per cent. On the other hand, the foreign price gap was found to have insignificant effects on inflation. When forecasts from the P-Star model are compared with forecasts from alternative inflation models, the P-Star model outperforms these models. Policy wise, the results in this study underscore the usefulness of the P-Star model in providing forecasts of inflation for Kenya.

Keywords: P-Star Model, inflation, price gap, exchange rate, output gap, Kenya, forecast evaluation

1. Introduction

Inflation forecasting is considered crucial for monetary policy operations given the need to control inflation and ensure minimal deviation from target. Kenya is no exception in this respect as the country has in the past suffered major setbacks on the inflation front yet at the same time striving to maintain a target level of inflation as prescribed by the authorities. The country experienced double digit inflation on many occasions since 1974 (figure 1). The highest level of inflation ever experienced was however in 1993 when inflation rose to 46 per cent. Due to the incessant macroeconomic instability in the 70's and 80's the Kenya Government embraced radical reforms under the IMF and World Bank structural adjustment programs. The reforms led to interest rate decontrols in 1991, liberalization of the exchange rate in 1993 and the repeal of the Exchange Control Act in 1995. Price stability has been maintained since then and it is only recently that inflationary pressures have again been felt owing to several factors. These include the post election violence of 2008 which disrupted supplies, the global financial crisis as well as the recent euro-zone crisis. The crises have resulted in frequent inflationary pressures with inflation for instance rising to 26 per cent in 2008. Inflation therefore remains the country's major concern and is monitored closely by the monetary authorities; hence the need to come up with a framework for forecasting and monitoring inflation in Kenya. The P-Star model presents such an opportunity to predict inflation and could provide a forecasting solution as required by monetary authorities.

The P-Star model of inflation, proposed by Hallman, Porter &Small (1991) follows the quantity theory of money. P-Star in itself represents the equilibrium price level, that is, the price level which is consistent with prevailing level of money supply given potential output (y*) and long-run velocity of money (v*). The P-Star model postulates that the deviation between actual price level (P) and equilibrium price level (P-Star or simply P*) determines inflation in the economy. If actual price level falls below the equilibrium price level, prices will be expected to rise thus suggesting an increase in inflation. Prices will rise until equilibrium is restored. On the other hand, if prices rise above equilibrium price level, prices will be expected to decline thus suggesting a decline in inflation. This decline in prices occurs to restore prices to equilibrium level. Thus, the gap between the actual price level and the equilibrium price level, referred to in this case as the "domestic price gap" determines the rate of inflation. How close this relationship is remains an empirical issue.

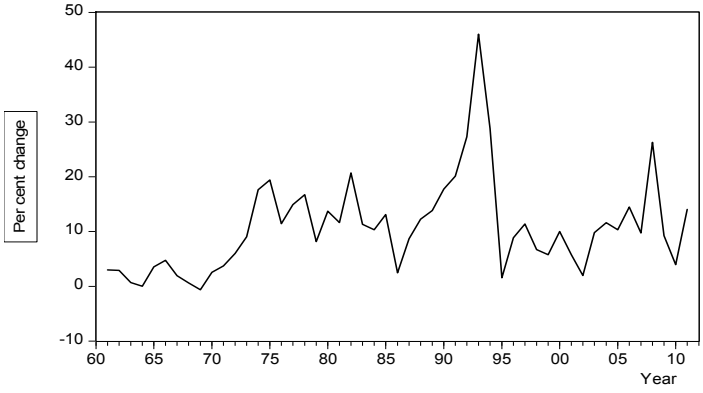

Figure 1. Kenya's infiation rate: 1960-2011

The P-Star model has been tested in a number of countries. In some, the P-Star model is a great success in predicting inflation or just as good as other models in forecasting. Subsequent research has applied different versions of the P-Star model. In some studies the price gap has been decomposed to reflect disequilibrium in the money market (v*-v) and disequilibrium in the goods market (y-y*). Thus, the price gap is a comprehensive indicator of inflationary pressure which combines information on the goods market (output gap) and the money market (liquidity gap). It is therefore an extended relationship. The impact of monetary policy on inflation is transmitted through real demand or the output gap. Some early studies (e.g. Kool and Tatom, 1994) indicated that the P-Star model achieved more favorable results in large developed economies. The dismal performance in small open economies was attributed to major effects of imported inflation in these economies. Thus, subsequent studies tried to resolve this problem by incorporating a measure of the foreign price gap in addition to the domestic price gap in order to improve the performance of the P-Star model in small open economies. In this respect, consideration of the foreign price gap is relevant in examining inflation dynamics in Kenya. In the literature, the foreign price gap has been derived borrowing heavily from purchasing power parity (PPP) relationships.

The purpose of this study is therefore threefold: to extend the P-Star methodology by applying an alternative approach to the derivation of the foreign price gap; secondly, to estimate the P-Star model using Kenyan data over the period from 1960 to 2011 in order to test the relevance and performance of the P-Star model in the Kenyan context and finally, to compare the forecasting performance of the P-Star model with alternative inflation models. This study fills an existing gap in the literature since there are very few studies examining the performance of the P-Star model in developing economies and no such study has been undertaken for Kenya.

This study is organized as follows: section 2 below reviews literature; sections 3 and 4 discuss the methodology and data used in analysis, respectively. Section 5 discusses the empirical results and their interpretations while section 6 concludes the study and presents a brief discussion of policy implications.

2. Overview of the Literature

Empirical analysis initially revolved around assessing the theoretical underpinnings of the P-Star model, while at the same time evaluating the significance of alternative measures of the price gap. In fact, while advancing the P-Star model, Hallmark, Porter and Small (1991) argued that the P-Star approach provides a reference point that takes into account all past money growth so that the P-Star model becomes more relevant in assessing long-term price developments. Atta-Mensah (1996) examined this view by testing the significance of cumulative growth of M1 and the deviations of M1 from its long-run path within the framework of the P-Star model. The study concludes that the cumulative growth of M1 and M1 gaps are useful for predicting the long-run path of inflation thus validating the P-Star approach. Scheide and Trabandt (2000) considered two main methods for calculating the price gap in the Euro Area: a long-run money demand function estimated in which the price gap is just the residual and the equilibrium values of output and velocity which are used to define the price gap. They found the residual not a driving force in the inflation process and therefore adopted the latter measure of price gap. Many studies consider the price gap as a whole but also use in analysis the decomposed price gap into output gap and liquidity gap (i.e. deviation of velocity from long-run level).

Some early studies such as Kool and Tatom (1994) found that the original P-Star methodology as introduced by Hallmark, Porter and Small (1991) worked well for large advanced economies and not very well for small open

economies. Consequently, Kool and Tatom attributed this finding to the likely effects of imported inflation in these economies. Since then, the foreign price gap was introduced to account for these external factors. Going by the formulation in Kool and Tatom, (1994), the foreign price gap applies more to countries pursuing fixed exchange rates or countries that observe a peg of the domestic currency to that of a dominant global currency such as the dollar. It could still apply in a liberalized exchange rate regime such as Kenya's since despite liberalization of the exchange rate in Kenya the public continues to monitor the Kenya Shilling-US dollar exchange rate expecting monetary authorities to intervene whenever the exchange rate experiences major fluctuations. Policy analysts and the public at large thus push for stability in the exchange rate which if strictly done would produce an unannounced peg to the US dollar. These are the considerations in Kool and Tatom (1994) while extending the P-Star model to incorporate the foreign price gap as their study considers the case of one large country which provides an anchor for the system. By setting its monetary policy to achieve own domestic goals, the dominant country provides an anchor for smaller economies. Small economies take the anchor country's monetary policy as given and commit themselves to a fixed exchange rate objective. Thus, a price gap determined abroad through the exchange rate constraint is expected to influence domestic inflation. Kool and Tatom show that in these circumstances monetary authorities do not determine their own long-run price level. Instead their long-run equilibrium price level is imported from countries whose currency is the basis of the peg. By incorporating the foreign price gap, they were able to improve the model's fit for all the economies studied. The findings by Kool and Tatom (1994) and subsequent applications of their approach thus emphasize the importance of accounting for imported inflation in the study of inflation dynamics in developing economies.

The significance of the price gaps (domestic and foreign) as evaluated in various studies has yielded strong support for the P-Star model. Application of the P-Star model by Tsionas (2000) incorporating both domestic and foreign price disequilibria was found to work quite well in the case of the Greek economy. Foreign and domestic price disequilibria were found to be important determinants of Greek inflation. However, domestic disequilibria were found considerably important. Scheide and Trabandt (2000) use the price gap as the long-run relationship and other variables are added to the regression to capture the short-run dynamics. The resulting loading coefficient of the price gap is quite high (i.e. 0.18). It implies that a price gap of one per cent today leads to almost 0.2 per cent more inflation in the next quarter. The response of consumer prices to the price gap is strongly positive. Other factors such as raw material prices and unit labour costs also have some explanatory power. Qayyum and Bilquees (2005) show that compared to the simple autoregressive model and the M2 growth augmented model, the P-star model can be used to obtain the leading indicator of inflation in Pakistan because it has additional information about the future rate of inflation. Pallardo and Esteve (1999) tested the performance of the P-Star model for the Spanish economy and as expected, the coefficient on the price gap (P-P*) is strongly significant and negative. Results show that the model works reasonably well at explaining short-run dynamics for prices. Frait, Komárek and Kulhánek (2000) applied the P-Star model to a time series from the period 1991 to 1998. They conclude that the inflation dynamics in the Czech Republic follow the premises of the P-Star model. The foreign component of the price gap seems to be more relevant than the domestic one. This result confirms the hypothesis that equilibrium price level in the Czech Republic is significantly affected by German monetary policy through the explicit and implicit connection of the Koruna's exchange rate to the DEM or later the Euro.

A number of studies have also evaluated the forecasting performance of the P-Star model. In some countries, the P-Star model turns out a more powerful tool compared to other models while in other countries it is just as good. Qayyum and Bilquees (2005) find that the P-Star based indicator of inflation performs better than autoregressive models and M2 growth indicator in forecasting future inflation. Hallman, Porter and Small (1991) evaluated actual and forecasted inflation rates for various models. The study finds that the forecast from the price gap model contains useful information beyond that contained in the forecasts from the other models. Christiano (1989) argue that in terms of the square root of mean squared error (RMSE) the P-Star model outperforms the T-bill model at all horizons. However, in terms of bias and average absolute error the T-bill model outperforms the P-Star model at all forecast horizons. Hoeller and Poret (1991) tested in-sample tracking ability and forecasting performance of P-Star model for 20 OECD countries. For most countries, P-Star equations outperform other simple financial-market-based inflation models.

3. Methodology

The starting point in the analysis of the P-Star model of inflation is the quantity theory of money which is of the form.

$$M_t V_t = P_t Y_t \tag{1}$$

Where, M is money Stock

V is velocity

P is domestic price level

Y is real output

Equation (1) can be rewritten as price equation,

$$P_t = \frac{M_t V_t}{Y_t} \tag{2}$$

Taking the equilibrium price level consistent with money supply, M, to be P* and considering that P* corresponds to potential or equilibrium output and the long-run level or equilibrium velocity, equation (2) can be rewritten as,

$$P_t^* = \frac{M_t V_t^*}{Y_t^*} \tag{3}$$

Where the asterisk represents equilibrium value or long-run level of the variable;

Dividing through by $P_t = \frac{M_t V_t}{Y_t}$ we obtain,

$$\frac{P_t^*}{P_t} = \frac{M_t V_t^*}{M_t V_t} \times \frac{Y_t}{Y_t^*} \tag{4}$$

Taking natural logs and redefining the variables and using small letters for the log form of the variables, we have,

$$p_t^* - p_t = (v_t^* - v_t) + (y_t - y_t^*) \tag{5}$$

Equation (5) decomposes the price gap (p*-p) into velocity gap (v*-v) and output gap (y-y*).

To relate the price gap to inflation, an error correction model is adopted to combine the long-run component and the short run dynamics. Hence,

$$\Delta P_t = \alpha_0 + \alpha\left(p_{t-1}^* - p_{t-1}\right) + \sum_{t=1}^{n} \beta_i \Delta p_{t-i} + \varepsilon_t \tag{6}$$

α is the speed of adjustment of prices to long run price level, P_t^*.

Equation (6) is a conventional error correction model (ECM) and has been applied in empirical analysis by also expanding the price gap in the manner stated in equation (5). Equation 6 predicts that if P_t is below P_t^*, inflation will rise as actual price level adjusts upwards towards its equilibrium level. Conversely, if P_t is aboveP_t^*, inflation will fall due to the downward adjustment of prices towards equilibrium. Similarly, no change in inflation occurs if P_t=P_t^*. In brief, the price gap predicts the direction of movement of inflation and hence is a good indicator of inflation.

The price gap discussed so far is the domestic price gap. Going by the significance of foreign price gap in a number of studies already discussed in this paper, equation (6) needs to be extended to include a foreign price gap. The foreign price gap has been discussed extensively in Kool and Tatom (1994). They derived a foreign price gap based on monetary approach to balance of payments. In this paper we deviate somehow by examining instead the link between competitiveness and inflation, following the approach in Kamin and Klau (2003) thus allowing for an alternative derivation of the foreign price gap. In this latter approach, a small open economy is considered which basically produces, consumes and exports a home good whose price in domestic currency is P^H. The small open economy also imports and consumes a foreign good. The adjustment in home prices is attributable to aggregate demand changes. The price of the foreign good given in domestic currency is P^F which in effect is foreign price stated in foreign currency multiplied by the nominal exchange rate. The real exchange rate is therefore given as P^F/P^H. Using an asterisk to denote and distinguish the equilibrium real exchange rate level from the actual level, the equilibrium (or long-run) real exchange rate can be given asP^{F*}/P^{H*}. An increase in the real exchange rate defined in this manner represents depreciation while a decrease represents an appreciation. Assuming a partial adjustment of actual real exchange rates to its long-run level or equilibrium,

$$\log\left(\frac{P_t^F}{P_t^H}\right) = \log\left(\frac{P_{t-1}^F}{P_{t-1}^H}\right) + \lambda\left[\log\left(\frac{P_{t-1}^{F*}}{P_{t-1}^{H*}}\right) - \log\left(\frac{P_{t-1}^F}{P_{t-1}^H}\right)\right] \tag{7}$$

It can be shown after some manipulation that changes in home prices (inflation) relate to foreign prices and also the deviation between actual and equilibrium real exchange rates[1], that is,

$$\Delta \log P_t^H = \Delta \log P_t^F + \lambda \left[\log\left(\frac{P_{t-1}^F}{P_{t-1}^H}\right) - \log\left(\frac{P_{t-1}^{F*}}{P_{t-1}^{H*}}\right) \right] \quad (8)$$

λ is the adjustment coefficient and takes values between 0 and 1. $1/\lambda$ is the speed of adjustment. Equation (8) states that if the actual real exchange rate rises above equilibrium value, prices of home goods increase, resulting in inflation. Thus, deviation of the real exchange rate above equilibrium level leads to build-up of inflationary pressure. The measure of foreign price gap being proposed is therefore the real exchange rate deviation from equilibrium. In figure 2, the proposed measure is shown to be very close to the measure initially proposed by Kool and Tatom (1994) and applied by Tsionas (2001) and Frait et al (2000) among others[2].

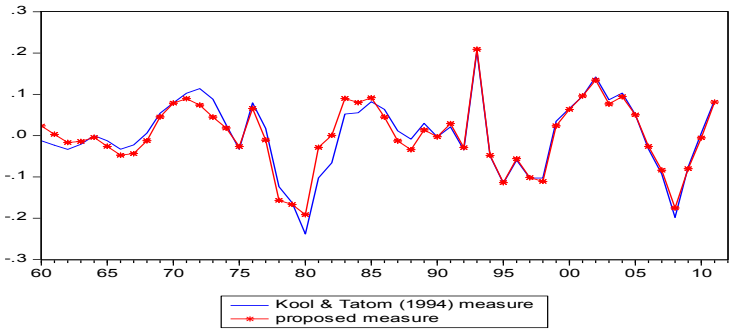

Figure 2. Measures of the foreign price gap for Kenya: Kool and Tatom (1994) versus proposed measure

This study therefore incorporates the foreign price gap which can be redefined for ease of presentation as(rer_{t-1}-rer^*_{t-1}). Hence, equation (6), can be rewritten to yield the following dynamic equation to be estimated in the study,

$$\Delta P_t = \alpha_0 + \alpha_1\left(p_{t-1} - p^*_{t-1}\right) + \alpha_2(rer_{t-1} - rer^*_{t-1}) + \sum_{i=1}^{n}\beta_i \Delta p_i + \sum_{j=1}^{m}\delta_j \Delta rer_j + \tau_i Z_i + \varepsilon_t \quad (9)$$

Where rer is actual level of the real exchange rate and rer* is the equilibrium real exchange rate.

Equation (9) incorporates both domestic and foreign price gaps. However, other exogenous variables (represented by Z_i) will be included to proxy for foreign shocks (i.e. changes in world commodity and fuel prices) and domestic factors (i.e. foreign exchange market liberalization, post-election violence, etc.) with potential to contribute to domestic inflationary pressure.

4. Data

Data is obtained from the World Bank African Development Indicators. The definition of variables is given in table 1. The data obtained from the World Bank are GDP in constant prices, money supply ($M_{2)}$ and Kenya consumer price index (CPI). From the International Financial Statistics of the IMF are obtained nominal exchange rate for the Kenya shilling – US Dollar and US consumer price index. The United States, being a large economy is considered to proxy for the rest of the world.Therefore the real exchange rate (rer) is obtained by taking the product of the nominal exchange rate and US CPI and dividing by Kenya's CPI.

The domestic price gap has been defined as the difference between the log of CPI and the trend of log of CPI. The trend of log CPI is derived using the Hodrick –Prescott Filter with a smoothing parameter of 100. A similar approach is applied to derive output gap by computing the difference between the log of real output and the trend of log real output as derived using Hodrick- Prescott Filter. As argued byLim and Papi (1997) the difference between actual and equilibrium real exchange rates provide a measure of disequilibrium in the external sector that impacts on price developments. The expected sign of exchange rate disequilibrium is positive; when real exchange rate is more depreciated than its long run level, upward pressure on inflation follows. In this study, a partial adjustment process to equilibrium of the real exchange rate is assumed such that deviations from equilibrium real exchange rate are expected to impact positively on prices and inflation. The Hodrick-Prescott

filter is used to derive the long-run level of the real exchange rate. The difference between observed real exchange rates and the estimated long-run values represent deviations from equilibrium or foreign price gap (rer-rer*).

Table 1. Definition of variables

Variable	Definition
M	Money supply, M_2
P	Consumer Price Index, CPI
Y	Real GDP
P- P^*	Domestic Price Gap (Log CPI –Log CPI trend)
rer-rer^*	Foreign price gap (log RER-logRERtrend)
Oilp	World oil price
FDP	World food price
YGAP	Output gap (y-y*)
DUM1993	Dummy variable to proxy for foreign exchange market liberalization; 1993=1, zero otherwise
DUM2008	Dummy variable to proxy for post-election violence with negative supply effects; 2008=1, zero otherwise

5. Empirical Results and Interpretations

In figure 3, the log of CPI is compared with the log of P-star. The deviation between the two is shown in figure 4 and compared with actual inflation series. Although there was major deviation between CPI and P-star in the early 90's, a strong positive relationship between the two series is visible albeit with a lag over some periods. The relationship between foreign price gap and inflation as shown in figure 5 is however not very clear as it tends to be negative over most of the period. One can note however the strong positive relationship in the early 90's during the exchange rate liberalization interval.

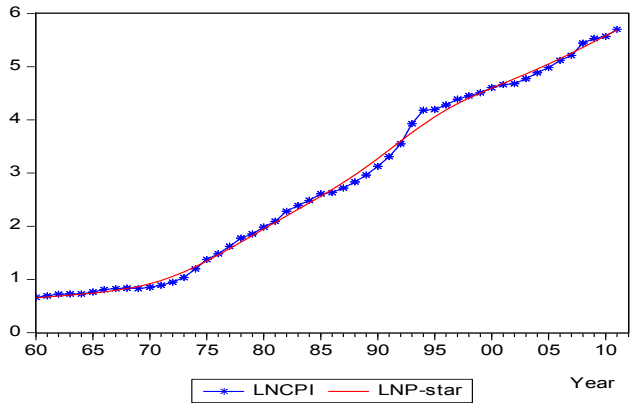

Figure 3. Logaritmic values of consumer price index (lnP) and P-Star (lnP^*)

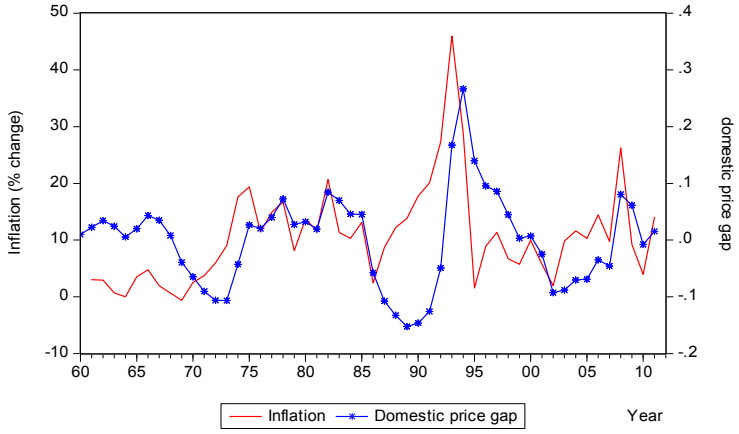

Figure 4. Domestic price gap and inflation

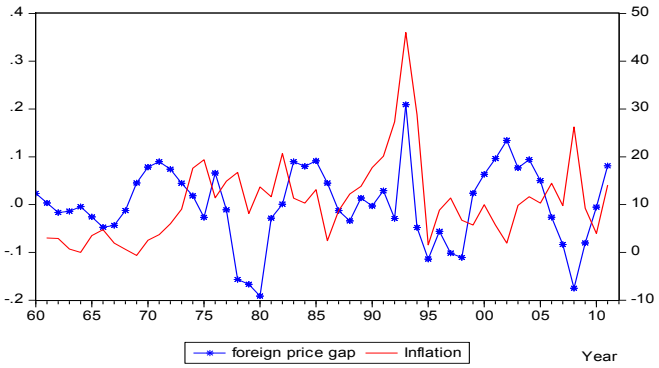

Figure 5. Foreign price gap (logarithmic value) and inflation (% change)

Unit root tests are given in table 2 and were carried out using Augmented Dickey Fuller and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. The results show that money supply, price level, real exchange rates and world food and fuel prices are integrated of order 1 and hence become stationary upon differencing. Domestic and foreign price gaps as well as output gap are found to be stationary and therefore enter the estimation without differencing.

In the estimation that follows and results displayed in table 3, the P-Star model equations (referred to as models 1&2) are compared with alternative inflation equations; namely, two models which incorporate output gap (models 3 &4), and a simple univariate autoregressive model (model 5). As shown in figure 6 and based on the partial autocorrelation function (PACF), an autoregressive model of lag order one is found to be sufficient for our analysis. The lag order for the AR model was identified using the partial autocorrelation function and the Akaike information criterion (AIC).

Table 2. Unit root tests[a]

Variable	levels		Differences	
	ADF	**KPSS**	**ADF**	**KPSS**
Money, log(M)	-2.275	0.93**	-6.068**	0.379
Prices, log(P)	0.642	0.959**	-3.522*	0.321
Output, log(Y)	-1.689	0.947**	-4.845**	0.326
Real Exchange rate, log(RER)	-0.517	0.164	-6.386***	0.228
Domestic price gap, (p*-p)	-3.722**	0.037	-	-
Foreign price gap (rer-rer*)	-3.653**	0.033	-	-
Oil price, log(oilp)	-0.658	0.771**	-7.185**	0.097
World food price, log(FDP)	-1.409	0.66*	-5.289**	0.115
Output gap (YGAP)	-5.198**	0.041		

[a]ADF is the augmented Dickey-Fuller test while KPSS is Kwiatkowski-Phillips-Schmidt-Shin test statistic. * indicates 5% level of significance while ** indicates 1% level of significance. Significance of the ADF test statistic indicates rejection of the null hypothesis of non-stationarity. The significance of the KPSS statistic implies the opposite, that is, rejection of the null hypothesis of stationarity. In the latter case therefore, rejection implies the series has unit root or is integrated of order (1).

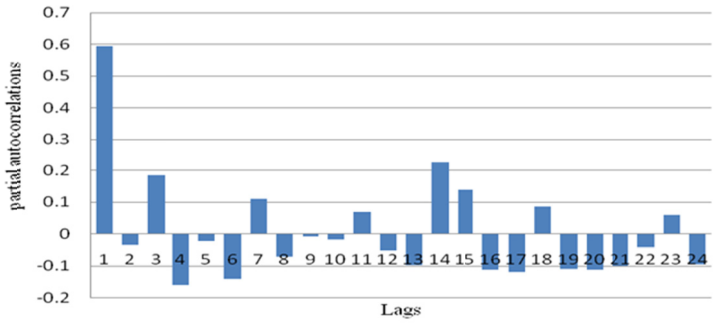

Figure 6. Partial Autocorrelation Function (PACF) for ΔlnP

As indicated in table 3, out of the estimated models, the first two do test for the significance of the price gap terms, third and fourth models analyze the significance of output gap and the fifth is the univariate autoregressive model. Because of the close association between world food prices and world oil prices, we chose to test the significance of these two variables individually by running separate regressions. For a start, Model 1 incorporates the domestic price gap and foreign price gap. Also included in the estimation are oil prices and two dummy variables to capture effects of exchange rate liberalization in 1993 and the supply shocks related to post election violence combined with onset of the global financial crises of 2008. Model 2 on the other hand is estimated with independent variables which include domestic and foreign price gaps lagged one period, real exchange rate and change in world food prices. Results of the analysis shows that the domestic price gap is highly significant at 1 per cent and has positive effects on inflation with the implied result that a 1 per cent increase in price gap leads in the subsequent period to an increase in inflation by 0.5 per cent. The foreign price gap has negative and insignificant effect on inflation. However, the change in the real exchange rate has highly significant positive effect on inflation. An increase in competitiveness by 1 per cent leads to close to 0.3 per cent inflation in subsequent period. World oil price is significant at 5 per cent level and has expected positive effect on inflation. Two dummy variables are found to be highly significant; dummy variable capturing the exchange rate liberalization of 1993 and the post election violence of 2008 both of which had the effect of raising inflation. In model 2, World food prices have significant positive effects on inflation. A 1 per cent increase in world food prices however leads to 0.08 per cent inflation compared to 0.03 per cent inflation resulting from 1 per cent fuel price increase. Past inflation contributes significantly to current inflation suggesting a high level of persistence of inflation. High inflation will therefore persist into the future. Overall, domestic price gap is more significant in Kenya's case than the foreign price gap in predicting inflation. This complements the findings by Kool and Tatom (1994) who find that the domestic price gap is more important in flexible exchange rate regimes.

The insignificance of the foreign price gap suggests that agents consider the deviation from equilibrium of the real exchange rate as transitory and thus more likely to reverse in the period ahead. Theoretically, as the real exchange rate depreciates beyond its long-run level, aggregate demand is expected to increase. The increase in

aggregate demand consequently pushes up domestic prices owing to increased cost of imported inputs and upward price adjustments by local firms which produce import substitutes and possibly second round effects of higher wage demands. The increase in prices of domestic goods leads to an appreciation of the real exchange rate thus pushing the real exchange rate back to its long-run level. On the other hand, if the real exchange rate is more appreciated than its long-run level, aggregate demand declines, domestic prices fall and the real exchange rate depreciates towards its long-run level. Based on the definition of the exchange rate in this paper, a more depreciated exchange rate is expected to move downwards towards equilibrium level in response to aggregate demand changes while a more appreciated exchange rate is expected to move upwards towards equilibrium. Any deviation from equilibrium is therefore followed by aggregate demand changes which in effect reverse the deviation from equilibrium, thus suggesting that the real exchange rate deviation is transitory in nature. Similar views have been expressed in Cerisola and Gelos ((2005) in their study of inflation in Brazil. They found that longer lags of the real exchange rate result in negative signs suggesting transitory nature of real exchange rate deviations from equilibrium.

Table 3. Parameter estimates: P-Star Models (models 1&2), models incorporating output gap (models 3&4) and univariate autoregressive model (model 5)

Dependent variable: first difference of log(P), (ΔlnP)

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model5**
Constant	0.003 (0.008)	0.006 (0.009)	0.033 (0.012)***	0.049 (0.011)***	0.045 (0.011)***
ΔlnP_{t-1}	0.552 (0.059)***	0.546 (0.062)***	0.424 (0.086)***	0.439 (0.085)***	0.488 (0.128)***
ΔlnP_{t-3}	0.346 (0.061)***	0.360 (0.064)***	-	-	
$(p-p^*)_{t-1}$	0.449 (0.06)***	0.474 (0.062)***	-	-	
$(rer-rer^*)_{t-1}$	-0.075 (0.056)	-0.080 (0.059)	-	-	
$\Delta lnRER_{t-1}$	0.273 (0.052)***	0.273 (0.056)***	0.282 (0.07)***	0.268 (0.078)***	
$\Delta lnOilp_t$	0.037 (0.014)***	-	0.049 (0.021)**		
$\Delta lnOilp_{t-1}$	0.0263(0.014)*	-	0.039 (0.02)*		
Dum1993	0.026 (0.029)***	0.172 (0.031)***	0.239 (0.042)***	0.258 (0.045)***	0.215 (0.023)***
Dum2008	0.180 (0.028)***	0.138 (0.029)***	0.149 (0.042)***	0.142 (0.044)***	0.142 (0.007)***
$\Delta lnFDP_{t-1}$	-	0.076 (0.031)**		0.129 (0.055)**	
$\Delta lnFDP_{t-4}$				0.114 (0.056)**	
YGAP			0.361(0.183)*		
$YGAP_{t-1}$				0.353 (0.186)*	
$R^2_{adj.}$	0.872	0.86	0.71	0.68	0.58
D.W.	2.127	1.94	1.52	1.74	1.79
Serial correlation LM test (p value)	F=0.171 (0.843)	1.444(0.249)	2.199(0.125)	1.222(0.306)	0.924(0.405)
Normality test (p value)	J-B =2.039 (0.361)	0.179(0.914)	0.463(0.793)	0.974(0.614)	1.93(0.381)
Heteroskedasticity test (p-value)	F=0.731 (0.678)	0.518(0.836)	1.19(0.33)	0.888(0.525)	2.654(0.06)
RESET test (p-value)	F= 0.544 (0.465)	0.024(0.861)	0.292(0.593)	0.175(0.678)	1.27(0.266)
AIC	-4.199	-4.135	-3.442	-3.369	-3.076
SC	-3.802	-3.802	-3.091	-3.054	-2.923

Note: Standard errors of estimates appear in the parentheses.* signify 10% significant levels, ** signify 5% significant levels while ***signify 1% significance level. Residual normality is tested using Jarque-Bera (J-B) statistic. AIC and SC are Akaike Information Criterion and Schwarz Criterion respectively.

Models 3 & 4 show estimated results for two inflation models which incorporate output gap with one incorporating also oil prices and another world food prices as proxy for world commodity prices. In model3, the output gap turns out to be significant at 10 per cent level of significance. Current and previous changes in the log of oil prices are found to be significant at 1 per cent and 5 per cent levels of significance respectively. The change in the real exchange rate remains highly significant at 1 per cent level of significance. In model 4, output

gap was found to be significant also at 10 per cent level of significance. First and fourth lags of food prices are significant at 5 per cent level of significance. The change in real exchange rates is highly significant at 1 per cent level of significance. The same applies to the two dummy variables which remain significant at 1 per cent level of significance. The first lag of inflation is also highly significant at 1 per cent level of significance, confirming once again inflation persistence. In the simple univariate autoregressive model (model 5), lagged inflation is highly significant at 1 per cent significance level. The two dummy variables are also highly significant at 1 per cent level of significance as in the other models. The information criterion for each model is given which clearly indicate that the P-Star model is more parsimonious going by the maximized log likelihood function of Akaike Information Criterion (AIC) and Schwarz Criterion (SC) for models 1 and 2 compared to models 3, 4 and 5.

In summing up, the following key results are derived:

- Domestic price gap is significant at 1 per cent significance level.
- The coefficient on foreign price gap is negative and insignificant. However, the coefficient on the change in real exchange rates is positive and highly significant at 1 per cent significance level.
- Past inflation is highly significant at 1per cent significance level across the estimated models.
- Change in the log of world oil prices is highly significant at 1 per cent significance level.
- Change in the log of lagged world food prices is significant at 5 per cent significance level.
- Output gap is significant at 10 per cent level of significance.

Next, a forecast evaluation is carried out comparing the forecasts of the five alternative models; the two P-star model variants, the two model variants which incorporate output gap and the simple univariate autoregression model (see table 4 and figures 7-11). In the evaluation, static model solutions and dynamic model solutions are obtained and compared across models. The Static model solution is basically a one-step-ahead forecast while the dynamic solution allows for multi-step ahead forecasts. The forecast evaluation is based on five measures: root mean squared error, mean absolute error, theil inequality as well as bias and variance proportions. The P-star model outperforms forecasts of the rest of the models. The P-star model has lower forecasting error and the mean and variance of the forecasts closely approximate actual values. This finding holds for both set of forecasts from static and dynamic model solutions. Figures 7-11 show the dynamic solution to models 1-5, again demonstrating the superior forecasting performance of the P-Star model.

Table 4. Inflation forecast evaluation

	Root mean squared error		Mean absoluteerror		Theil inequality coefficient		Bias proportion		Variance proportion	
	static	dynamic	static	dynamic	static	dynamic	static	dynamic	Static	dynamic
Model 1	0.024	0.025	0.019	0.019	0.094	0.100	0.000	0.054	0.027	0.000
Model 2	0.025	0.031	0.020	0.025	0.101	0.124	0.000	0.031	0.032	0.001
Model 3	0.036	0.044	0.029	0.035	0.144	0.180	0.000	0.000	0.068	0.222
Models 4	0.038	0.046	0.031	0.037	0.151	0.184	0.000	0.000	0.078	0.186
Models 5	0.048	0.059	0.038	0.048	0.200	0.252	0.000	0.000	0.135	0.336

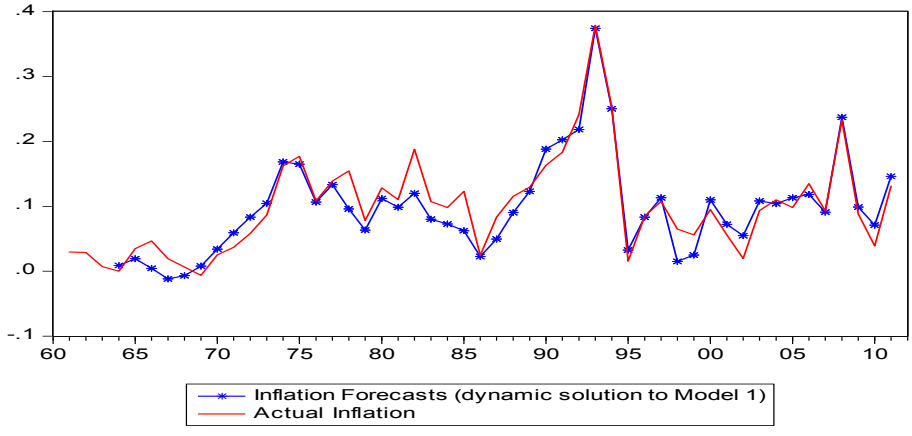

Figure 7. Model 1 Inflation forecasts (dynamic solution of the model)

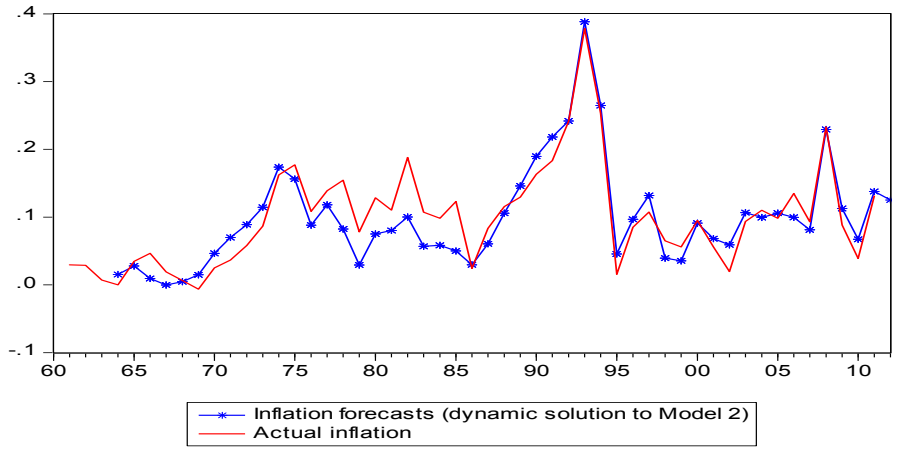

Figure 8. Model 2 inflation forecasts

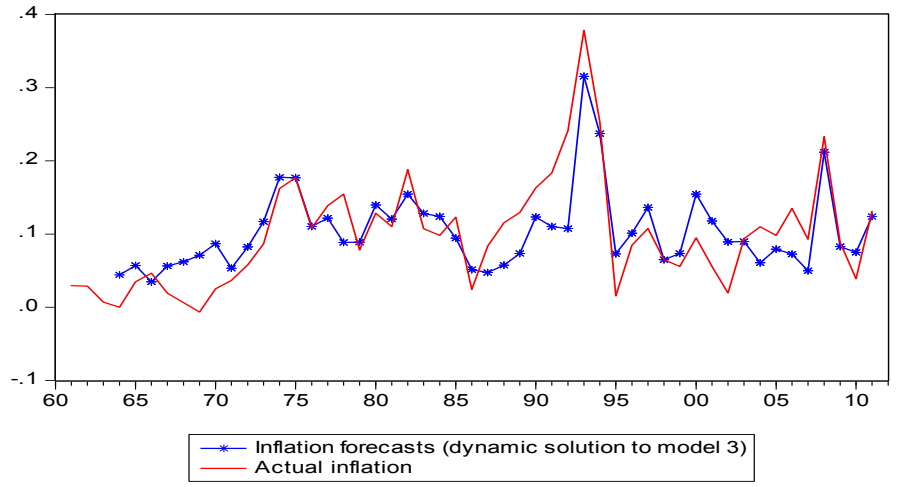

Figure 9. Model 3 inflation forecasts

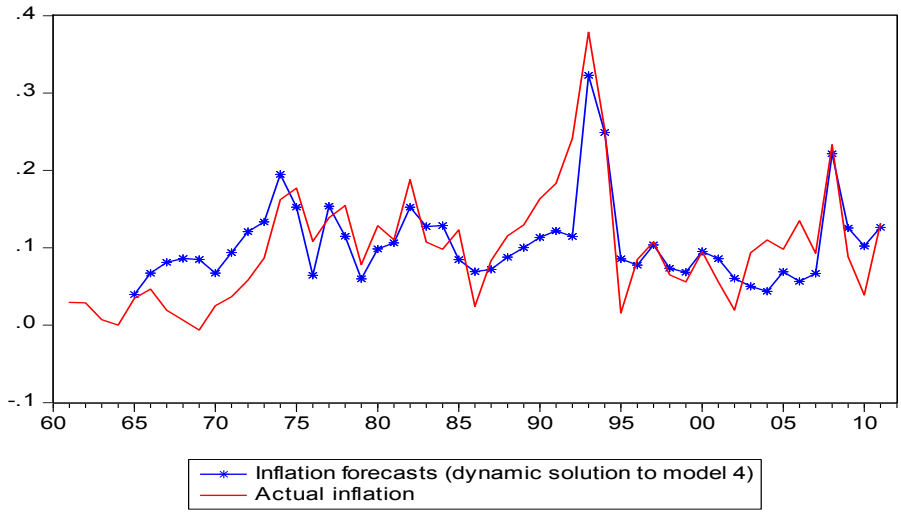

Figure 10. Model 4 inflation forecasts

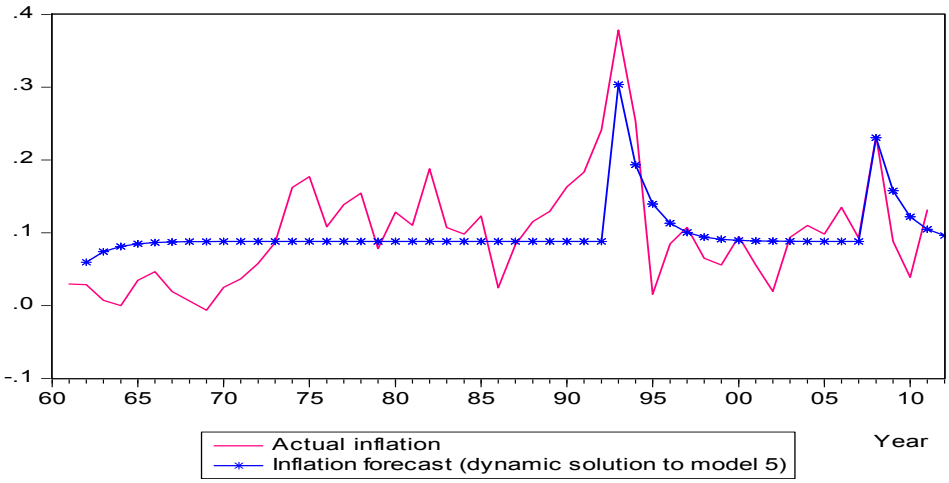

Figure 11. Model 5 inflation forecasts

6. Conclusions and Policy Implications

This study extends the P-Star methodology by applying an alternative approach to the derivation of the foreign price gap. The analysis uses Kenyan data over the period from 1960 to 2011 to test the relevance and performance of the P-Star model in the Kenyan context. Results of the analysis show that the domestic price gap is highly significant at 1 per cent and has positive effect on inflation with the implied result that a 1 per cent increase in price gap leads in the subsequent period to an increase in inflation by 0.5 per cent. The foreign price gap has negative and insignificant effect on inflation. However, the change in the real exchange rate has highly significant positive effects on inflation. An increase in competitiveness by 1 per cent leads to close to 0.3 per cent inflation in subsequent period. World oil price is significant at 5 per cent level and has expected positive effect on inflation. Similarly, world food prices have significant positive effects on inflation. A 1 per cent increase in world food prices leads to 0.08 per cent inflation compared to 0.03 per cent inflation resulting from 1 per cent fuel price increase. Exchange rate liberalization of 1993 and the post election violence of 2008 also had significant positive effects on inflation. Past inflation contributes significantly to current inflation suggesting a high level of persistence of inflation. Overall, the domestic price gap is found to be more significant in predicting Kenya's rate of inflation when compared with the foreign price gap.

The results arising from a forecast evaluation indicates that the P-star model outperforms forecasts of other alternative inflation models for Kenya. The P-star model has lower forecasting error and the mean and variance of the forecasts closely approximate actual values. This finding holds for both set of forecasts from static and dynamic model solutions.

On the policy front, it can be argued that Kenya's inflation in the medium to long-term is driven by domestic developments though in the short-term other factors too play a role. Such short-term movements in inflation could result from price developments abroad and real exchange rate changes. In the long-term however, domestic factors dominate as evidenced by the significance of the dometsic price gap and the relevance of the P-Star model. Bearing in mind that P-Star is tied to long-term monetary developments and potential output, the results in this study underscore the usefulness of the P-Star approach in providing forecasts of inflation and thus serving as source of leading indicator of inflation for Kenya. Such an indicator would present the opportunity to effect policy change in a timely manner hence making it possible to achieve price stability and ensure consistency between monetary policy decisions and the prevailing macro environment.

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Notes

Note 1. Partial adjustment of real exchange rates.

We assume a partial adjustment of actual real exchange rates to its long-run level or equilibrium. Hence,

$$\log\left(\frac{P_t^F}{P_t^H}\right) = \log\left(\frac{P_{t-1}^F}{P_{t-1}^H}\right) + \lambda\left[\log\left(\frac{P_{t-1}^{F*}}{P_{t-1}^{H*}}\right) - \log\left(\frac{P_{t-1}^F}{P_{t-1}^H}\right)\right] \tag{10}$$

$$\log P_t^F - \log P_t^H = \log P_{t-1}^F - \log P_{t-1}^H + \lambda\log\left(\frac{P_{t-1}^{F*}}{P_{t-1}^{H*}}\right) - \lambda\log\left(\frac{P_{t-1}^F}{P_{t-1}^H}\right) \tag{11}$$

$$-\log P_t^H + \log P_{t-1}^H = -\log P_t^F + \log P_{t-1}^F + \lambda\log\left(\frac{P_{t-1}^{F*}}{P_{t-1}^{H*}}\right) - \lambda\log\left(\frac{P_{t-1}^F}{P_{t-1}^H}\right) \tag{12}$$

$$\log P_t^H - \log P_{t-1}^H = \log P_t^F - \log P_{t-1}^F + \lambda\left(\log\left(\frac{P_{t-1}^F}{P_{t-1}^H}\right) - \log\left(\frac{P_{t-1}^{F*}}{P_{t-1}^{H*}}\right)\right) \tag{13}$$

$$\Delta\log P_t^H = \Delta\log P_t^F + \lambda\left[\log\left(\frac{P_{t-1}^F}{P_{t-1}^H}\right) - \log\left(\frac{P_{t-1}^{F*}}{P_{t-1}^{H*}}\right)\right] \tag{14}$$

Note 2. Kool and Tatom (1994) measure of foreign price gap.

Kool and Tatom (1994) measure is derived from exchange rate constraint and based on assumption of purchasing

power parity in the long run such that:

$$P_t^{H*} = \frac{P_t^{F*}}{RER_t^*}$$

Where, RER is real exchange rate while the other variables are as defined above.

Consequently,

$$Foreign \quad price \quad gap = \log P_t^H - \log P_t^{H*} = (\log P_t^{F*} - \log RER_t^*) - \log P_t^H \tag{15}$$

International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Internal Capital Markets and Patenting in Emerging Growth Firms

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Received: July 5, 2013 Accepted: July 30, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p96 URL: http://dx.doi.org/10.5539/ijef.v5n9p96

Abstract

Despite the overwhelming theoretical intuition in support of the arguments that internally generated capital should be an important determinant of corporate innovation, very little empirical evidence of this association has been established. In this paper we show that internal capital markets have a positive and significant relationship with patenting of emerging firms. However, for mature firms, the relationship between internal finance and patenting is negative but not significant. Our empirical analysis is grounded on the theoretical modeling of granting a patent as the maturity date of an American real call option, with internal capital and R&D expenses serving to shorten the maturity of the growth option and to speed up innovation.

Keywords: investment decision, internal capital markets, firm value, patenting, R&D, innovation, emerging firms

1. Introduction

It is universally recognized that innovation is an important source of economic growth and development. At the firm level continual innovation is often the key to corporate growth and competitiveness. There is a general presumption that patents are useful to encourage innovation despite the market distortions of the monopolies that they create. In most high-technology industries, for instance, pharmaceuticals, computer software and biotechnology, firms must "innovate or perish." The purpose of this study is to examine the impact of internal capital markets on the innovative activities of firms. In particular, we focus on emerging firms, which are especially affected by imperfections in external financial markets and so suffer disproportionately a disadvantage in accessing outside capital.

Several studies have demonstrated the information asymmetry of R&D investments for new product developments (e.g., Myers & Majluf, 1984; Stein, 1988). Inside managers have more information about the projects than outside investors do and are often reluctant to reveal "too much." However, an original idea must be financed in order for it to have a chance to eventually break-through. Inside managers have the option to tap external or internal capital. When approached for funding, outside investors have a tendency to ration funds because of the belief that insiders overstate the prospects of the projects. This has the benefit of preventing overinvestment (when the true state of the world is "bad") but it also has the cost of causing underinvestment (when the true state of the world is "good"). This financing problem may be modest for mature firms but it is critical for young and emerging firms whose individual projects would find it hard to attract external financing. The objective of this study is to empirically test the implications of those circumstances under which internal capital markets would tend to be the most effective mode of financial arrangement.

Financial economics literature on the theories of internal capital markets has focused mainly on two opposing views. According to the bright side of internal capital markets discussed by Alchian (1969), Weston (1970), Williamson (1975), Gertner, Scharsftein, & Stein (1994), Stein (1997), Matsusaka & Nanda (2002), and Maksimovic & Phillips (2002), internally generated cash flows are pooled and subsequently allocated optimally to divisions or units of the firm. In this winner-picking model, internal capital markets add value and benefit the firm since the allocation is mainly justified by the presence of investment opportunities. Managers whose units have greater investment opportunities ultimately should receive larger allocations of internal capital. The dark side argument, however, claims that internal capital markets are strongly influenced and guided by internal political processes (e.g., Coase, 1937; and Bower, 1970). This view suggests that internal resource allocation

would typically be inefficient since investment opportunities are not considered that much. In this model, managers who are more powerful or who are better connected to the CEO receive greater allocations even when their units do not have better investment opportunities (Milgrom, 1988; Milgrom & Roberts, 1988; Sharfstein & Stein, 2000; Rajan, Servaes, & Zingales, 2000; and Wulf, 2009). In a recent survey study providing further support to this view, Graham, Harvey, & Puri (2011) find that the opinion of a CEO of a divisional manager is the second most important determinant of capital allocation within the firm after the net present value rule. For a detailed survey of the literature on internal capital markets, see Stein (2003) and Maksimovic & Phillips (2007).

While substantial progress has been made in theoretically modeling internal capital markets as reflected in the works cited above, not much is known empirically. Exceptions are Duchin & Soyura (2013) and Glaser, Lopez-De-Silanes, & Sautner (2013). Duchin & Soyura (2013) study the role of divisional managers at S&P 500 firms in internal capital budgeting and document evidence of strong negative correlation between managerial connection and investment efficiency but only under weak corporate governance. They also show that under high information asymmetry within the firm, connections facilitate information transfer which leads to increased investment efficiency and firm value. Glaser, Lopez-De-Silanes, & Sautner (2013) analyze the internal capital markets of a multinational conglomerate and find evidence largely consistent with the prediction of the dark side view of internal capital markets. These studies are important because they document how, and under what circumstances, the interactions of the CEO with the divisional managers impact internal capital allocation. However, we are still left with relatively little knowledge about the effect of internal capital markets on investment opportunities. Do firms with larger internal capital markets produce more organic innovations, hence growth opportunities? Are the roles of internal capital markets uniform among emerging and well established firms in effecting innovation? In this paper, we seek to answer these questions with direct evidence from testing a theoretical valuation model of growth opportunities on a sample of emerging innovative U.S. manufacturing firms in comparison with mature corporations. We define an emerging firm as a relatively young company that has never issued dividends and has never acquired or merged with another firm.

Economists have argued that internally generated capital should be an important determinant of R&D investments whose outputs are measured by the number of patents awarded or product and process improvements attained. Yet to date there has been relatively little empirical evidence of a relationship between internal capital markets and innovation. One recent exception is the work of Himmelburg & Peterson (1994), which finds a substantial effect of internal finance on R&D investments for small firms. One reason for the lack of evidence is that most research has examined mainly the growth strategy of large and diversified firms that have relatively fewer constraints in accessing external capital markets than young firms (e.g. Lamont, 1997); Stein, 1997; Shin & Stulz, 1998; and Scharsftein & Stein, 2000). The other explanation has to do with the difficulty in theoretically modeling growth opportunities to such a rigor that would support sound empirical analysis.

The main contribution of our paper is to empirically document the role of internal capital markets in funding investment opportunities. Moreover, we do this by presenting a testable theoretical valuation model of corporate growth opportunities. We consider a patent as a measure of the firm's success in financing innovative investments that are characterized by a high probability of failure. It is possible that patent counts may not accurately reflect corporate innovation for reasons of secrecy and dynamic competitive environments. However, in young firms and industries where product-oriented innovation is predominant, patenting is important (McGahan & Silverman, 2001). Griliches (1981) suggests that both R&D and patents are inputs of innovation. Cockburn & Griliches (1988) find that in the absence of R&D variables, past patents are significantly valuable. Ben-Zion (1984) explains that whereas not all patents result in the production of new profitable products, a firm's patents are relevant for other firms in the industry in the sense that they contribute to increased technical knowledge or indicate a potential for new lines of research. Austin (1993) shows that patents are useful as indicators of innovative output but may produce no value if they have been fully anticipated by the market. In comparison to these studies, the aim of this paper is, however, rather specific in scope and is simply to examine the impact of internal finance on the ability of a company to produce patentable innovations.

The paper is organized as follows. Section 2 presents and discusses the theoretical model of corporate growth opportunities. Section 3 describes the empirical design of the study and the data. Empirical analysis and discussion are provided in Section 4. Section 5 concludes.

2. Theoretical Basis of the Study

It is now apparent that the conditions under which the financing of a firm would not matter as hypothesized by Modigliani & Miller (1958) do not hold in practice. The valuation in Modigliani and Miller is determined by the assumed ability of the acquired assets of the firm to generate earnings into the future. Due to relatively high ratio of

intangible to tangible assets, and the high uncertainty governing the payoffs to intangible assets, the market value of an emerging firm is therefore not independent of its financial structure. For these companies, access to internal sources of financing, as in Myers' *pecking order theory* (1984) and Myers & Majluf's benefit of financial slack (1984), become a binding constraint. According to the *pecking order theory*, firms are said to prefer available liquid assets (e.g. retained earnings) to finance their investments. This is followed in order of preference by debt, and last comes external equity financing. Diamond (1989) suggests that start-ups and emerging firms with little reputation have less access to debt than well-established firms. This is consistent with Jensen and Meckling (1976), Myers (1977) and Stulz (1990) who show that leverage is expected to be negatively associated with the extent of growth opportunities. Thus, for emerging firms if internal funds are lacking then there is no access to external capital either, and the firm fails to enter the strategic growth competition.

Recent advances in real options analysis have produced models that better capture the interaction between current financing and future growth opportunities. The models most relevant to our study include Myers (1977) and Ottoo (1998). In Myers (1977), R&D is valued as a call option on a given set of future investment opportunities. In Ottoo (1998), granting a patent is a credible signal that the firm has won the competitive race to innovate, thereby creating a barrier for rival firms. Winning the race gives the firm the right, but not the obligation, to launch a new product into the market and capture the value of growth opportunities. The elegance of this model is that a firm gains access to productive technology only by successfully completing the basic R&D project before any competitor, thereby procuring patent protection to secure access to expected monopoly rents. The value of growth opportunities, *G*, is modeled as a real American call option:

$$G = \left[\frac{f(x)}{r + f(x) + f(y)}\right]\left[VN(d_1) - KN(d_2)e^{-rT}\right] \tag{1}$$

where:

- *V* is the present value of the expected net cash flows from the new product launch;
- *K* denotes the capital expenditure that must be incurred at time *T* to manufacture the product and generate the potential cash flows;
- *T* represents the time when the firm wins the competitive race to innovate and is granted a patent. It is also the maturity date of the real call option, the date at which the firm exercises the option to produce and capture growth opportunities. Algebraically, *T* is a function of the R&D (*x*) of the firm as well as the R&D (*y*) of its rivals and is expressed as:

$$T = \frac{f(x)}{[f(x) + f(y)]^2} \tag{2}$$

  where *f*(*x*) and *f*(*y*) are the hazard rates of success for the firm and the rivals, respectively;
- *r* is the risk-free rate of interest;
- σ^2 is the variance or volatility of expected cash flow value, *V*;
- $N(d_1)$ is the cumulative standard normal density function, a probability weight equivalent to the inverse of the hedge ratio for *V*, where $d_1 = \frac{\ln \frac{V}{K} + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$; and
- $N(d_2)$ is the cumulative standard normal density function, which denotes the probability that the real call option will be exercised (the option will finish in-the-money), i.e., $V > K$) and $d_2 = d_1 - \sigma\sqrt{T}$.

It is evident that each of the competing firms has an incentive to speed up discovery, which is a function of both financial prowess and technological (competitive) advantage. It follows that for an emerging firm, a shorter maturity date (*T*) is consistent with a higher ability to patent, which depends on sufficient availability of internal funds, leading to increased market capitalization.

3. Empirical Design

The preceding theoretical exposition and intuitive description show that patenting may be influenced by a number of factors. In a functional form, we may present the relationship as

$$P = f(\textit{Internal Capital}, x, y, K, V, G, \sigma^2, \textit{Control Variables}) \tag{3}$$

3.1 Cross-sectional Regression

We conduct cross-sectional regressions, year by year and across firms, following Fama & MacBeth (1973). The final form of the least-squares regression equation expresses patents, *P*, as the dependent variable:

$$P = \gamma + \beta_1 CF + \beta_2 V + \beta_3 K + \beta_4 x + \beta_5 y + \beta_6 G + \beta_7 \sigma + \beta_8 D + \beta_9 CF + \beta_{10} AGE + \beta_{11} HH + \beta_{12} L + \hat{e}_t \quad (4)$$

where γ is the intercept coefficient of the regression; $\beta_1, \beta_2, \ldots \beta_{12}$, are the coefficients of the independent variables fully described below; and ê is the error term.

3.2 Fama-MacBeth and Fama-French Methodology

We use a cross-sectional regression approach proposed by Fama & French (1997), following Fama & MacBeth (1973), in determining influencing variables on the valuation of growth opportunities of a firm to verify our findings. The Fama-MacBeth regressions have the following form:

$$P_{i,t} = \mu_0 + \sum_{j=1}^{H} \mu_{j,t} F_{i,j,t} + e_{i,t} \quad \text{for} \quad i = 1, 2, \ldots, N_t \quad (5)$$

where *H* is the number of explanatory variables, *N* is the number of firms, and $F_{i,j,t}$ is the realization of explanatory factor *j* for firm *i* in year τ *(*τ = 1, 2,……, *t*). Our sample period remains 1987–1993. We test the null hypothesis that the time-series average of year-by-year regression slopes is zero. That is,

$$\frac{\sum_{t=1} \mu_{j,t}}{T} = 0 \text{ for } j = 1,2,\ldots\ldots, t. \quad (6)$$

A t-test that assumes normality and identical independent distribution (i.i.d.) of the regression slopes is conducted. The time-series average slope coefficients are divided by their standard errors and multiplied by the square root of the number of observations. Two sets of regressions are run for each panel, with excess firm value *P*, as dependent variable: (i) single variable regressions of their current, past and future changes without any control variable and (ii) full variable regressions controlling for the influence of the rest of other variables. Only the two-year variable changes are included in the analysis. We run single level regressions to first evaluate the effects of each variable on the dependent variable independent of influences from any control variable. Following Kothari & Shanken (1992) and Fama & French (1997), we include in each regression a two-year change in patenting activity, $\Delta PV_{t+2} = (P_{t+2}-P_t)/A_t$, to absorb any noise induced by their unexpected changes. When the dependent variable is P_t, the single-level cross-section regression for R&D, for example, is:

$$P_t = \mu_t + \beta_1 X_t + \beta_2 \Delta X_{t+2} + \beta_3 \Delta X_{t-2} + \beta_4 \Delta P_{t+2} \quad (7)$$

where μ_t is the intercept term, and $\beta_1, \ldots, \beta_4$ are regressor coefficients.

We then conduct a full level regression analysis to determine if each of the variables would still retain its power in explaining changes in growth opportunities, after controlling for all other variables including the noise term. We examine if the coefficients are not zero and their t-values to confirm our earlier results. The full-level regression is expressed as follows:

$$\begin{aligned} P_t = {} & \mu_t + \beta_1 AGE_t + \beta_2 \Delta A_{t+2} + \beta_3 \Delta A_{t-2} + \beta_4 \Delta S_{t+2} + \beta_5 \Delta S_{t-2} + \beta_6 G_t + \beta_7 \Delta G_{t+2} + \beta_8 PP_t + \beta_9 x_t + \\ & \beta_{10} \Delta x_{t+2} + \beta_{11} \Delta x_{t-2} + \beta_{12} y_t + \beta_{13} \Delta y_{t+2} + \beta_{14} \Delta y_{t-2} + \beta_{15} K_t + + \beta_{16} \Delta K_{t+2} + \beta_{17} \Delta K_{t-2} + \beta_{18} \alpha_t + \\ & \beta_{19} L_t + \beta_{20} \Delta L_{t+2} + \beta_{21} \Delta L_{t-2} + \beta_{22} D_t + \beta_{23} \Delta D_{t+2} + \beta_{24} D_{t-2} + \beta_{25} CF_t + \beta_{26} \Delta CF_{t+2} + \beta_{27} \Delta CF_{t-2} + \\ & \beta_{28} HH_t + \beta_{29} \Delta HH_{t+2} + \beta_{30} \Delta HH_{t-2} + \beta_{31} \sigma_t + \beta_{32} \Delta \sigma_{t+2} + \beta_{33} \Delta \sigma_{t-2} + \beta_{34} \Delta V_{t+2} \end{aligned} \quad (8)$$

3.3 Description of Variables

We define the relevant variables as follows: Our dependent variable, *P*, denotes the relative probability of innovation and is proxied by the number of patents divided by the industry number of patents. *P* is scaled by the ratio of firm assets to industry assets. All variables are normalized by total assets unless otherwise specified. The relative excess capitalized market value is employed to proxy the value of growth opportunities. The market value of the firm (*MV*) is composed of the value of assets already in place (*A*) and the present value of growth opportunities (*G*). The relative excess value of the firm is thus measured as the market value of common stock plus the book value of debt (*MV*) minus the book value of assets (*A*) normalized by assets (*A*). We compute the market value of common equity as closing stock price times the number of shares outstanding. Replacement costs are difficult to value. We consider (G_t/A) to proxy average Tobin's Q by using book assets as a proxy for replacement costs.

V represents the expected innovation (monopoly) rents and is proxied by two variables. One is the growth rate of sales derived by applying a simple exponential trend regression of net sales. In the year-by-year cross-sectional

regression, we instead use expected change to represent the growth rate of sales. For example, the expected change (value) in sales over the next one year is expressed as $((Sales_2 - Sales_1)/A_1)$. The other variable is the Herfindhal-Hirschman index (*HH*) calculated by expressing market share of each firm (using sales) in the industry as a percentage and summing up the squared terms. *K,* the strike price is estimated by the levels of capital expenditures; *x* represents current R&D spending and *y* denotes rival R&D expenditures which is computed as R&D of the industry less R&D of the firm. Project volatility, σ^2, is measured by the Chauvin & Herschey (1993) methodology using the natural logarithm of the ratio of the 52-week high and low stock prices for each firm, an index that is proportional to the Garman & Klass (1980) "ideal" volatility estimator. We choose this approach over equity beta estimation due to limitation of scope of data availability especially for emerging companies. *D* denotes debt ratio, the sum of debt in current liabilities and long-term debt divided by total assets, scaled by the industry's debt ratio. *CF* represents operating cash flow measured by operating income plus R&D expenditures which is meant to proxy internal capital. Another variable used is ΔA, the expected change in assets, a proxy for the net investment component of internal cash flows. *AGE* represents the natural logarithm of the number of years the company has been in existence since it was established. And *L* is a measure of labor productivity, the ratio of total output (net sales) to labor inputs (number of employees).

3.4 Data Sources and Sample Design

We first gather all active U.S. public firms with a record of R&D spending from the Standard & Poor's annual industrial and full coverage Compustat database. This first sample is restricted to companies within the industries with two-digit SIC codes 3000 through 3800. We then eliminate any industry that does not turn up an emerging firm. The final range covers fabricated metals and parts (3400); industrial and commercial machinery and computer equipment (3500); electrical and electronics (3600); transportation equipment (3700); and measuring and controlling devices (3800).

The companies are then traced as to whether their R&D efforts have turned up any patented innovations. Patent counts are collected from the U.S. Patent and Trademark Office (USPTO) patent database. The database contains bibliographic citations of U.S. patents assigned to individuals, private and public organizations and firms, from 1969 to the present. For our purpose, an entity is considered to have patented if the patent is issued to its subsidiary, division or to the parent firm itself. In most cases the USPTO database would not distinguish a subsidiary from a parent company. Mergers and acquisitions record and information on subsidiaries and divisions of these firms are assembled from several sources for verification purposes: the National Register Publishing's Directory of Corporate Affiliations, Dun and Bradstreet Directory, Walker's Corporate Directory of U.S. Public Companies, and CorpTech Directory of Technology Companies. USPTO also does not record assignees distinctly as private or public firms. We resolve this problem by cross-checking the CorpTech Directory whose listings identify private and public technology firms as well as foreign-owned companies. Firms that are not cited by USPTO from 1969 to end of 1995 are not included in the sample. As it turned out, all the companies excluded based on this criterion did not have adequate financial data in Compustat and would have again been disqualified.

This study covers the period from 1987 to 1995. The final selection of 201 firms constitutes a sample that must have all years of financial data for the period 1987-1993. The two-year lag for financial relative to patent data described in the empirical design explains the cut-off dates of 1993 and 1995 for financials and patents, respectively. Year of incorporation (founding) is accessed from Disclosure, Dun and Bradstreet, and CorpTech Directories databases. The sample is further divided into two panels: established firms and emerging firms. A firm is classified as emerging if it had never issued cash dividends as of the end of 1993 and has never acquired or merged with any other firm. We set 1995 as the end-date for our study to coincide with the period in the U.S. before a flood of Internet patents began to emerge. Internet patents cover business processes and models that have created and continue to expand digital commerce. Early well known examples of Internet patents include Priceline.com's reverse auction model for purchasing airline tickets (filed in 1996) and Amazon.com's patent on the "one-click" technique merchandise ordering (filed in 1997). There has been intense debate as to who should capture the growth opportunities arising from competitive Internet innovation and whether a flurry of Internet-implemented processes and methods should qualify as patentable subject matter given the importance of the Internet as a rapidly growing commercial platform combined with concerns for an open and free Internet (Allison, Tiller, Zyontz, & Bligh, 2012). While the inclusion of the Internet patents in our study would be of great interest, obtaining a reasonable sample size of emerging firms with many years of R&D and patent data for a meaningful statistical analysis would be problematic. We therefore decided to leave that for future research where we would attempt to extend our work and model the role of internal capital markets on the valuation of growth opportunities under a digital commercial platform. This explains our decision to mark the period cut-off date to 1995 and to limit the sample to the manufacturing industries listed above whose R&D and patent awards at the time bore no relation to the Internet.

3.5 Industry Classification

Table 1 presents industry classification of the companies to be analyzed. A total of 201 firms make up the final sample of which 107 (53.23%) are emerging and 94 (46.77%) are established firms. Five major industries are formed according to the two-digit SIC codes. Electrical and Electronics industry accounts for the largest share of the sample with 40.30% of the companies followed by Measuring Instruments and Devices (22.39%) and Industrial and Computer Equipment (21.89%). The majority of emerging firms (42.99%) are in the Electrical and Electronics industry. There is only one emerging company compared with 25 mature firms in the transportation industry, which includes automotive, aircraft and defense. The Measuring Instruments industry is fairly balanced, with 23 emerging and 22 mature firms, respectively.

Table 1. Sample distribution by industry classification

2-Digit SIC	Industry	Emerging Firms	Mature Firms	Total	Percent
3400	Fabricated Metals and Parts	3	2	5	2.49
3500	Industrial and Computer Equipment	34	10	44	21.89
3600	Electrical and Electronics	46	35	81	40.30
3700	Transportation	1	25	26	12.94
3800	Measuring Instruments	23	22	45	22.39
Total		107	94	201	100.00

This table presents the classification of Industry by the two-digit Standard Industrial Classification (SIC) code. Only firms with financial data filed by Compustat and whose patents are cited in USPTO database are included.

4. Empirical Analysis

4.1 Descriptive Statistics

The descriptive statistics are presented in Table 2. Mature firms are relatively much older, with 1931 being their median year of founding compared with 1975 for emerging companies. Emerging firms on average employ 871 people, ranging from the smallest company with 19 to the largest company with 30,240. On the other hand, mature firms have a mean number of employees of 26,791 ranging from 68 to 354,508. Total assets of established firms are about 63 times larger ($4,975 million with a standard deviation of $22,765 million) than those of emerging firms ($78 million with a standard deviation of $208 million). Mature firms also generate almost 52 times as much net sales as emerging firms, $4,217 million against $81 million. However, they have a much lower rate of growth in sales (4.94%) than emerging firms (11.35%). Emerging companies generally spend less on capital expenditures ($8.03 million) and R&D ($9.39 million), compared to mature firms' capital expenditures ($272.14 million) and R&D ($176.71 million). Mature companies experience lower levels of unanticipated changes (surprises) in capital expenditures (-15.94%) than emerging firms (-52.76%). On average, there are 3 patents procured by an emerging firm per year compared to 39 by a mature company (Table 2 and Figure 1). However, emerging firms do appear to outperform mature firms in generating the growth in patents granted (Figure 2). For each patent assigned, a mature firm spends $4.5 million in R&D. This is higher than the $2.9 million incurred by an emerging firm (Figure 3).

Debt ratios don't appear to be significantly different between the two subsamples, 21.51% and 18.87% for mature and emerging firms, respectively. In terms of investment volatility, emerging companies are much riskier, with the natural logarithm of the ratio of the 52-week high to 52-week low of stock price of 0.422 compared to 0.267 for mature firms. Established companies enjoy higher levels of operating cash flows ($492 million) compared to that of emerging firms ($13 million). On average, emerging companies register a much higher ratio of excess value (growth opportunities) to book value of assets (61%) than established companies (7%). Mature firms tend to operate in more highly concentrated industries with a Herfindhal-Hirschman index of about 2200 while emerging companies are in more diffused industries at about a 1500 level of the same index.

Table 2. Descriptive statistics for selected variables

Variable	Emerging Firms	Mature Firms	All Firms
Year Founded (median)	1975	1931	1964
Employees	0.871	26.791	13.458
	(3.219)	(87.533)	(62.252)
Patents	3.215	39.122	20.153
	(10.832)	(91.468)	(66.524)
Stock of Patents	21.965	467.440	238.278
	(68.358)	(1035.636)	(755.208)
Net sales	80.884	4216.591	2089.088
	(232.298)	(15811.640)	(11184.700)
Growth Rate of Sales	11.354	4.943	8.241
	(23.378)	(9.323)	(18.226)
Total Assets	78.160	4975.058	2455.981
	(208.248)	(22764.980)	(16012.520)
Capital Expenditures	8.028	272.141	136.275
	(29.737)	(1128.795)	(795.932)
Surprise in Capital Exp.	-52.762	-15.938	-34.881
	(80.366)	(28.160)	(63.488)
R&D Expenditures	9.393	176.714	90.640
	(32.441)	(665.688)	(470.790)
Growth Rate of R&D	7.762	6.856	7.322
	(16.399)	(13.182)	(14.895)
Rival R&D	1987.139	4648.871	3279.615
	(1806.186)	(4880.103)	(3867.023)
Debt Ratio	18.874	21.507	20.153
	(19.056)	(14.312)	(16.931)
Operating Cash Flow	12.780	491.506	245.239
	(42.632)	(1879.365)	(1328.436)
Project Volatility	0.422	0.267	0.347
	(0.116)	(0.090)	(0.130)
Herfindhal-Hirschman Index	1521	2205	1853
Growth Opportunities	3.809	-817.555	-395.026
	(52.908)	(10000.600)	(6963.168)

This table summarizes the time-series means of variables computed over the period 1987 to 1995 (standard deviation in parenthesis). Patents are in units. Employees are in thousands. Volatility of the growth option, Growth rates of sales and R&D, debt ratio, HHI, and growth opportunities are all derived as explained under Section 3.3. "Surprise" is the unanticipated change in capital expenditures obtained by ordinary least squares by subtracting the actual from predicted percentage change. Rival R&D is obtained by subtracting firm R&D from industry R&D. Net sales, operating cash flows, total assets, capital expenditures, R&D, rival R&D, operating cash flow and growth opportunities are in millions of dollars. Industry is classified by the two-digit SIC code.

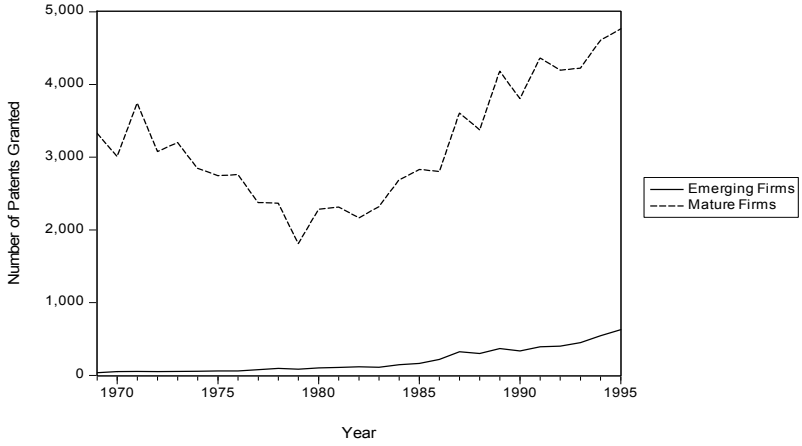

Figure 1. Number of patents granted annually to emerging and mature firms, 1969–1995

This figure plots comparable patent counts granted to emerging and mature firms over a twenty-seven year period.

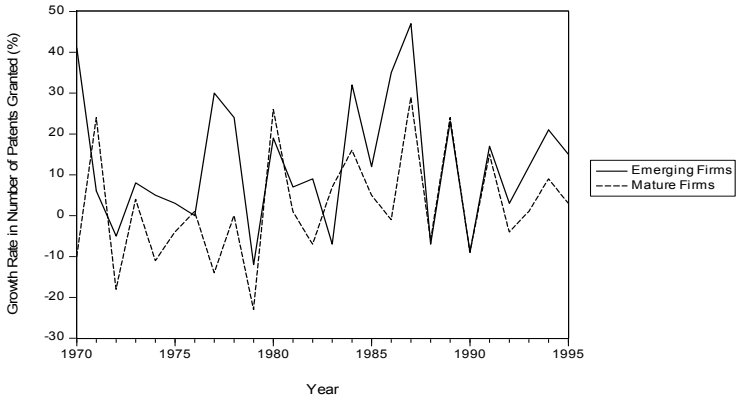

Figure 2. Annual growth rate in the number of patents granted to emerging and mature firms

This figure plots comparable annual growth rates in patent counts granted to emerging and mature firms over a twenty-seven year period, 1969–1995.

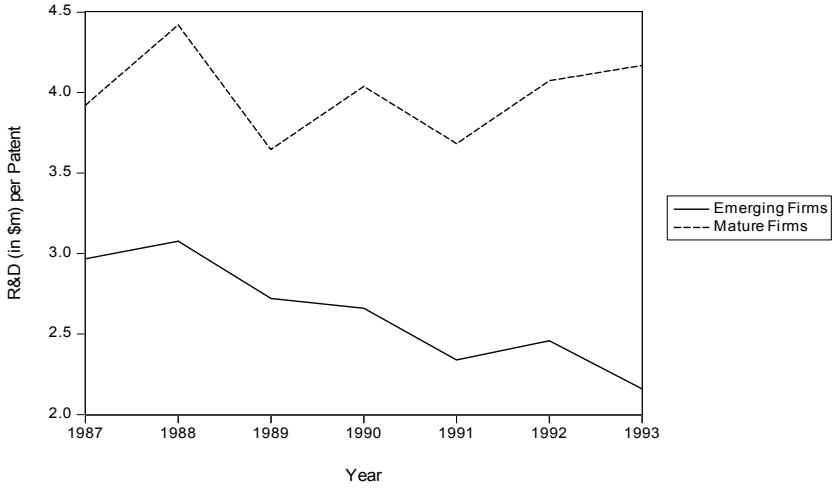

Figure 3. R&D investments per patent granted in 1987 dollars (in millions)

This figure plots the ratio of investments in R&D (in millions of dollars) per patent granted by year for both emerging and mature companies. R&D expenses are computed in 1987 constant dollars.

4.2 Empirical Results

In Table 3 we present tests of significance of the mean difference of selected variables in the two sub-samples. Both t-tests and Wilcoxon non-parametric approximations are performed. The results are very similar employing both methods. We find 8 of the 14 variables (without their change components) considered to be significantly different between the emerging and mature firm groups. In particular, the difference in growth opportunities (G_t) is highly significant, strongly supporting the hypothesis that emerging firms have distinctively larger real options than mature firms. On average, 63% of the market value of emerging firms compared to 6% for mature firms is accounted for by the present value of growth opportunities. Mean differences of stock of patents (*PP*), R&D (x), rival R&D (y), project risk (σ_v), capital expenditures (K), operating cash flows (CF), and industry concentration (HH) are all significant. We infer that emerging firms are in high R&D, less concentrated, and more volatile industries with less free-cash-flow and higher Tobin's Q ratio.

Cross-sectional regressions are then conducted. We regress current patents as the dependent variable and present results in Table 4. It is apparent that the impact and signs of some predictor variables in explaining the changes in the dependent variable do change from period to period. However, an overall picture of the power of a particular factor can be discerned. We find that the change in innovation, measured by the current number of patents (P_t) is significantly explained by the stock of patents (PP_t), R&D (x_t), and research-in-progress as proxied by expected future changes in the number of patents (ΔP_{t+1}). Operating cash flows (CF_t) and rival R&D (y_t) have greater impact on innovation in emerging than in mature firms.

One salient result is the influence of internal cash flows. For emerging companies, the net investment components of internal capital (ΔA_{t-1} and ΔA_{t+1}) are positive and significant. Current (CF_t) and future values (ΔCF_{t+1}) of operating cash flows are significantly negative, and past values (ΔCF_{t-1}) are positive. These results strongly support our internal capital markets hypothesis and are consistent with the positive view of the internal capital markets theory (e.g., Alchian, 1969; Weston, 1970; Williamson, 1975; Gertner, Scharsftein, & Stein, 1994; Stein, 1997; Matsusaka & Nanda, 2002; and Maksimovic & Phillips, 2002, among others). High Tobin's Q firms are high investment firms. And since for emerging companies investments must be financed internally, it implies that high Q emerging firms would have less cash flow left over after investments.

The negative sign of current operating cash flows for emerging firms also tends to support Jensen's (1986) assertion that after all positive net present value projects are considered and financed, and shareholders paid, the remaining "free cash flows" are often "wasted" by management. On the other hand, operating cash flows for mature firms are positive and highly significant, but the net investment component is negative for most of the sample period. The results for large firms are consistent with the managerial myopia hypothesis (Hayes & Abernathy, 1980; Stein, 1988; Chandler, 1990; and Hitt, Hoskinson & Ireand, 1990) and the dark side view of

internal capital markets theory (Milgrom, 1988; Milgrom & Roberts, 1988; Sharfstein & Stein, 2000; Rajan, Servaes, & Zingales, 2000; Wulf, 2009; and Glaser, Lopez-De-Silanes, & Sautner, 2013, among others).

For emerging firms, capital expenditure (*K*) signs are mixed, but generally show a negative relationship with growth opportunities in the two-year regressions. Unexpected values have positive signs in two of three regressions. Mature firms show a positive relationship of capital expenditures and their unexpected values with growth opportunities, overall. Volatility of the underlying investments (σ_v) has a positive relationship in both subsamples for most of the study period. Debt ratio (*D*) has a negative sign for emerging firms, but the signs are mixed for the established firms.

Table 3. T-tests and non-parametric comparisons of mean differences

Variable	Emerging Firms	Mature Firms	t-Statistic	Z-Statistic
ΔA	0.0990	0.0735	-0.5452	0.4076
ΔS	0.1442	0.0814	-1.2472	-0.4889
P	2.5000	1.5403	-1.3429	1.1848
PP	1.8119	1.8588	0.2132	2.1655**
x	0.1302	0.0543	-5.7884***	-7.0179***
y	0.0707	0.0577	-5.1853***	-4.8589***
K	0.0602	0.0607	0.0929	1.8790**
αk	-0.0461	-0.0034	0.3527	0.6159
L	11.8264	11.0063	-0.9725	-1.1410
D	0.9682	0.9029	-0.4804	0.7226
CF	0.0791	0.1437	2.3884**	1.3895
HH	1552	2216	3.5576***	3.8258***
σv	1.0017	0.6375	-6.5193***	-6.8092***
G	0.6262	0.0566	-2.9683***	-2.4006**

This table reports the non-parametric procedure of the Wilcoxon Normal Approximation. Industry is defined by the 2-digit SIC code. Δ*A* and *CF* are meant to proxy for internal capital. *CF* denotes operating cash flow measured by operating income plus R&D expenditures. Δ*A* is the annual change in total assets, a proxy for the net investment component of internal capital. Δ*S* is annual change (expected growth) in net sales. *HH* represents the Herfindhal-Hirschman index, calculated by summing the squares of percent market share of each firm (using sales) in the industry. Both Δ*S* and *HH* are meant to proxy for the expected value of the monopoly rents. *P* denotes the relative probability of innovation derived as the number of patents divided by the industry number of patents, and *PP* is stock of patents, computed by dividing cumulative patents within past 17 years by industry stock of patents, both scaled by the ratio of firm assets to industry assets. σ_v represents volatility of the growth option, computed as the natural logarithm of the ratio of the 52-week high to 52-week low of the stock price as in Chauvin & Hirschey (1993) following Garman & Klass (1980). *K* denotes capital expenditure, and α_k is the "surprise" or unexpected change in capital expenditures derived as the difference between $\text{Log}(K_{t+1}/K_t)$ and $\text{Log}(K_t/K_{t-1})$ where *t* is current year. *x* represents R&D. *y* denotes rival R&D obtained by subtracting firm R&D from industry R&D, normalized by industry assets. Labor productivity, *L*, is the ratio of total output (net sales) to labor inputs (number of employees). Debt ratio, *D*, is the sum of debt in current liabilities and long-term debt divided by total assets, scaled by industry debt ratio. *G* denotes the excess market value over replacement cost of the firm, a proxy for growth opportunities, and is computed as the sum of the market value of equity and total debt less total book assets. Δ*A, CF*, Δ*S, x, y, K*, and *G* are all normalized by assets. 1%, 5%, and 10% statistical significance is indicated with ***, **, and *, respectively.

Table 4. Cross-Sectional regression analysis with current patents, p, as dependent variable

	Emerging Firms		Mature Firms	
Variable	Coefficient	t-statistic	Coefficient	t-statistic
INT	-9.417	0.004	0.048	0.333
ET	-1.254	-3.212***	0.131	0.698
ΔA_{t+1}	0.147	0.213	0.641	0.887
ΔA_{t-1}	-0.617	0.480	-0.609	-0.765
ΔS_{t+1}	0.601	1.081	-0.653	-1.084
ΔS_{t-1}	1.534	0.657	0.940	1.465
PP_t	0.554	7.356***	0.178	4.831***
ΔP_{t+1}	0.094	2.678**	0.542	12.35***
x_t	8.695	2.932**	6.733	2.257**
Δx_{t-1}	6.057	0.681	-10.51	-2.009**
y_t	-33.10	-0.290	-11.17	-1.534
Δy_{t-1}	1377	1.878*	80.86	0.894
K_t	-0.202	0.163	0.935	0.369
ΔK_{t-1}	0.909	-0.238	-2.405	-0.401
α_t	0.040	1.071	-0.073	-0.344
L_t	-0.007	-1.052	-0.006	-0.332
ΔL_{t-1}	0.007	1.312	0.005	0.094
D_t	-0.193	-0.645	-0.017	0.935
ΔD_{t-1}	-0.633	-0.634	-0.238	-0.761
CF_t	-1.606	-1.428	-0.255	0.110
ΔCF_{t-1}	1.376	1.735*	0.769	-0.225
HH_t	0.006	0.355	0.000	-0.814
ΔHH_{t+1}	-0.008	-1.136	-0.003	-1.160
ΔHH_{t-1}	-0.043	-1.430	0.004	1.569
σ_t	-0.619	-1.314	-0.066	-0.565
$\Delta\sigma_{t-1}$	0.764	2.162**	0.195	1.024
Adj. R^2	0.500		0.682	
F-Stat.	6.7***		12.1***	

This table presents the mean coefficients and their t-statistics from Fama-MacBeth regressions run for each year *t* across all firms. *INT* denotes intercept and *ET* is the natural logarithm of the number of years of life of a firm since founded. All other variables are as defined in table 2. A firm must have financial data on all variables in the seven-year sample period, 1987-1993. Future change (one-year) in R&D is expressed as: $\Delta x_{t+1} = (x_{t+1} - x_t)/A_t$. Past change (one-year) in R&D is expressed as: $\Delta x_{t-1} = (x_t - x_{t-1})/A_t$. Changes (expected values) in all other variables are computed similarly and scaled as defined in table 3, except for *L,* α, and *HH* which are ratio changes. 1%, 5%, and 10% statistical significance is indicated with ***, **, and *, respectively.

5. Conclusion

In this study we examine the determinants of patenting of emerging firms, particularly the impact of internal capital markets. As predicted, the empirical results demonstrate that the roles of internal finance in emerging and established firms are significantly different. Based on theoretical arguments, we hypothesize that emerging firms tend to rely more on internal capital as opposed to mature companies that have greater access to external capital markets to finance investment opportunities. This is strongly supported by the empirical results. For emerging firms, operating cash flows and R&D expenditures are significantly positive. These results are consistent with our hypothesis that internal cash flows are a critical source of financing future growth opportunities, with R&D being a valuable determinant of patenting since it serves to speed up innovation and shorten the maturity date of the real call option.

However, mature firms show the opposite results: internal cash flows have a negative but not significant influence on patents while past R&D is negative and significant and current R&D is positive and significant. A plausible explanation is that the market recognizes available investment opportunity sets for these established firms but may prefer that they purchase ready technology through, for instance, synergistic mergers and acquisitions rather than engaging in risky R&D investments which have very uncertain payoffs. These results for the mature firms are nevertheless consistent with the dark side view of the internal capital markets theory.

If growth opportunities were a significant component of the market value of emerging firms, then we would expect acquisition of debt to have a negative impact due to the under-investment hypothesis of Myers (1977). We document that emerging firms have lower debt ratio than mature firms, but this difference is not significant. We also find that debt is negative for emerging firms but positive for mature firms. However, these influences are not significant, further indicating a weaker support for the hypothesis.

Patents are predicted by the model to be a good proxy for the time to maturity of the real option. Thus, we would expect patents to have a positive influence on growth opportunities. Our results show that they are valuable. However, they tend to lose power when controlled for other variables, especially R&D. Nevertheless, past patents and R&D have a significantly positive impact on the output of current patents.

Risk of R&D investments is significantly and positively associated with patenting of emerging firms. However, this association is weaker for mature firms, perhaps due to their ability to diversify, and the fact that their investments may be supported more by existing assets (collateral effect).

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International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Monetary and Fiscal Responses during the Financial Crisis in the Developing and Emerging Economies

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Received: June 14, 2013 Accepted: July 17, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p110 URL: http://dx.doi.org/10.5539/ijef.v5n9p110

Abstract

The study provides empirical analyses of the role of monetary and fiscal policy on economic growth during the financial crisis in developing and emerging economies. I investigate 72 episodes of financial crisis in developing and emerging countries, in order to assess the effect of monetary and fiscal policy on output cost over the financial crisis. I find out that effect of monetary and fiscal tightening will increase output cost during the financial crisis. The results show that fiscal policy has been more effective tools in dealing with financial crisis, than the effect of monetary policy. In addition, the result suggests that the coordination with an expansionary fiscal policy and a neutral monetary policy will reduce output cost during the financial crisis in developing and emerging countries.

Keywords: monetary policy, fiscal policy, financial crisis, economic growth

1. Introduction

The aim of this paper is to assess the effect of monetary and fiscal policy on economic growth during the financial crisis in developing and emerging countries. The economic downturn caused by the global financial crisis in 2007 has posed again discussion among the researchers regarding the impact of financial crisis on output growth. There are quite few studies that investigate the effectiveness of monetary and fiscal policy on output growth during the financial crisis. However, the question of the suitable monetary and fiscal measures has become more pronounced especially during the global financial crisis. Furthermore, there is no consensus among the researchers regarding monetary and fiscal policy mix. To address this question, I examine 72 episodes of the financial crisis in developing and emerging countries, in order to measure the effect of monetary and fiscal policy on output cost during the financial crisis.

In addition, different monetary and fiscal strategies have been applied in advanced economies and emerging and developing countries in order to prevent further progress of the financial crisis and smoothing economic recession. Most of advanced economies the government has been more focused both in expansionary monetary policies by Central Bank's interest rate cut and fiscal stimulus packages, supporting financial and real economic activity. Regarding emerging and developing countries the fiscal and monetary measures have been different from the developed countries for the reason that they believe that those countries have small room in terms of applying expansionary monetary and fiscal policy stimulus. During the financial crises the policymakers of the monetary policy in developing and emerging countries have been more interested in maintaining higher interest rates and administrative lending controls in order to keep the inflation under control and to prevent capital outflows. However, some of the developing and emerging countries have adopted somehow an expansionary fiscal policy by changes of the budget structure, cutting current expenditure in favor to capital spending, some of them introducing a cut in public administration costs.

In the literature, most of the studies ague that fiscal policy is more effective than monetary policy during the financial crisis and therefore fiscal expansion can reduce output cost or output loss (IMF report, 2008a and 2008b). As for monetary policy the report shows that countercyclical monetary policy can support shortening of economic recession, however its efficiency is limited during the crisis. Baldacci at al., (2009) examine effect of fiscal policy on real output during the financial crisis and they find out that government consumption can shorten duration of the financial crisis and such measure is more effective than policy supporting public investment or

tax cuts. On the other hand, Li J., and Tang L., (2010) analyze the effectiveness of monetary and fiscal policy response twin crisis for 72 episodes during 1977-2010 in 57 emerging and developing countries. They find out that monetary expansion (contraction) can decrease (increase) output cost, whereas fiscal expansion (contraction) has no effect on both banking and currency crisis. They conclude that policy mix has to be coordinated by discretionary monetary expansion with a neutral fiscal policy during the financial crisis, since fiscal expansion or contraction has no effect on output cost. On the other hand the study by Hutchison at al. (2010) investigate the effect of monetary and fiscal policy over the financial crisis in emerging and developing economies and they conclude that fiscal expansion is more effective than monetary expansion. They find out that expansionary fiscal policy is related with lower output cost during the financial crises, whereas the effects of expansionary monetary policy have not been identified. Goldfain and Gupta (2003) analyses a financial crisis in 80 countries for the period 1980-1998, and they find out that if the economies have currency and banking crisis the monetary and fiscal policy are ineffective.

Moreover, little empirical evidence has addressed to the question regarding optimal macroeconomic policy mix during the financial crisis. I try to fill this gap in the literature. Therefore the main objective of this paper is to examine the impact of the financial crisis on real output for developing and emerging countries and what kind of macroeconomic measure should be used in the developing and emerging countries during the economic crisis in order to alleviate economic recession. For this purpose, I analyze 72 episodes of financial crisis that have been occurred over 1980-2010 in developing and emerging countries in order to measure the effect of monetary and fiscal policy on output growth during the financial crises. I employ cross-sectional methodology and following methodology adopted by Gupta et al. (2007).

The reminder paper is organized as a follows: Section II Econometric analysis of the impact of monetary and fiscal policy measure on output cost; Section III Data description; Section IV empirical result and Section V conclusions

2. Econometric Analysis of the Effect of Monetary and Fiscal Policy on Output Cost during the Financial Crisis

To investigate the effect of monetary and fiscal policy on output cost during the financial crisis I employ benchmark empirical model that contain a standard set of variables. I follow the methodology by Jie (2013) and Hutchison at al., (2010), who investigates the effect of monetary and fiscal policy on output cost. The benchmark model of output cost or output-loss includes important control variables in the regression in order to measure marginal effect of macroeconomics variables and avoiding omitted-variables bias.

The specification of econometrics model is as follows:

$$Cost_i = B_0 + B_1 X_i + B_2 D_i^{fisc} + B_3 D_i^{mon} + u_i \quad (1)$$

Where output-cost is the cost of output associated with financial crisis $\boldsymbol{i}$, D_I^{fisc} are binary indicators for expansionary and contractionary changes in fiscal policy stance, X_i is a vector of control variables, D_i^{mon} are binary indicators for expansionary and contractionary monetary policy. I measure monetary policy by the changes in the international reserves and in the discount rate as monetary indicators. Fiscal policy is measured by changes of fiscal stance that are independent of the business cycle. The constructions of monetary and fiscal indicators are explained in detail in the following section.

3. Description of Data

3.1 Definition of Financial Crisis

In this part I explain the characteristics of financial crisis both banking crisis and currency crisis. I utilized the database calculated by Laeven and Valencia (2008, 2010) (LV-henceforth) and they identify 124 systematic banking crisis and 208 banking crisis. They define banking crisis as "a corporate and financial sectors experience a large number of defaults and financial institutions and corporations face great difficulties repaying contracts on time. The currencies crisis is defined as "a nominal depreciations of currency of at least 30% percent that is also a 10 percent increase in the rate of depreciation compared to the year before."

The sample episodes include 72 countries over the period from 1977 to 2010. I denote the starting of a both crises in period t, as a banking crisis, associated with currencies crisis over the period [t-3, t+3]. The details of the episodes and data sources are reported in Appendix A and B.

In Table 1, I display frequency of both crises such as banking crisis and currency crisis. As seen from the Table 1, in period of 1970, banking and currency episodes are infrequent, which is 0.2 on averages per year, whereas

from 1980, the frequency of both crisis are considerably increased from 2.2 on average per year to 3.43 on average per year. Since 1980, an increase of both crises, (banking crisis and currencies crisis), perhaps could be as result of financial liberalization (Kaminsky and Reinhart, 1999). In addition, both crises are larger than single crisis, which indicate that banking crisis can lead to a currency crisis or after the currency crisis. Thus, the policy makers have to take into account both crises should not consider separately.

Table 1. Frequency of banking and currency crises

	1970-2003		1970-1979		1980-1989		1990-2003	
	total	average	total	average	total	average	total	average
banking crises	72	12.4	4	0.4	39	3.9	81	5.79
both crises episodes	72	7.2	2	0.2	22	2.2	48	3.43
currency crises	207	20.7	25	2.5	7.2	7.2	110	7.86

Note: both crises episodes are beginning data of a banking crisis with currency crises over (t-3, t+3). Average is average per year. Source: Author's calculation.

3.2 Definition of Variables in Empirical Research

a. Output-loss or output cost

There is several ways to measure output-cost associated with financial crisis. Following Laeven et al., (2008, 2010), I construct the data for output cost by calculating the data (pre-crisis) for average GDP growth rate trend for given countries t-3 to t-1, t is starting crisis and (post-crisis) GDP growth rate t+1 to t+3, until GDP growth rate return back to its trend. Therefore, the difference between real GDP growth rate trend (pre-crisis) and actual real GDP growth (post-crisis) represent the output-cost for each given countries.

b. Fiscal policy

I' m interested to measure discretionary fiscal policy response to output cost. As the budget- balance can move with the same path with rate of economic growth, I have to decompose budget-balance into their structural and cyclical component in order to assess discretionary fiscal measure during financial crisis. I employ standard method used by Blanchard, (1990), Jie (2013) and Hutchison at al., (2010), in order to take out both trend and cyclical component from budget-balance. The discretionary fiscal policy I calculate from the residual of each country based on the following equation. This is standard measure for fiscal stance which allows us to find discretionary fiscal measure.

The model for estimating fiscal indicator is as follows:

$$BB_t = \alpha_0 + B_1 y_t + B_2 y_{t-1} + \alpha_1 t + \eta_t \quad (2)$$

where BB_t is budget balance in percent of GDP of each countries $\boldsymbol{i}$, y_t denotes the real GDP for each countries, $\boldsymbol{t}$ denotes the time trend and η_t denotes the residuals in the regression. Then I estimate the discretionary measure of fiscal policy such as:

$$\Delta_i^f = \hat{\eta}_t - \hat{\eta}_{t+1} \quad (3)$$

Where η_t is the calculated the residuals from equation (2). By this estimation I eliminate simultaneity bias of fiscal stance with output movement in our empirical research. Finally I estimate the binary dummy variable of changes in the fiscal surplus by arranging the 56 observation from small to large. The expansionary fiscal policy is provided from the first 28 observation and I denote the country/year with 1 fiscal expansion and 0 otherwise. The last 28 observation represents contractionary fiscal policy and I denote in the same manner country/year with 1 fiscal contraction and 0 otherwise. This is standard measure of fiscal policy stance see more Blanchard, (1990), Jie (2013) and Hutchison at al., (2010).

c. Monetary policy

There are several way to measure monetary policy, I follow Jie (2013) and Hutchison at al., (2010), Baig and Goldfajn (2001), Goldfajn and Gupta (2003) and they consider changes of international reserves and discount rate. Accumulating international reserves is accompanied with an increase of the monetary base which is the instrument of monetary loosing. De-accumulating international reserve is accompanied with a decrease of the monetary base which is the instruments of monetary tightening. In this context, I perform binary variable for monetary expansion and contraction. Monetary expansion is calculated by one or more changes in the reserve which is higher than two standard deviation from the country mean, and I denote with value 1 monetary

expansion and 0 otherwise. Monetary expansion is calculated by changes in the reserve, which is smaller than two standard deviation from country mean and I denote with value 1 monetary tightening and 0 otherwise. I have not introduced interbank inters rate as it is not available measure in developing and emerging countries. In addition, the interbank inters rate does not show market behavior in those countries, and it is not under the control of the monetary authority. Therefore, I introduce the discount rate as it is under the control of monetary authority and show discrete policy movement. The discount rate is calculated as a monthly increase of the discount rate which is the instrument of monetary contraction and a monthly decrease of the discount rate which is the instrument of monetary expansion. As result, I construct binary dummy variable for monetary expansion and tightening in order to limit the problem of endogeneity. Monetary tightening is calculated by one or more changes in the discount rate, which is higher than two standard deviation from the country mean, and I denote with value 1 monetary tightening and 0 otherwise. Monetary expansion is calculated by changes in the discount rate, which is smaller than two standard deviation from country mean and I denote with value 1 monetary expansion and 0 otherwise.

d. Control variables

I use domestic and international the control macroeconomic variables in multiple regression in order to take into the account omitted-variables bias. The list of control variables are based on the previous literature, particularly, Li and Tang (2010) and Clavo et al., (2004). The list is important since I'm interested to control for factors (unless monetary and fiscal variables) which may affect output growth during the financial crisis. The lists of variables that I use in my empirical research are trade openness, inflation rate and degree of openness of the capital account.

4. Empirical Results

4.1 Descriptive Statistics of Financial Crisis, Fiscal and Monetary Policies

Table 2 shows the summary statistics of output cost (OC), monetary and fiscal policy indicators and control variables. I include variety fiscal and monetary indicators such as: fiscal expansion/ tightening (Fiscale/Fiscalt) and monetary expansion/tightening (Discountdec/Reservedinc and Discountinc/Reservedec) in order to provide more robust result.

Table 2. Data description for fiscal and monetary policy

Variable	Obs.	Mean	SE	Min	Max
OC	56	-7.014961	65.92507	-352.101	217.684
FISCALE	56	0.340426	0.478975	0	1
FISCALT	56	0.106383	0.311661	0	1
DISCOUNTINC	56	0.468085	0.504375	0	1
RESERVEINC	56	0.063835	0.247092	0	1
DISCOUNTDEC	56	0.319149	0.471186	0	1
RESERVEDEC	56	0.297342	0.359876	0	1
TROP	66	62.89607	36.73843	6.32	185.665
INFLATION	66	404.3609	1044.335	-12.907	5018.108
KAOPEN	66	-0.347291	1.320673	-1.81162	2.531836

Source: Aouthor's calculation.

Moreover, I introduce the control variables in order to provide more accurate result of the effect of monetary and fiscal variables on output cost, during the financial crisis. For this purpose, I include three control variables trade openness (TROP), inflation (INFLATION) and openness of the capital account (KAOPEN).

4.2 Model Estimates

The result from table 3 show investigations of eq. 1, applying standard model for output cost for 72 episodes of financial crisis in developing and emerging countries. I include variety fiscal and monetary indicators and three control variables (trade openness, inflation and openness of the capital account) in order to provide more robust result of the effect of monetary and fiscal variables on output cost, during the financial crisis. A positive value of the coefficient of explanatory variables mean a decrease of output cost or output loss and negative value of the coefficient of explanatory variables mean an increase of the output cost or output loss during the financial crises.

As seen from table 3, I find out that fiscal and monetary tightening will shapely increase cost of crisis and

coefficients are statically significant (column (3.1) and (3.2)). Furthermore, the evidence shows that the impact of monetary expansion on output cost is not statically significant (both discount rate and international reserve), while fiscal expansion shows positive impact on output cost and coefficient is statistically significant. A one percentage increase in the fiscal expenditure will decrease output cost or cost of the crisis by 1.41 percentages. The 70 percentage the variation output cost is explained by explanatory variables. In the Column (3.2), I exclude the policy variables that are statistically insignificant. As seen from (3.2), the number of observation is reduce due to the missing of variables for some countries, and the coefficient of determination is slightly increase by 0.02. Almost I find the same result, the fiscal and monetary contraction has significant negative impact on output cost associated with crises and the coefficients are significant. Fiscal expansion has positive impact on output cost during the crisis and the coefficient is statistically significant. A one percentage increase fiscal expenditure reduces output cost by 1.38 percentages and the coefficient is significant.

Table 3. Regressions with policy indicators and control variables

Variable	(3.1)		(3.2)	
Intercept	8.25932**	(0.71)	8.69691***	(0.83)
FISCALE	1.41061**	(2.44)	1.38598*	(2.50)
FISCALT	-2.90112***	(-2.69)	-2.899403**	(2.79
DISCOUNTINC	3.49973	(0.13)		
RESERVEINC	-2.16384	(-0.07)		
DISCOUNTDEC	11.91431	(0.85)		
RESERVEDEC	-3.3897**	(-2.23)	-3.41492***	(-2.32)
INFLATION	0.01929	(3.48)	0.01924	(3.61)
KAOPEN	2.94250***	(0.84)	2.79976**	(0.87)
TROP	-0.04635	(-0.32)	-0.04653	(-0.34)
R-squared	0.700615		0.7213	
F-test	65		7.2	
Obs.	54		43	

Note: The table reports output loss following financial crises, dependant variables output loss to one percent policy variables with control variables (associated t-statistics in parenthesis), *,**,***, show the significance at 10, 5 and 1 percent respectively.

Finally, I find out that fiscal policy is more effective tools than monetary policy during the financial crisis in the developing and emerging countries. My result is consistent with the result of Hutchison et al., (2010), where they find that fiscal policy is more effective tools than monetary policy. However, my result is different than the result of Jie (2013) where they find that monetary policy is more effective than fiscal policy.

5. Conclusion

The paper examines the effect monetary and fiscal policy on output cost or loss during the financial crisis for 72 episodes of financial crisis in developing and emerging countries from 1980 to 2010. The result suggests that in developing and emerging countries fiscal policy is more effective then monetary policy during the financial crisis. An increase of government expenditure by one percentage reduces output cost by approximately 1.4 percentages during the financial crisis, while the coefficient of monetary expansion is statistically insignificant. Moreover, I find out that monetary and fiscal contraction increase significantly output cost. Therefore, the macroeconomic policy mix with an expansionary fiscal policy with a neutral monetary policy reduces output cost during the financial crisis in developing and emerging countries.

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Appendix A. Financial crisis episodes in developing and emerging countries

Albania	1994	Kenya	1992
Algeria	1990	Korea	1997
Argentina	1980	Lebanon	1990
Argentina	1989	Malaysia	1997
Argentina	1989	Macedonia	1993
Argentina	2001	Mexico	1981
Armenia	1994	Mexico	1994
Azerbaijan, Rep.	1994	Morocco	1980
Belarus	1994	Mozambique	1987
Brazil	1994	Nicaragua	1990
Bulgaria	1996	Nigeria	1991
Cameroon	1994	Paraguay	1995
Central African Rep.	1994	Peru	1983
Chad	1992	Philippines	1983
Chile	1981	Philippines	1997
Congo, Dem. Rep	1983	Russia	1998
Congo, Dem. Rep	1991	Principe	1992
Congo, Rep	1992	Sierra Leone	1989
Dominican Repub.	2003	Sweden	1991
Ecuador	1982	Tanzania	1987
Ecuador	1998	Thailand	1997
Egypt	1980	Togo	1993
Estonia	1992	Turkey	2000
Finland	1991	Ukraine	1998
Georgia	1991	Uruguay	1981
Ghana	1982	Uruguay	2002
Guinea-Bissau	1994	Venezuela	1994
Haiti	1994	Yemen	1995
Indonesia	1997	Zambia	1995
Jordan	1989		

Source: Laeven and Valencia, 2008. Systematic banking crises: a new database, IMF, working paper.

Appendix B. Data Sources

Variables	Data Sources
Real GDP growth rate	WDI
Discount rate/International reserves	IMF, IFS
Annual budget balance (% of GDP)	IMF, GFS
Trade openness	WDI
Inflation	WDI
Capital account openness	Chin and Ito, 2006

International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971XE-ISSN 1916-9728
Published by Canadian Center of Science and Education

Sectoral Foreign Aid and Income Inequality

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Received: August 5, 2012 Accepted: July 31, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p117 URL: http://dx.doi.org/10.5539/ijef.v5n9p117

Abstract

This study contributes to the empirical understanding of foreign aid and income inequality by investigating the effect of foreign aid on income inequality in recipient countries, based on the disaggregation of foreign aid figures. For this purpose we include four main sectoral foreign aid (social sector, economic sector, production sector and multi sector) as determinants of income inequality. This study utilized the Generalized Method of Moments (GMM) method for a panel of 75 foreign aid recipient countries covering the period of 1995-2009. The results indicated that different sectoral foreign aid affected income inequality differently. Aid to economic sector has significant impact in reducing income inequality. In contrast, aid to multi sector significantly increased income inequality.

Keywords: foreign aid, income inequality, GMM

1. Introduction

Over the past decade, foreign aid has been regarded as an important tool in fighting poverty in less developed and developing countries. Foreign aid or known as official development assistance (ODA) can be define as a flow or transfer of payment including a grant element made by official agencies, state and local governments, or by their executive agencies for developing countries and multilateral institutions. The main objective of giving foreign aid is to develop economic and welfare development in poor and developing countries. Foreign aid is believed enable to address the poverty and income inequality problem by facilitating faster and sustained economic growth in these countries. Poor countries are facing scarce of capital for saving and investments in order to generate income and economic growth. According to Nelson (1956), Erikson (2005) and Sachs et al. (2005), poor countries have low incomes and savings which leave them in a "vicious circle of poverty" or "poverty trap". In other words, they experience a "low-level equilibrium trap" where higher income does not lead to increase saving but only results in higher population growth.

The earlier study on the role of foreign aid on economic growth was undertaken by Chenery and Strout (1966) using "two-gap" model. In this model, they assumed that foreign aid filling the financing gap and trade balance gap simultaneously. The financing gap means that a country has insufficient resources for investments. While trade balance gap is the gap between import requirement for a targeted level of production and foreign-exchange earnings, which implies that a country possesses insufficient foreign currency to pay for imports. Perhaps foreign aid will dissolve the "vicious circle of poverty" and connects less developed countries to the virtuous circle of productivity and growth. Then inceased in growth will improve the standard of living of the poor countries.

However, after fifty years, the role of foreign aid in fostering economic growth and development in poor countries continues to be a subject of debate among policy makers and researchers. These arguments were supported by the voluminous of empirical literatures which indicated little evidence that foreign aid promoted economic growth. For instances, Cassen (1994), Papanek (1973), Mosley (1980), Mosley et al. (1987) and Boone (1994) found inconclusive result between aid and growth. In contrast, Burnside and Dollar (2000) found positive impact of aid on growth conditional with good fiscal, monetary and trade policies of the recipient countries. However, Easterly (2003) finds that foreign aid is no longer effective in countries with good economic policies in different time, country and sample size.

Despite the lack of robust positive correlation between aid and growth, the economists and policy makers shift to focus on the direct impact of foreign aid on poverty and income inequality in recipient countries. Among the

studies that focus on the impact of aid on poverty are Collier and Dollar (2002), Lensink and White (2002), Kraay and Raddatz (2007) and Bahmani-Oskooeeand Ayolola (2009). However, poor economic performance and disappointing poverty reduction experience in major aid recipient contrasted with nations that have managed to achieve significant progress without foreign aid. Currently only a few empirical studies have been performed looking at the impact of foreign aid on inequality (Bourguignon et al. 2008; Calderon et al. 2009; Shaifullah 2011).

Recently, there were several studies contributed to foreign aid and growth literature by assessing the impact of different categories of foreign aid and growth (Ouattara and Strobl 2008;Mavrotas 2005; Mavrotas 2002a). They disaggregated foreign aid into different categories and found different category of foreign aid affected growth differently.These findings spur a question whether income inequality will have the same significant impact when aid is evaluated at disaggregated level. Does different sectoral foreign aid have significant impact on income inequality on the recipient countries? If yes, which sector of aid reduced income inequality? Thus, the objective of this study is to analyze the impact of sectoral foreign aid on income inequality in aid recipient countries.

This paper is organized as follows. The next section reviews the empirical evidence on the impact of foreign aid on income inequality using aggegate foreign aid figures. Then, the model specification and econometric methodology conducted in this study will describes in Section 3. Section 4 discusses the data source of this study, followed by the interpretation of results and discussions in Section 5; finally, Section 6 concludes.

2. Literature Review

In the history of foreign aid, Friedman (1958) theoretically argued that aid was only likely to benefit a political elite. The first empirical analysis of the aid on income inequality was done by Chase-Dunn (1975). He indicated that foreign aid has positive impact on income inequality. Then, Boone (1997) and Collier & Dollar (2004) found that aid increases the amount of resources the recipient government has at hand. Aid deteriorates governance since a less “resource-constrained” has reduced interest in being accountable to the local population (Rajan& Subramanian 2007). Aid funds can not only diminish democracy but funds may not even reach their intended purpose (helping the poor). As a matter of fact, these funds are sometimes embezzled and expended by the local elite in association with governing people (Drazen 2000). All political systems are believed to favor high-income political elite (Boone 1997) and as such foreign aid would mean more funds for governing people and the local elite to misappropriate. Aid can be used to maintain and augment existing disparities in income and political clout.

Recently, Calderón et al. (2006) found no robust relationship between inflows of foreign aid and income inequality eventhough in good institutional quality. However, the undoing of foreign aid benefits through trade barriers restricting access to markets in developed countries is also discovered (Bourguignon et al. 2008). Foreign aid is found to improve income distribution in the presence of good institutions (Calderon et al. 2009). Two studies, on the other hand, find a negative relationship (Bjørnskov 2009; Layton & Nielson 2009) but the relationship to be robust in one of the cases. Although the other study produces somewhat inconclusive results, they find a robust “zero to positive” correlation between aid and inequality (Layton & Nielson 2009). It is also found that aid deteriorates the current period inequality more than inequality in the following period or later. Recently, Shaifullah (2011) presented the theoretical perspectives of foreign aid's impact on income distribution and look for empirical evidence of such an alleged relationship in a panel of 94 countries over 20 years. They found the evidence to the contrary that aid causes small reductions in inequality.

Until now, the past studies of foreign aid and income inequality employed aggregate foreign aid figures and found inconclusive result about the impact of foreign aid on income inequality. However, the current contribution to foreign aid and growth literature by assessing the impact of different categories of foreign aid on growth show more significant findings. As pointed by Ouattara and Strobl (2008), aggregate aid figures lead to an aggregation bias findings because these figures cannot disentangle the individual effect of foreign aid on growth. In addition, Mavrotas (2005) argues that the state of aid coordination may differ in each country. Thus it makes sense to predict that the impact of aid in each country is not similar. Besides that Mavrotas (2002a) was divided aid to India during the period 1970–1992 into three categories, which are program aid, project aid, and technical assistance grants. He indicates that all three types of aid affected growth negatively.

Here, there is clear evidence that disaggregation foreign aid figures produced more appropriate findings rather than aggregate figures. Study on the impact of foreign aid on income inequality should be focus on the disaggregate foreign aid figures in order to disentangle the individual effect of different categories of foreign aid on income inequality. Thus, this study will analyze the impact of foreign aid on income inequality using the dissaggegated foreign aid figures into sectoral level.

3. Methodology

3.1 Model Specification

This study modified Calderon et al.(2009) model in estimating the impact of sectoral foreign aid on income inequality. The basic specification of this study can be represented by the following equation:

$$Y_{it}=\beta_0+\beta_1 Aid_{it}+\beta_2 X_{it}+\varepsilon_{it} \quad (1)$$

where all variables are in logarithm form as a percentage of GDP except inflation rate.Yrepresents income inequality, as proxied by the Gini coefficient. Aid is the set of sectoral aid, which includes aid to social sector, economic sector, productionsector and multi sector. Firstly, aid to social sector aims to improve aid human capital, living standards and reduce income inequality in recipient countries. The sub-sectors of this aid are aid to education, health, population program and reproductive health, water supply and sanitation, government and civil society, and others. Secondly, aid to economic sector may improve total productivity in the recipient economies and directly adds to investment and help to the constraint on public funds available for necessary public investment. Aid of this sector aims to increase growth and reduce income inequality. Aid to this sector consists of aid to transportation and storage, communications, energy, banking and financial services, business and other services. Thirdly, aid to production sector was aims to increase capital accumulation by enlarging the pool of resources available for investment. The sub-sectors of this aid are agriculture, forestry, fishing, industry and mining, construction, trade policies and regulations. Lastly, aid to multi sector, which aid for general environment protection, and other multi sectors. Both of these aids also are expected to reduce income inequality. X is a set of control variables which includes the level of real GDP, employment, trade openness and inflation rate .ε denotes an error term. All the variables are expected to be negatively correlated to income inequality except inflation rate. Thus the sign of the etimated coefficient of all variables must be in the negative sign.

3.2 Econometric Methodology

This study conducted the General Method of Moments (GMM) estimation procedure to examine the impact of sectoral aid on income inequality. This technique allows us to eliminate time invariant country-specific effects and to control for the endogeneity of the explanatory variables. We assume that all explanatory variables are potentially endogenous. Time-invariant variables are eliminated from (1) since under our estimator the data is first differenced. This study follows the GMM system which is developed by Blundell and Bond (1998). The consistency of the GMM estimator depends on whether lagged values of the explanatory variables are valid instruments in the regression.

4. Data Sources

This study utilized a panel data set of 75 aid recipient countries for the period 1995-2009. The data on GINI coefficient is sourced from the online database of Standardized World Income Inequality Database (SWIID), Version 3.1 (Solt, 2011). SWIID interpolates the missing data that is available from the World Income Inequality Database (WIID). The sectoral aid data was collected from OECD in Development Assistance Committee (DAC) and Credit Reporting System (CRS). The data covered both bilateral and multilateral donors. The sectoral ODA data was listed in terms of commitments starting 1995-2009 and the disbursements of sectoral ODA available starting 2002 until 2009. We calculated the sectoral disbursement for the period 1995-2001 data base on the commitments data using Clement et al (2004) approach. In this approach, we assume that the fraction of disbursements in each of aid category in given period is equal to the fraction of commitments in each category in that period. The real GDP, employment rate, trade opennes and inflation rate were derived from the World Development Indicator online database.

5. Results and Discussions

The estimated results of the impact of sectoral foreign aid on income inequality are summarized in Table 1. Before discussing the results on the estimated coefficients it is crucial to analyze our diagnostic tests. The first test concerns the validity of the instruments. The Hansen p-value is greater than 5 percent significance level, which is 0.749. It implies that we failed to reject the null hypothesis of no over-identifying restrictions. The second test concerns the question of 1st and 2nd order serial correlation. The p-values of the Arellano and Bond test for AR (1) is 0.042 which are less than 5 percent for shows that the residuals are correlated at 1st order conditions. However the residuals are not correlated at 2nd order conditions when p-values of the Arellano and Bond test for AR (2) are greater than 5 percent significance level, which is 0.296. Thus both Hansen and Arrelano-Bond statistics confirm that the instruments used have no-over-identifying restriction and residuals are independent.

Turn to the estimated coefficients; Table 1 presents the estimated results of the effect of sectoral foreign aid on

income inequality in recipient countries. The results indicated that aid to economic sector exhibit a negative and significant impact on income inequality at 1 percent significant level. Meaning that aid to economic sector is effective in reducing income inequality in aid recipient countries. Moreover, aid to multi sector indicated a positive and significant at 5 percent level impact on income inequality. This result shows that aid to this sector seems to increase income inequality. Even though aid to social sector and production sector do not appear to exert any statistically significant effect on income inequality, but they affected income inequality by the opposite direction. Aid to social sector has a negative correlation to income inequality and aid to production is positively correlated to income inequality. Then GDP and employment attempted to have negative and significant at 5 percent level and positive impact at 5 percent significant level on income inequality, respectively. The inflation rate has a negative significant impact on income inequality, while trade openness was not significant in affecting income inequality.

Table 1. Sectoralforeign aid and income inequality, 1995-2009

Independent Variable	(1)	
Constant	3.507***	(-5.9)
Real GDP	-0.033**	(-2.33)
Employment	0.257**	(-2.31)
Aid to Social Sector	-0.017	(-1.04)
Aid to Economic Sector	-0.038***	(-3.50)
Aid to Production Sector	0.003	(-0.28)
Aid to Multi Sector	0.024**	(-1.87)
Trade Openness	-0.008	(-0.18)
Inflation	-0.0008**	(-2.28)
Number of Observations	872	
Number of Countries	75	
Diagnostic Checking		
AR (1) test (p-value)	0.042	
AR (2) test (p-value)	0.296	
Hansen test (p-value)	0.749	

Note: Dependent variable is *Gini coefficient*. The figures in parentheses are Robust t-statistic.

** The coefficient is significant at 5%.*** The coefficient is significant at 1%.

6. Conclusion

This paper has contributed to the recent empirical literature on impact of foreign aid on income inequality. We tested the impact of sectoral aid (social sector, economic sector, production sector and multi sector) on income inequality using the GMM-SYS approach to dynamic panel estimator for a sample of aid recipient countries over the period 1995–2009. This method is powerful in solving the endogeneity problem and produced unbiased estimation results. This study support the findings pointed by Mavrotas (2005), Mavrotas and Ouattara (2006a) that different category of aid exerted a different macroeconomic and social effects on the recipient economy. It depends on the category and the purpose of giving that aid. Our findings suggest that aid to economic sector plays significant role in reducing income inequality in aid recipient countries. Aid to this sector includes of aid to transportation and storage, communications, energy, banking and financial services, business and other services. These sectors are main sectors that generate economic growth in a country. Thus, aid to this sector will increase economic efficiency, total productivity, economic growth and reduce income inequality in the recipient economies. In contrast, aid to multi sector seems to increase income inequality. This type of aid includes aid goes to the general environment protection, and other multi sectors which is more benefited of the top segment of the society. Thus, study on the impact of foreign aid on income inequality using disaggregated aid figures provided more appropriate and important findings rather than aggregate aid figures. Hopefully these findings can be a benchmark for policy makers to design more appropriate and better policy to make aid more effective and achieved its goals.

Acknowledgements

The authors wish to acknowledge are Associate Professor Dr. Zulkornain Yusop, Associate Professor Dr. Normaz Wana Ismail and Associate Professor Dr. Law Siong Hook for their guidance in the study especially with regards to the method of data analysis.

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International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Does Philips Relations Really Exist in Nigeria? Empirical Evidence

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Received: May 21, 2013 Accepted: July 29, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p123 URL: http://dx.doi.org/10.5539/ijef.v5n9p123

Abstract

The paper examines the existence and the stability of Phillips relations for Nigeria, using time series data from 1970 to 2010. Graphical, Augmented Dickey Fuller and Philip Peron unit root tests were employed to check for stationarity. ARDL and DOLS general to specific approaches to cointegration have been used to explore the Philips relations and ECM to understand short run dynamics. The estimates shows that relation between the change in inflation rate and the unemployment rate is theoretically negative in the short run—a low unemployment rate leads to an increase in the inflation rate and therefore an acceleration of the price level- however, the relation became non existence in the long run with positive relationship between inflation and unemployment signifying stagflation. Meanwhile, recursive residual, CUSUM and CUSUMsq tests confirm a stable Philips relation.

Keywords: Phillips Curve, dynamic model, ADF, cointegration, DOLS, Nigeria

1. Introduction

Fifty four years ago, A. W Phillips plotted nominal wage inflation against unemployment in the United Kingdom, and remarked on their tight and stable negative relation over the previous century. Twenty-five years after Phillips's paper, Robert Lucas and Thomas Sargent set the simultaneously high inflation and unemployment - evident across practically all developed economies – against a Phillips curve backdrop and decried the econometric failure on a grand scale. This followed a sequence of papers during the 1970s that had both supported and called into question the econometric and theoretical basis of the Phillips curve and hence its usefulness for public policy purposes (Lipsey, 1960; Solow, 1970; Onder, 2004 and Faridul et al, 2011).

The possibility of a trade off offers policymakers a tool to deal with macroeconomic disequilibrium. However, the failure to explain economic crises of the 1970s had cast serious doubts about the validity of the relation. While Phelps (1967), Friedman (1968), Lucas (1976) and Okun (1975) argued against the hypothesis, Onder (2004), Kustepeli (2005), Furuoka (2007), Tang and Lean (2007), Schreiber and Wolters (2007), Dammak and Boujelbene (2009) lent support to a stable non linear relation. Others found an unstable relation between unemployment and inflation (Lucas, 1972, 1973, 1976); Okun (1975); Turner (1997); Atkeson and Ohanian (2001); Niskanen (2002); Demers (2003) and Reichel (2004).

Akerlof et al. (1996, 2000), Karanassou et al. (2005), and Holden (2004) discuss models in which long-run trade-off between output and inflation can exist if the inflation rates are low. Karanassou et al. (2003) provides support to a long-run inflation-unemployment trade-off for some EU countries; and Franz (2005) for German. Thus whether or not a long-run inflation-unemployment trade-off exists should be left to empirical tests using appropriate tools. This may help clarify some of the mysteries underlining the relationship between inflation and unemployment (Mankiw, 2001).

Much of the existing literatures have been examined within the context of developed countries. According to Faridul et al, sound macroeconomic policy is considered critical for pursuing economic growth and this is more relevant for African countries which are more vulnerable to major shocks. The objective of this study is therefore to analyse both the existence and stability of Philips relation in Nigeria. Since we are not aware of any study purporting to or that has explored these issues for Nigeria using annual data from 1970 to 2010 the research thus fills a gap in knowledge and thus contributes to the literature.

The rest of study is organized as follows. Literature review is discussed in Section II. Section III describes the methodology. Findings are discussed in section IV. Conclusions and policy implication are drawn in Part V.

2. Literature Review

The high rate of both inflation and unemployment experienced by many countries in the 1970s brought about concerted attacks on Philips curve as Friedman (1968) argues that this relationship was only a short run phenomenon. In the long run according to Friedman, workers and employers takes inflation into account result in employment contracts that increase pay at rates near anticipated inflation. This implies that over the long run, there is no trade-off between inflation and unemployment. Niskannen (2002) points out that the Philips curve in its original form suffers misspecification and that the positive slope of the long run Philips relation may be due to lack of indexed tax code. Gali et al, (2005) and Rudd and Whelan (2005) use GMM approached but failed to find strong Philips relation. Reichel (2004) applied co integration method to the industrialised economies but found trade-off only for US and Japan.

However, Karanassou et al, consistently provide further support for long run inflation-unemployment trade-off. For instance, their work in 2003 for some EU countries provides further support for long run inflation-unemployment trade-off. Karanassou, et al (2008) also analyses the relation between US inflation and unemployment from the perspective of 'frictional growth'. In particular, they focus on the interaction between money growth and nominal frictions and conclude that monetary policy has not only persistent, but permanent real effects, giving rise to a long-run inflation-unemployment tradeoff. Karanassou, et al (2010) employ the chain reaction theory (CRT) approach within the new Phillips curve to provide a synthesis of the traditional structural macroeconometric models and the (structural) vector autoregressions. Karanassou, et al again show that frictional growth, i.e. the interplay between lags and growth, generates an inflation-unemployment trade-off in the long run. They therefore suggest that a holistic framework, such as the chain reaction theory (CRT), should be used to jointly explain the evolution of inflation and unemployment.

DiNardo and Moore (1999) used a panel of OECD countries with ordinary Least Square (OLS) and Generalised Least Square (GLS) methods and found the Philips relation. These finding are corroborated by the work of Malinov and Sommers (1997) and Turner and Seghezzea (1999), where they both employed Seemingly Unrelated Estimation method. Eliasson (2001) specified linear Phillips curve for Sweden, Australia, and the United States and checked for parameters stability. They did not find the Phillips curve for Australia and Sweden, but found one for the US. Unlike Islam et al. (2003) who revisit the US Philips relation using 1950-99 data but did not find a strong relation.

Lipsey (1960) found an inverse relation for Britain for 1914-18, but not after the War. Turner (1997) argues that structural break since the 1970s in Britain may have caused the instability of the Phillips curve. He emphasizes more on the stability, than its existence. Atkeson and Ohanian (2001) also support Turner. Hansen and Pancs (2001) found inverse relation between the series for Lativa. Bhanthumnavin (2002) finds the Phillips curve for Thailand, but only in the post 1997 Asian flu. Graham and Snower (2002) demonstrate a stable Phillips curve for Chile. They argue that the trade off in long run is due to inter-relation between money growth and rise in nominal wages. Using Stock-Watson procedure, Furuoka (2007) found relation between inflation and unemployment for Malaysia, which was later confirmed by Tang and Lean (2007). Schreiber and Wolters (2007) applied VAR cointegration approach and found a long run relation for German.

Cruz-Rodriguez (2008) found Phillips curve for Dominican Republic. However, the link with output gap is found positive, which may be due to world oil prices and exchange rate shocks. Del Boca et al. (2008) found Phillips curve for Italy for 1861-1998. The paper captures the effects of structural changes and asymmetries on the estimates of the trade-off relation and found that a trade-off exists only during low inflation and stable aggregate supply. Russell and Banerjee (2008) investigate vertical Phillips curve assuming non-stationarity in the series. They find positive relation between inflation and unemployment rate in short run for the United States. Paul (2009) argues that droughts, oil shocks and liberalization-policy of the early 1990s may be the reason for the absence of a Phillips curve in India. After adjusting for the shocks he finds the Phillips curve suggesting a short-run trade-off between inflation and industrial output for India. Recently, Faridul et al (2011) estimates a Philips curve for North Cyprus using ARDL bounds testing and Dynamic Ordinary Least Squares (DOLS) approaches. Their results also confirm trade-off between inflation and unemployment.

Focusing on regimes of inflation and unemployment and using the statistical technique of fuzzy clustering, Ormerod et al, (2013) explored for the United States, the United Kingdom and Germany between 1871 and 2009. They reported that the factors which govern the inflation/unemployment trade-off are so multi-dimensional that it is hard to identify periods of short-run Phillips curves which can be assigned to particular historical periods

with any degree of accuracy or predictability. They therefore identify for each country three distinct regimes in inflation/unemployment space and found that similarities exist across countries in both the regimes and the timings of the transitions between regimes. Further, even within a given regime, the results from the cluster analysis reveal persistent fluctuations in the degree of attachment to that regime of inflation/unemployment observations over time. Their implies that, first, the inflation/unemployment relationship or Phillips curve experiences from time to time major shifts. Second, that it is also inherently unstable even in the short run. They however conclude that, the typical rates of inflation and unemployment experienced in the regimes are substantially different.

3. Methodology

The methodology used here is based on the recently developed autoregressive distributed lag (ARDL) framework (Pesaran & Shin, 1995, 1999; Pesaran et al, 1996; Pesaran et al, 1998) which does not involve pre-testing variables, thereby obviating uncertainty. Put differently, the ARDL approach to testing for the existence of a relationship between variables in levels is applicable irrespective of whether the underlying regressors are purely 1(0), purely I(1). The statistic underlying the procedure is the Wald or F-statistic in a generalised Dickey-Fuller regression, which is used to test the significance of lagged levels of the variables in a conditional unrestricted equilibrium correction model (ECM) (Pesaran et al., 2001: 1). The estimates obtained from the ARDL method of cointegration analysis are unbiased and efficient given the fact that: (a) it can be applied to studies that have a small sample, such as the present study; (b) it estimates the long-run and short-run components of the model simultaneously, removing problems associated with omitted variables and autocorrelation; (c) the ARDL method can distinguish between dependent and independent variables.

Researchers have included variables such as real GDP and marginal cost of production in estimating Phillips curve. Gordon (1981) recommends using real gross national product for unemployment rate. To measure inflation consumer price index (CPI) has been used. Overall inflation rate through CPI is a better measure for inflation rate for a developing economy (Faridul et al, 2011). Open unemployment data, real gross domestic products and money supply through M2 are employed for this study. While all data are sources from the Central Bank of Nigeria statistical bulletin and annual reports and statement of accounts (2010) and National Bureau of Statistics (2010), money supply is from the World Development indicators (2010).

The study employed data from 1970-2010 and before implementing co integration technique, the variables used in the model are subjected to stationary tests using Augmented Dickey-Fuller (ADF) and Philip Perron test following equation 1. Our ADF test consists of estimating the following equation:

$$\Delta Y_t = \alpha + \beta_t + \delta Y_{t-1} + \Psi \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \tag{1}$$

Where α represent the drift, t represents deterministic trend, β, δ, ψ are parameters to be estimated, m (lag length) is a lag large enough to ensure that ε_t is a white noise process; and Δ is the difference operator. In the ADF approach, we test whether $\delta = 0$

The Philips-Perron test is based on the following statistic:

$$\tilde{t}_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0 - \gamma_0)(se(\hat{\alpha}))}{2 f_0^{1/2} s} \tag{2}$$

Where: $\hat{\alpha}$ estimate; $\tilde{t}_\alpha$ is the t-ratio of $\alpha; se(\hat{\alpha})$ is the coefficient standard error; T is the sample size or number of observations and s is the standard error of the test regression. In addition, γ_0 is a consistent estimate of the error variance in the standard Dickey-Fuller equation (calculated as $(T - k)s^2/T$, where k is the number of repressors). The remaining term, f_0, is an estimator of the residual spectrum at frequency zero.

In our search for a long run relation, we use cointegration approach. When variables are cointegrated, the long-run relations are estimated by cointegrating vectors focusing on the order of integration of each series. Moreover, ARDL remains valid irrespective of the order of intergration. But ARDL procedure will collapse if any variable is I(2). Johansen (1988a, 1991) derived distribution when the cointegrated system is parameterized as a vector error correction model (VECM). For a set of I(1) variables and a single cointegrating vector, Stock and Watson (1993) can be applied. The method has come to be known as the "dynamic OLS" (or GLS, as the case may be). The resulting "dynamic OLS" (respectively GLS) estimators are asymptotically equivalent to the Johansen estimator. In finite sample, these estimators perform better, relative to other asymptotically efficient estimators, when simple short-run dynamics is involved.

The DOLS procedure requires partial knowledge of the series expected to cointegrate and the orders of

integration. With DOLS the problems associated with simultaneity, endogeneity and serial correlation are resolved by including leads and lags in small sample. The DOLS procedure is helpful if the series has different orders of lags (Stock-Watson, 1993). In the case of normal distribution the estimators have desirable properties as compared to Phillips and Perron (1988), Phillips and Loretan (1991) and Phillips and Moon (1999, 2001). In particular, the Engle–Granger's approach may not be satisfactory if in a multivariate case more than one cointegrating vector is present (Seddighi et al. 2000). Engle-Granger estimator suffers from a non-standard asymptotic distribution. Inferences on the parameters of the cointegrating vectors using DOLS estimator are efficient. Monte Carlo studies by Agrawal (2001) favor DOLS in estimating the long run relation. Predictive properties DOLS are better than the standard Engle-Granger (1987), Johansen (1988, 1991); Johansen-Juselius (1990) and Phillips & Hansen (1990) procedures. As such we also apply the ARDL using the unrestricted error correction method. Following Faridul *et al* (2011) our model is specify thus:

$$INF_t = \psi_0 + \sum_{i=1}^{p} \varphi_t INF_{t-1} + \sum_{t=0}^{q} \eta_t UNP_{t-1} + \varepsilon_t \quad (3)$$

We expect the coefficient of UNP to be negative and significant for the existence of Philips curve. Generally the short and the long run models follow thus:

$$\Delta \text{inf} = a_0 - b_1 \text{inf}_{t-1} + c_1 un_{t-1} + d_2 y_{t-1} + d_3 m2 + \sum_{i=1}^{p} e_i \Delta \text{inf}_{t-1} + \sum_{i=1}^{p} f_i \Delta un_{t-1} + \sum_{i=1}^{p} g_i \Delta y_{t-1} + \sum_{i=1}^{p} h_i \Delta m2_{t-1} + \varepsilon_t \ldots\ldots\ldots (4)$$

In Equation-4, 1 g refers to a constant and 2 g to the long run parameter. The number of lags is denoted by *p; k* refers to lag length of the leads terms. The e refers to the error term. The selection of lags and leads is based on AIC.

In traditional approaches to cointegration, structural break in time series can be checked by Chow test. In ARDL, the CUSUM and CUSUMsq tests provide diagnosis for such information. For example, in Fig I and II, if the blue lines cross the red lines then structural break is likely. Based on the results obtained of this study, such outcome is unlikely. Also ARDL bounds test approach applies notwithstanding ambiguity in the order of integration7. This issue is relevant because in the presence of structural break in the data generating process, the traditional approaches may not capture cointegrating relation. This can potentially affect the outcome of the unit root test and the predictive powers (Leybourne and Newbold 2003; Perron, 1989, 1997)8. The ARDL approach is implemented by the following unrestricted error correction method (UECM) form (See Pesaran et al. 2001)):

$$\Delta \text{inf} = a_0 + \sum_{i=1}^{p} e_i \Delta \text{inf}_{t-1} + \sum_{i=1}^{p} f_i \Delta un_{t-1} + \sum_{i=1}^{p} g_i \Delta y_{t-1} + \sum_{i=1}^{p} h_i \Delta m2_{t-1} + jECM_{t-1} + \varepsilon_t \ldots (5)$$

The ARDL model calculates (p+1)k number of regressions based an appropriate number of lags. The p indicates the number of lags in ARDL bounds testing and k is the number of actors in the model. In selecting lags, the minimum of AIC and SBC is used. The model has been subjected to sensitivity analysis to tests for serial correlation, functional form, normality, White heteroscedisticity, model specification and ARCH. CUSUM and CUSUMsq check for the stability of long and short run parameters.

4. Results and Discussions

4.1 The Unit Root Test

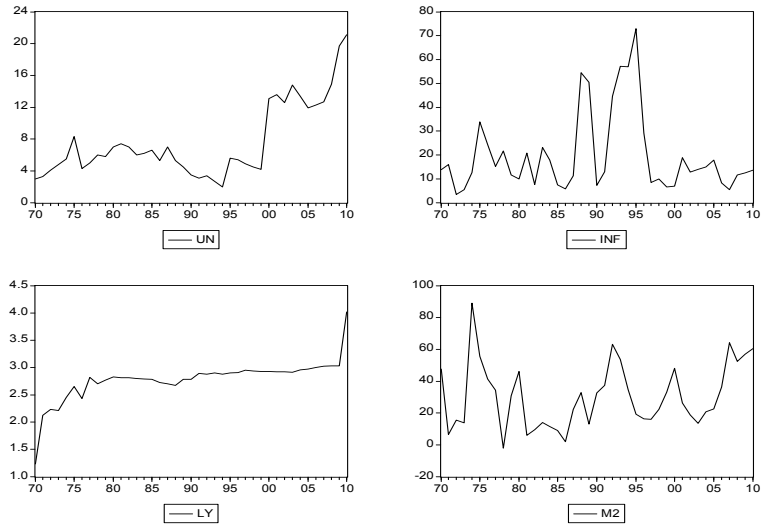


Figure 1. The initial clue about the likely nature of the time series under study

INF and M2 appear to fluctuate around a constant mean while both UN and LY appear to and upward trend over the period of study, suggesting perhaps that their mean have been changing. Therefore we can deduce that INF and M2 are stationary while UN and LY are not.

Table 1. Unit root test—ADF and PP

Var	ADF Sta	C.V 5%	Order	PP Sta	C.V 5%	Order
INF	-3.1360	-3.5266	I(1)	-2.9520	-3.5266	**I(1)**
	-6.3668	-3.5330		-12.635	-3.5297	
UN	-1.0730	-3.5266	I(1)	-0.0038	-2.9369	**1(1)**
	-6.5303	-3.5297		-6.5329	-3.5297	
LY	-5.2728	-3.5266	**I(0)**	-5.2725	-3.5266	**I(0)**
	-5.6979	-3.5297		-5.6305	-3.5297	
M2	-3.8711	-3.5266	**I(0)**	-3.9671	-3.5266	**I(0)**
	-7.7348	-3.5297		-9.7711	-3.5297	

Source: Computed by the authors. Note: tests include intercept only.

Using the ADF and Philip Perron unit root tests, Table 1 confirm that while INF and UN are stationary at first difference; LY and M2 are stationary at level. This confirm that the variables in our study are integrated of both I(1) and I(0) which necessitate the adoption of ARDL model. However, the informal and formal unit root tests contradict each other. We now test for the significance of our model.

Table 2. Co integration test: bound test

Model For Estimation	F-Statistics	Lag	Outcome
F_{INF}(INF)	4.374149**	2	Co integration
Critical Bounds	Lower		Upper
1%	3.66		5.26
5%	2.73		3.92
10%	2.31		3.35

Note: The lag selection is based on AIC.

4.2 ARDL General to Specific Dynamic Ordinary Least Square (DOLS)

From the robustness perspective, the Dynamic Ordinary Least Square result below shows that the coefficient of the ECM contains information about whether the past values of variables affect the current values of the variables under study.

$\Delta INF = 0.7878194483*UN(-1) - 1.66209896*\Delta UN(-1) - 0.3559895048*ECM(-1)$

0.0836	*0.2773*	*0.0075*	*Prob*
0.442657	*1.506691*	*0.125614*	*S.E*
1.779752	*1.779752*	*-2.833985*	*t.Stat*

$R^2 = 0.193394$

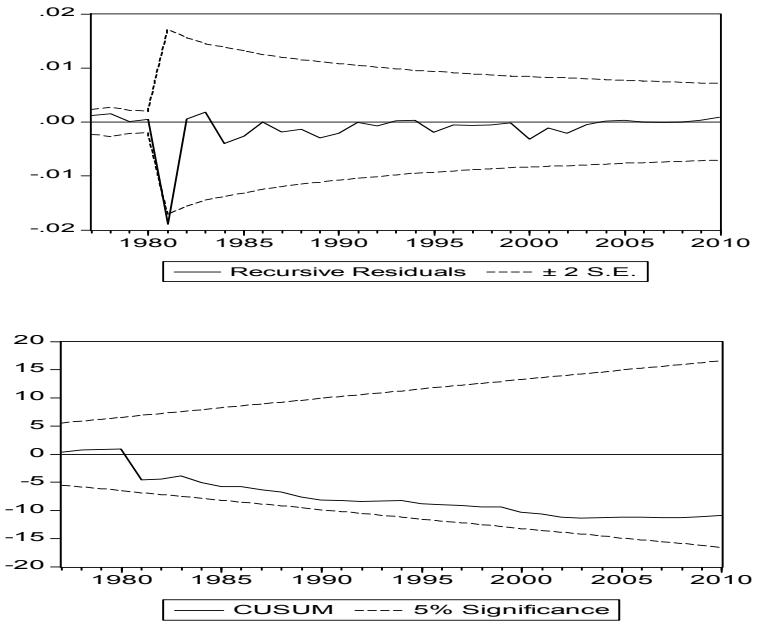
The absolute value of the coefficient of the error-correction term implies that about 35.6 percent of the disequilibrium in the Philips relations model is offset by short-run adjustment within a year. In this case, full adjustments are achieved, and take twelve months to complete the cycles. Thus, to maintain long run equilibrium between inflation and unemployment in Nigeria, it is important to reduce the existing disequilibrium over time.

As expected, the relation between the change in inflation rate and the unemployment rate from the specific analysis is negative in the short run—a low unemployment rate leads to an increase in the inflation rate and therefore an acceleration of the price level, hence the existence of Phillips curve. The specific result shows that a percentage increase in unemployment reduces inflation by 1.66 percent. However, the relation became positive in the long run since the coefficient of the first lag unemployment suggests that a percentage increase in unemployment increases inflation rate by 0.79 percent. More so the negative and significant coefficient of the first lag of INF (-0.3559895048) confirms a true long run relationship of the bound test result.

This negative short run relationship in Nigeria therefore supports the basic tenet of Philips curve of inverse relationship between unemployment and inflation rate. However, the long run result shows positive relationship between inflation and money supply and also economic growth. This inconsistent relationship is not expected since they are not in tandem with the theory. This can be as a result of continuous changes in the composition of the labour force consequent upon the demographic changes and random economic shocks such as currency devaluation, unanticipated increase in crude oil prices and various other policy inconsistencies in Nigeria.

These contradictory results might be as a result of the high level of natural rate of unemployment in Nigeria. Meanwhile, the recursive residual, the CUSUM and CUSUMsq tests suggest stability of the parameters.

4.3 Stability Test



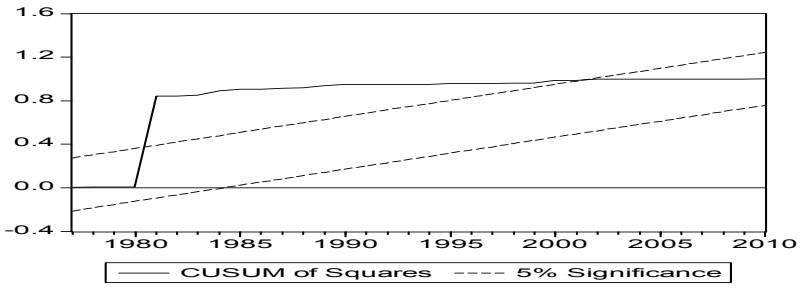


Figure 2. The recursive residuals and CUSUM of squares

Furthermore, issue of the stability of parameters of the model was considered. To this end we adopted the Bahmani-Oskooee and Shin (2002), as well as applying the cumulative sum of recursive residuals (CUSUM) to the residuals of the general model. For stability of short-run dynamics and long-run parameters of Philips relations, it is core that the residuals and cusum of squares stay within the 5 percent critical bound (represented by two straight lines whose equations are detailed in Brown, Durbin, and Evans, 1975, Section). As shown in the fig 2, neither the recursive residuals nor CUSUM of squares plots move outside the 5 percent critical lines. The result is suggestive of coefficient stability, therefore, we can safely conclude that the estimated parameters for the short-run dynamics and long-run of inflation function exists over the entire sample periods since residual result shows the future tendency of further stability. However, as with the CUSUM test, movement outside the critical line between 1981 and 2002 is suggestive of parameter or variance instability. Meanwhile, the test does not tell us the source of the instability that whether on account of intercept or on account of slope. This issue can be address in feature research. Meanwhile, the cumulative sum of squares is generally within the 5 percent significant lines, after 2002 suggesting that the residual variance is somewhat recently stable, corroborating the other stability test results.

The continued existence of this observed relationship implies that policy makers could only choose between inflation or unemployment in the course of macroeconomic management. It means that high levels of employment can only be obtained by tolerating a high rate of inflation. Conversely Nigeria government can achieve low rate of inflation only at the cost of high unemployment rate. Our result revealed the twin evil of macroeconomic with which both unemployment and inflation have being derived at least in the short run.

5. Conclusion

The paper estimates a Philips Curve for Nigeria using ARDL General to Specific bounds testing and DOLS approaches. ADF unit root test is applied to check the order of integration. Results establish co integration between inflation, unemployment, money supply and real gross domestic product for Nigeria suggesting a long run relationship over the study period. The results from General to specific OLS and DOLS confirm a theoretical trade off between inflation and unemployment variables in the short run but prove otherwise statistically in the long run. The result shows that while inflation is increasing unemployment also increase in the long run which implies that Phillips curve does not exists for Nigeria in the long run. This suggests that policy makers cannot use the trade-off relation in choosing appropriate strategy. They should be careful in adopting a monetary policy that would keep inflation at a politically acceptable level in Nigeria. These contradictory results might be as a result of the high level of natural rate of unemployment in Nigeria. Rational policy making therefore means that Nigeria policy makers would have to settle for that combination that minimizes the twin macroeconomic evils.

Meanwhile, the recursive residual, the CUSUM and CUSUMsq tests suggest stability of the parameters in the long run.

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Appendix

Appendix 1. ARDL specific dynamic OLS

Dependent Variable: DINF

Method: Least Squares

Date: 06/02/07 Time: 21:46

Sample(adjusted): 1972 2010

Included observations: 39 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.355990	0.125614	-2.833985	0.0075
UN(-1)	0.787819	0.442657	1.779752	0.0836
DUN(-1)	-1.662099	1.506691	-1.103145	0.2773
R-squared	0.193394	Mean dependent var		0.269231
Adjusted R-squared	0.148582	S.D. dependent var		19.49935
S.E. of regression	17.99250	Akaike info criterion		8.691591
Sum squared resid	11654.29	Schwarz criterion		8.819557
Log likelihood	-166.4860	Durbin-Watson stat		2.053761

Appendix 2. ARDL wald test

Wald Test:Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	4.374149	(4, 31)	0.0064
Chi-square	17.49659	4	0.0015
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(1)		-0.666135	0.161882
C(2)		0.674968	392.4126
C(3)		4.067210	36.59857
C(4)		-1.282848	0.993525
Restrictions are linear in coefficients.			
Wald Test: Equation: Untitled			
Test Statistic	Value	df	Probability
F-statistic	2.688363	(4, 31)	0.0494
Chi-square	10.75345	4	0.0295
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(1)		0.315582	0.106607
C(2)		0.018069	0.023374
C(3)		10.05978	46.32704
C(4)		-1.265454	4.312378
Restrictions are linear in coefficients.			

Appendix 3. ARDL general dynamic OLS

Dependent Variable: DINF

Method: Least Squares

Date: 06/01/07 Time: 16:50

Sample(adjusted): 1972-2010

Included observations: 39 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.666135	0.161882	-4.114936	0.0003
LM2(-1)	0.674968	392.4126	0.001720	0.9986
LY(-1)	4.067210	36.59857	0.111130	0.9122
UN(-1)	-1.282848	0.993525	-1.291208	0.2062
DLM2(-1)	1676.203	898.4109	1.865742	0.0716
DLY(-1)	-157.5581	84.42141	-1.866328	0.0715
DUN(-1)	-0.346899	1.523962	-0.227630	0.8214
C	-26.39144	537.2538	-0.049123	0.9611
R-squared	0.403828	Mean dependent var		0.269231
Adjusted R-squared	0.269209	S.D. dependent var		19.49935
S.E. of regression	16.66928	Akaike info criterion		8.645694
Sum squared resid	8613.810	Schwarz criterion		8.986937
Log likelihood	-160.5910	F-statistic		2.999780
Durbin-Watson stat	1.722052	Prob(F-statistic)		0.015897

International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Determinants of Commercial Bank Profitability in Sub-Saharan Africa

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Received: June 11, 2013 Accepted: June 10, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p134 URL: http://dx.doi.org/10.5539/ijef.v5n9p134

Abstract

The central theme of this study was to investigate the determinants of commercial bank profitability in Sub-Saharan Africa. The analysis used an unbalanced panel of 216 commercial banks drawn from 42 countries in SSA for the period 1999 to 2006.

Using the cost efficiency model, bank profitability was estimated using panel random effects method in static framework. The explanatory variables are growth in bank assets, growth in bank deposits, capital adequacy, operational efficiency (inefficiency), and liquidity ratio as well as the macroeconomic variables of growth in GDP and inflation. The findings clearly show that both bank-specific as well as macroeconomic factors explain the variation in commercial bank profitability over the study period.

These findings demonstrate the importance of both bank level as well as macroeconomic factors in explaining commercial bank profitability in Sub-Saharan Africa. The policy implications drawn from this paper are that if banks are to attain profitability improvements, both bank level as well as macroeconomic factors are important.

Keywords: commercial bank, cost efficiency, profitability

1. Introduction

1.1 Background and Motivation

Despite extensive reforms in the financial sector in Sub Saharan Africa during 1980s and 1990s, with a view of improving access to financial services to private agencies, financial depth in the sub-region has remained very low and not improving over the years. Commercial bank performance has been poor characterized by low levels of private credit, high interest rate spreads, high levels of non-performing loans, poor asset quality, operational inefficiencies, among others (Panayiotis, et al., 2005).

The low financial depth of commercial banks would suggest investment and economic growth is still heavily dependent on foreign savings in form of external finance. The World Bank (2006) acknowledged that there are few signs of sustainable progress arising from financial sector and public enterprise reform. The report called for more wide reforms in the financial sector to achieve higher efficiency in the banking sector. It is the growth and efficiency of commercial banks in many countries that would be important to finance the desired economic growth in the different segments of the economy.

With extensive information gap on commercial banking in SSA, This paper therefore examines the determinants of commercial bank profitability in Sub-Saharan Africa, considering the effect of the variables related to bank size, capital adequacy, liquidity risk, asset quality, credit risk, operational efficiency as on the prevailing economic environment. The study is in response to what has been previously been proposed by different scholars that there is need for more research and information on African commercial banks to inform policy decisions for the sector improvements.

1.2 Objectives of the Study

The main objective of the study is to investigate the determinants of commercial banks' profitability in SSA over the period 1999 to 2006. The research draws policy implications for industry improvement in the sub-region. The analysis utilises both bank level as well as macroeconomic factors to measure profitability performance over the years.

1.3 Significance of the Study

Empirical evidence clearly shows that studies focusing on Sub-Saharan Africa's commercial banking sector are still scanty and limited. Even the few studies which have been undertaken point to a need for further investigation of the factors that have continued to cause poor performance of commercial banks in the sub-region, notwithstanding the reforms in the last two decades. Most of the evidence in regard to commercial bank performance is largely focused on the developed economies environments and the conclusions may not be useful for African commercial banking improvements. Much of the empirical work on developed countries and a few on Africa and other developing countries on financial systems' performance, have suggested a need to undertake further research on SSA banking system using sufficient data and robust methods to be able provide sufficient information for effective policy implementation of commercial banking. It is also apparent that the a few studies on SSA commercial banking are more of country specific and don't provide comparative information across countries. It is against this back ground that research was undertaken and its significance is that;

It contributes to the frontier of knowledge on SSA commercial banking using larger scope of commercial banks drawn from 42 SSA countries. A few studies on SSA have used data only drawn from single country studies or smaller sub-regions like West Africa, North Africa and Middle East and East Africa. The conclusions from these studies may not be objectively relied on to inform policy on the entire SSA banking system.

It uses robust econometric panel methods, using elaborate panel data of 216 commercial banks of drawn from 42 SSA countries to explain bank profitability. A few studies on Africa commercial banking have applied simple econometric tools to measure performance. These tools however may be lacking in explaining the variability in performance within and across banks which this paper addresses.

1.4 Organization of the Paper

The paper is organized as follows. Chapter section 1.0 presents the background and study motivation. In section II, the literature review on bank performance is explained. The conceptual framework and methodology are discussed in chapter III. In sections IV and V, the regressions results on bank profitability are explained. Lastly, the conclusions and implications drawn from the study findings are given in chapter VI.

2. Literature Review

2.1 Determinants of Bank Profitability

The available empirical evidence tend to show that studies on banking have extensively been concentrated more on developed and a few developing countries and limitedly on SSA. There is thus insufficient information on the determinants of bank performance in SSA that would require further investigation (Short, 1979; Bourke, 1989; Molyneux and Thornton, 1992; Demerguc-Kunt and Huizinga, 2001). The study in this in direction would therefore be important. Studies on bank performance have focused on bank specific, industry specific and macroeconomic factors to explain bank performance (Nissanke and Aryeetey, 2006). While the results on bank specific and macroeconomic factors are explicit and point to one directional effect to bank performance, the results on the impact of industry specific factors are mix and in most cases insignificant to explain the behavior of banks. The sections that follow discuss the key factors of bank profitability performance.

2.2 Bank-Specific Determinants

In trying to understand commercial bank performance in global context, studies on profitability have largely used returns on average bank assets (ROAA), net interest margin (NIM) and return on average equity (ROAE), as common measures. As such traditionally, the impact on bank performance has been measured by bank-specific factors such as capital adequacy, credit risk, liquidity risk, market power and regulatory costs. More recently, research has also attempted to focus on the impact of macroeconomic factors on banks' performance.

Mercia, et al. (2002), Toddard, et al. (2004), and Panayiotis et al. (2005) showed that bank profitability is a function of internal and external factors. Internal factors include bank-specific; while external factors include both industry-specific and macroeconomic factors. According to this literature, there are six standard key bank-specific indicators that are widely used to study banks. These include profitability, capital adequacy, asset quality, operational efficiency, and growth in bank assets. Industry–specific factors include ownership, bank concentration index; while macroeconomic factors include interest rate, interest rate spread, inflation and levels of economic growth represented either GDP or GDP per-capita. Most of these factors are included in this study to estimate bank profitability for SSA banks.

Al-Hashimi (2007) investigated the determinants of bank net interest margin in 10 SSA countries, and applied an

accounting decomposition model as well as panel regressions. The study indicated that credit risk and operational inefficiencies explain most of the variation in net interest margins across the region, with macroeconomic factors, having less influence on performance

There is also an extensive literature based on the idea that an expense-related variable should be included in a profit function. For example, Bourke (1989) and Molyneux and Thornton (1992) found a positive relationship between better-quality management and profitability. Anthanasoglou, et al. (2006) study on the South Eastern European banking industry over the period 1998 to 2002, proposed new approaches in understanding bank profitability.

2.3 Industry-Specific Determinants

Another strand of literature emphasizes the importance of market structure and bank specific variables in explaining performance heterogeneities across banks. This literature is based on the structure-conduct-performance (SCP) paradigm and is also applicable to contestable markets, firm-level efficiency, and the roles of ownership and governance in explaining bank performance (Berger, 1995; Berger and Humphrey, 1997; Bikker and Hu, 2002; Goddard et al., 2004).

Extensive empirical evidence does not provide conclusive proof that bank performance is influenced either by concentrated market structures and collusive price setting behavior or superior management and production techniques. Bank efficiency levels vary widely across banking sectors (Altunbaş et al., 2007; Schure et al., 2004). While some studies have questioned the relationship between bank ownership status and market power to profitability or not, there is contrasting evidence on the role of market power on bank performance (Short, 1979), Bourke (1989) and Molyneux and Thornton (1992) and Eichengreen and Gibson (2001).

2.4 Macroeconomic Determinants

The last group of profitability determinants deals with macroeconomic control variables. The common variables include inflation rate, the long-term interest rate and rate of economic growth (Panayiotis et al., 2005). More recently, a number of studies emphasize the relationship between macroeconomic variables and bank risk. Allen and Saunders (2004) provided evidence of the importance of macroeconomic factors in determining the profitability of banks in the sampled.

Saunders and Schumacher (2000) applied a model of Ho and Saunders (1981) to study the determinants of interest margin in six European Union and US banks during the period 1988 to 1995. They established that macroeconomic volatility and regulations have a significant impact on bank interest margin. The result pointed out an important trade-off between ensuring bank solvency, as defined by high capital to asset ratio, and lowering cost of financial services to consumers, as measured by lower interest rate margin.

Bourke (1989), Molyneux and Thornton (1992), Demerguc-Kunt and Huizinga (1999) and Bikker and Hu (2002) identified possible cyclical movements in bank profitability. Bikker and Hu (2002) established that bank profits are positively correlated with movements in the business cycle. Afanasieff et al. (2002); and Naceur, Steiner and Goaied (2003), studies on emerging countries (Brazil, Colombia, Malaysia and Tunisia) documented significant effects of financial liberalization on bank performance.

Afanasieff et al. (2002) also made use of panel data techniques to uncover the main determinants of bank performance in Brazil and found out that macroeconomic variables such as GDP growth rate, inflation expectations are important in determining bank profitability over time. Neeley and Wheelock (1997) also explored the profitability of sampled US commercial banks and found a positive impact of per-capita income on profitability.

Overall, empirical review for this research provides back ground information of commercial bank profitability in general drawing from various studies which are largely focused on developed countries, a few in developing countries and limitedly on Africa. Information on African banking systems seems to be scanty and limiting in terms of scope and extent of econometric methods to explain bank profitability determinants. In light of these knowledge gaps and methodological requirements, the paper provides additional empirical evidence using a larger scope of sample commercial banks drawn from 42 SSA countries and applying robust econometric panel methods to quantify the relations ship bank profitability and determinants.

3. Conceptual Framework and Methodology

3.1 Conceptual Framework

In this section, the theoretical basis for generating bank profitability function is explained. The basis for the variable identification that was considered in the model specification is also illustrated. Adopting the theoretical

model with some extensions generated a generalised model that was used to estimate the determinants of commercial bank profitability in Sub-Saharan Africa (SSA) using a panel data set drawn from 42 countries.

3.2 Theoretical Framework for Commercial Bank Profitability Measurement

3.2.1 Theoretical Basis for the Model

A cost efficiency profit model was employed to measure bank profitability. This approach was adopted from the work done by Joaquin Maudos et al. (1999); Mercia, et al. (2002); Marco (2006), Goddard, et al. (2004); and Panayiotis et al. (2005), among others on bank efficiency in developed and a few developing economies. In measuring bank profitability using this framework, bank as well as macroeconomic indicators are utilised as inputs and outputs in the estimation process.

3.2.2 Cost Efficiency Model

The cost efficiency frontier is a technical efficiency concept based on a production function that is used to measure bank cost efficiency. Cost efficiency is derived from the cost function and is a modified form of Cobb-Douglas production function. This provides information on how close (or far) bank costs are from the best practice, producing the same output under similar conditions.

Cost and profit efficiency definitions correspond, respectively to two important economic objectives: cost minimisation and profit maximisation. Cost efficiency is the ratio between the minimum cost at which it is possible to attain a given volume of production and the cost actually incurred. Thus, efficiency volume (Ec) implies that it would be possible tom produce the same vector of production (1- Ec).100 percent of costs. Efficiency ranges between (0,1) interval, and equals one for the best-practice bank in the sample.

The costs of the bank depend on the output vector (y), the price of inputs (w), the level of cost inefficiency (u) and a set of random factors (v) which incorporate the effect of errors in the measurement of variables. Thus the cost function is simply expressed as:

$$C = C(y, w, u\ v) \tag{1}$$

In logarithmic terms, assuming that the efficiency and random error terms are multiplicatively separable from the remaining arguments of the cost function;

$$lnCi = f(yi,wi, \beta) + lnvi + lnui \tag{2}$$

Where Ci is the observed cost of production; yi is the logarithm of output quantity of bank variables; *wi* is the vector of logarithms of input prices, β is a vector of unknown parameters to be established; vi is the random error term and ui is the non-negative inefficiency effect.

The profit efficiency function is generated by adopting the reduced form of the cost efficiency generalised equation (2), by replacing the cost variable with a profit variable as;

$$\Pi it = xit\beta + vit - uit \tag{3}$$

where Π is the profit variable and *Xi* = other bank variable indicators vit are random errors assumed to be independently normally distributed, uit is group specific variation that is time invariant.

The model permits estimations of unbalanced panels and uis are assumed to be exponential function of time, involving only one unknown parameter. Estimating bank profitability, this study also adopts a similar framework as applied by Naceur et.al. (2003) on Tunisian banks and Panayiotis et al. (2005) on Greece banks.

Based on economic theory, the general functional form of profit efficiency is expressed as;

$$\Pi it = \alpha + \alpha i \Sigma \Pi t\text{-}i + \beta iXit + \gamma Macro + uit \tag{4}$$

where Πi is the profitability variable and Xi = other bank variable indicators, and Macro are macroeconomic variables. Empirical theory identifies average asset *ROAA*, net interest margin *NIM* and return on average equity *ROAE* as common possible choices for measuring bank profitability. Macro refers to macroeconomic factors which influence bank behavior.

3.2.3 Model Specification and Variables

Model specification and variable identification is implemented in line with Naceur et al. (2003) and Panayiotis et al. (2005) classification of bank indicators. Bank indicators are classified into six categories: profitability that measures the overall performance of the bank; capital adequacy that measures the bank ability to meet regulated capital standards; credit risk that measures changes in the bank loan quality and risk; operational efficiency that measures the bank ability to generate revenue, pay, expenses and measure of employment expense; liquidity ratio that measures the changes in the bank cash position; and growth indicator that measures the bank change in

assets. It is on the basis of this classification that the regression analysis of estimating bank profitability is implemented.

Using the profitability function equation and considering actual variable notations, the specification is given by;

$$\Pi it = c + \beta 1 lnTAit + \beta 2 ETAit + \beta 3 lnTDit + \beta 4 CTIRit + \beta 5 NLTAit + \beta 6 lnGDPAit + \beta 7 INFLit + \varepsilon it \quad (5)$$

where Πit is profitability variable represented by either return to average assets *ROAA* or net interest margin *NIM* or return on average equity *ROAE*, *LnTA* is growth in bank assets, *ETA* is bank equity to total assets, *lnTD* growth in bank deposits, CTIR is cost to income ratio, liquidity ratio *NLTA* is net loans to total assets, *lnGDPA*, is *GDP*-growth and *INFL* is inflation expectation given by current inflation.

3.2.4 Variables and Expected Impact on Bank Profitability

Table 1 presents the variables and expected impact on bank profitability as concluded in empirical studies by Anthanasoglou et al. (2005), among others on studies on bank performance largely in I n developed economies and limitedly on Africa.

Table 1. Determinants of banks' profitability and expected impact

Explanatory variable	Expected impact
Growth in total assets - *(lngta)*	Positive
Capital adequacy - *(eta)*	Positive
Growth in total deposit- (*lntd*)	Positive
Cost income ratio - *(ctir)*	negative
Liquidity ratio - *(nlta)*	negative
Growth in GDP- *(lngdpa)*	Positive
Inflation - *(infl)*	Negative

Source: Empirical literature.

3.3 Methodology, Empirical Data and Analysis

To construct the sample, data is drawn from financial statements of individual banks provided in the Bank-Scope-Database. The Bank-Scope Database is a collection of data of balance sheets, income statements and other relevant financial accounts of several banks in the World. The data base is accessed through Bank of Uganda (BoU). To ensure consistency, only data for commercial banks in the unconsolidated format is used. The period of study is 1999 to 2006. Data is generated from 42 countries and 216 commercial banks with at least two years of operation from 1999 to 2006. In total, there are 1316 observations. The specification takes a static framework as there was no verified time trend effect in the specification. Both Bank levels as well as macroeconomic variables that influence bank profitability are included in line with theory and empirical evidence. Bank level variables are bank asset growth in assets, capital adequacy, credit risk, operating efficiency, liquidity ratio; while macroeconomic variables include growth in GDP and inflation. Data is downloaded in Microsoft Office, arranged in panel sets, and analyzed using STATA- 11. The same data set, but using different variables is used in estimating the model.

In order to understand the variability in bank profitability across SSA sub-region, the banks are further categorized by income category based GDP-per-capita. Category one are commercial banks drawn from low income country of GDP per-capita of less or equal to 750 USD and second category are commercial banks drawn from medium income countries of GDP per-capita of greater or equal 750 USD. By disaggregation the first category is 164 group banks and second category is 62 group banks. The bank categories are labeled gdpcdummy for lower and gdpcdummy2 for medium income category respectively.

Estimation utilizes panel methods of fixed effects (FE), random effects (RE) and feasible generalized Least Squares (FGLS) in static framework. In estimating the model, bank profitability is a dependent variable and represented by return on average assets (ROAA), net interest margin (NIM) and return on average equity (ROAE), but the discussion used the ROAA regression results.

3.3.1 Criteria in Commercial Bank Selection

Using the Bank Scope data base, bank data was downloaded in Microsoft Excel 2007. The final selection of the bank to part of r the sample was based on a banking data for a minimum period of two years within the timeframe from 1999 to 2006. Ownership of these banks was not specified. They were selected as commercial

banks.

3.4 Robustness and Specification Tests

Panel stationary test is conducted by the Augmented Dickey-Fuller (DF) and Fisher type-tests that are recommended for unbalanced panels (Baltagi, 2005). In this test non-stationarity in the panel series is the rejection of null hypothesis that all the panels have unit root. This is where the t(z)-statistic is less than t (z)-critical. The fisher-test uses four other type tests including inverse-chi-squared test (P), inverse normal (Z), inverse logit (L*) and modified inv.chi-squared (PM). The inference is made using at a maximum limit of p value =1.00. Baltagi (1998) concluded that when panels are stationary, it so happens that they are integrated and could generate at least one co-integrating equation.

4. Determinantrs of Bank Profitability in Sub-Saharan Africa

4.1 Data Characteristics

Table 2 presents the descriptive statistics of the variables utilized in this study. The variables are computed in percentage points and millions of US dollars at constant 2000 prices in USD. The results confirm the adequacy of the data used in estimating the commercial bank profitability, ranging above 1000 observations. Looking at profitability as a key measure of bank performance, a mean of 2.28 percent, minimum and maximum of minus 56.7 percent to 49.64 percent would indicate that most of the SSA commercial banks have lower levels of profitability which could be arising from the low levels of capitalization, low levels of liquidity, high operational inefficiency, low levels of demand deposits, low levels of growth in assets and poor macroeconomic environment characterized by low growth in GDP and high inflation pressures.

Table 2. Descriptive statistics of the variables

Variable	Obs.	Mean	Std.dev.	Min	Max
Return on average asset *(roaa*)	1297	2.28	4.31	-56.7	49.64
Growth in banks assets*(lta*)	1285	5.73	2.71	0.072	762805
Growth in bank deposits *(ltd*)	1261	5.51	2.81	0.194	5874527
Operational efficiency*(ctir*)	1207	62.98	44	1.66	974
Capital adequacy *(eta)*	1294	13.18	9.9	1.6	80.27
Liquidity- *(nlta)*	1315	43.93	19.78	0.21	96.64
Growth in GDP (lgpda)	1138	22.36	1.2	19.81	25.8
Inflation rate (infl.)	1091	13.87	41.57	-10	550

Source: Panel estimates: 1999 - 2006.

In Annex II, the correlation relationship between the explanatory variables for measuring commercial bank profitability is illustrated. The results confirm some level of correlation between the dependent variable (return on average asset) and independent variables (bank assets, bank deposits, operational efficiency, capital adequacy, GDP and inflation). However, the overall correlation relationships between the explanatory variables range below 0.5, implying a lower degree of collinearity between the variables.

4.2 Robustness and Specification Test

4.2.1 Panel Unit-Root and Co-Integration Test

To test for stationarity of the variables in the model, unit-root test by the Augmented Dickey-Fuller and Fisher-type tests was applied. This test is recommended by Baltagi (1998 and 2005) and in other econometric literature, as appropriate for unbalanced panels for an advantage of accommodating any number of lags. The fisher test uses four types of other tests: inverse-chi-squared (P), inverse normal (Z) inverse logit (L*). Table 4.2 shows the results of the Fisher-test for stationarity. The tests were implemented in levels (zero differenced and lag length (2).

Table 3. Unbalance panel unit-root test results

Variable	Fisher-type panel tests					
	P		PM		Lag length	Deduction
	Statistic	*P.Value*	*Statistic*	*P.Value*		$P \leq \alpha$; $p \geq \alpha$
Bank profitability -*(roaa)*	0.000	1.000	-12.000	1.000	2	I(0)
Growth in bank asset-*(lta*)	0.000	1.000	-12.1244	1.000	2	I(0)
Bank capitalization ratio- *(eta)*	0.000	1.000	-12.1655	1.000	2	I(0)
Growth in bank deposits *(ltd)*	0.000	1.000	-12.083	1.000	2	I(0)
Operational efficiency- (ctir)	0.000	1.000	-11.5758	1.000	2	I(0)
Growth in GDP *(lngdpa*)	0.000	1.000	-11.8322	1.000	2	I(0)
Growth in real exchange rate-*(lexe*)	0.000	1.000	-11.5326	1.000	2	I(0)

*Notes:*Ho: All the panels contain unit roots, HA: At least one panel is stationary, Panel mean included, Time trend included, Drift term excluded. Source: Panel Computation, 1999 - 2006.

The t-statistic of less or equal to p-value shows a rejection of the null hypothesis that at least one panel has non-stationary variables. The findings show that all the variables are stationary at zero difference level and lag length (2) for the both P and PM-fisher type tests. When panel variables are stationary, they as well integrated and could at least generate one co-integrating relationship (Baltagi, et al, 2005).

When panel variables have no unit root, they are stationary and therefore integrated. Econometric literature shows that when variables are integrated, they generate at least one co-integrating equation for efficiency analysis. This is confirmed by a rejection of the null hypotheses of stationarity. The results prove that the key bank variables: growth in bank assets, capital adequacy, credit risk, operational efficiency and bank liquidity; as well as the macro economic variables; of growth in GDP and inflation expectation were efficient and appropriate in measuring bank profitability in SSA over the study period 1999 to 2006.

4.2.2 Hausman Specification Test

This tests the efficiency and consistency between the FE and RE estimators. Although the econometric theory recommends RE estimation for unbalanced panels, a confirmatory test by use of the Hausman specification test is usually carried out to evaluate the efficiency between FE and RE estimation methods. A rejection of the null hypothesis is when Prob > chi2 = α, confirmed the efficiency and consistency of the RE in estimating the model. Table 4.3 presents the results based on the test.

Table 4. Hausman specification test between FE and RE estimators

Variable	***Coefficients***			
	(b) Fixed	*(B) Random*	*(b-B) Difference*	*Sqrt)diag(V_b-V_B)*
Growth in bank assets- (lnta)	-0.3952	-0.4792	0.7890	0.3621
Bank capitalization- (eta)	0.2076	0.1188	0.8883	0.0220
Growth in bank deposits - *lntd*)	1.4975	0.6201	0.8755	0.3775
Liquidity ratio – *(nlta*)	-0.0269	-0.0432	0.0163	0.0128
Operational efficiency - *(ctir)*	-0.0335	-0.4041	0.0069	0.0032
GDP growth- *(lngdpa*)	-2.5560	-0.3872	-2.1684	1.0992
Growth in exchange rate- *(lnexe*)	-0.0033	0.0070	0.0036	0.0030

Notes: 1. b = consistent under Ho and HA; obtained from xtreg.

2. B = inconsistent under HA, efficient under Ho; obtained from xtreg.

3. Test: HO: difference in coefficient is systematic.

4. Chi2(7) = (b-B)'[V_b-V_B) (-1)] (b-V) = 56.61; Prob > chi2 = 0.0000.

Source: Panel Computation, 1999 - 2006.

The findings are consistent with theory that the random effects estimator is expected to generate more efficient results where there is a high variability in the data set. Efficiency is achieved in controlling for a possible endogeinty and auto-correlation effects associated with dynamic lag models (Arrellano and Bover (1995) and Blundell and Bond (2000). The evaluation also confirmed that there was no time effect in the regression results hence focusing the analysis on static specification as shown in Annex V.

4.3 Discussion of Results

Table 5 shows the regression results for all the sampled banks. Estimation is by applying the random effects (RE) technique. Econometrics recommends the random effects (RE) method as an efficient estimator for unbalanced panel models (Baltagi, 1999). This is confirmed by the Hausman specification test which evaluates the efficiency between the random effects (RE) and fixed effects (FE) estimators for the panel regressions.

This is consistent with theory that random effects estimator is expected to generate more efficient results after controlling for possible endogeinty and autocorrelation effects associated fixed effects models (Arrellano and Bover, 1995) and Blundell and Bond (2000). The efficiency of the RE results was confirmed by FGLS results which generated the similar results.

Table 5. Random effects regression results for all sample banks

Variable	FE Model		RE Model		FGLS Model	
Dependent variable = Bank profitability -(roaa)	Coeff.	P.Value	Coeff.	P.Value	Coeff.	P.Value
Growth in banks assets- (lnta)	-0.034	0.378	-0.667	0.076*	-0.4666	0.075*
Bank capitalization ratio - (eta)	0.2077	0.000***	0.1146	0.088*	0.1146	0.000***
Growth in bank deposit - (lntd)	1.4975	0.001*	0.6195	0.018***	0.6196	0.018***
Bank liquidity- (nlta)	-0.02692	0.060*	-0.0419	0.000***	0.0419	0.000***
Operational efficiency - (ctir)	-0.0335	0.000**	-0.0404	0.000***	0.0404	0.000***
Growth in GDP - (lngdpa)	-2.5556	0.021	-0.3872	0.000***	-0.3872	0.000***
Inflation- (inf)	-0.0033	-0.117	-0.006	0.063*	-0.006	0.062*
Constant	-2.1973	0.118	13.3571	0.000***	13.3571	0.000***
No. of Obs.	*967*		*967*		*967*	
Group Banks	*184*		*184*		*184*	
R.sq:	*0.14*		*0.27*			
F-Statistics- F(7,776)= 32.86	*F> 0.00*					
Wald-Statistics			*Prob>chi2*			
-Wald chi2(7) = 359.60			*= 0.000*			
Wald-Statistics					*Prob>chi2*	
-Wald chi2(7) = 362.60					*=0.00*	
Log likelihood					*-4974.537*	

Source: Panel estimation, 1999-2006.

Note: 1. (Ln) = natural logs (log); 2. (***; **; *) = Significant at 0.01, 0.05 and 0.10, respectively.

Using return to average asset (ROAA) as measure of bank profitability, the findings reveal that the RE and FGLs have consistent and efficient results. The Wald statistic confirms that the model used as well as the variables are significant and correctly specified. Detailed discussed of the results follows.

The coefficient of the variable representing growth in bank assets is negative and significant at 10 percent significance level. A negative relationship of bank size suggests that the smaller the bank the, the more efficient the bank will be. Thus the case of Sub-Saharan commercial banks does not support the economies of scales the argument that the larger the bank, the bank will be more efficient. As observed by Hiroyuki (2009), among others, on SSA commercial banks, negative coefficient supports diseconomies of scale argument on bank on the relationship between growth in bank size and profitability.

The coefficient of the variable representing bank risk (growth in bank deposits) is positive and significant at 1 percent, 5 percent and 10 percent levels. This is consistent with Naceur et.al. (2003) finding that, other things constant, more deposits are transformed into loans. The higher the interest rate margins, the higher the profits and banks are able to shield themselves against hazards of credit risk resulting from adverse selection and moral hazard.

The coefficient of the variable representing capital adequacy (equity to total assets) is positive and significant with expected signs at1 percent, 5 percent and 10 percent levels, respectively. This would imply that well capitalized banks experience higher returns and the finding is consistent with Anthanasoglou et. al.(2006). Berger et.al. (1995), further showed that relaxation of one period assumption allows an increase in earnings to raise capital, provided the earnings are not fully distributed as dividends. Relaxation of perfect capital markets could allow capital to raise expected earnings by reducing the expected costs of bankruptcy financial distress in general. Positive effect on bank profitability could arise from relative growth in bank profitability as result of

the financial sector reforms (IMF, 2007). The positive impact of the variable to bank profitability in most SSA countries reveals some levels of increased capitalization of the banks following the recent reforms in the financial sectors. This variable also measures the bank ability to withstand losses.

The coefficient of the variable representing liquidity risk (net loans to total assets) is negative and significant with expected signs at1 percent, 5 percent and 10 percent levels, respectively. This is consistent with theory that the higher liquidity ratio could influence bank profitability. Higher ratios may be an indicative of improved bank profitability because of increased interest incomes from borrowed funds (Berger et al., 2006). On the other hand, the same study pointed out that this variable could also have a negative effect on bank profitability. However theory has is that this variable can have a negative effect on bank profitability. This is when high ratios could result in reduced liquidity due increase in loan defaults

The coefficient of the variable representing operational efficiency (cost/income) is negative and significant with expected signs. This is consistent with theory that the higher costs of operation negatively affect bank profitability. Operational efficiency indicator is the expense variable and explains how banks could be efficient in resource allocation and utilization including human resource and technological improvements in banking. The negative growth in bank profitability could probably be explained by high costs of operation across commercial banks.

The macroeconomic variables chosen for this study are growth rate in GDP and inflation. The coefficient of growth in GDP variable, measured at constant 2000 prices in US dollars, is negative and significant at 1, 5 and 10 percent levels. This finding agrees with theory and empirical evidence that; the relationship between GDP trend growth and bank profitability could be pro-cyclical. There are several reasons why the effect of growth in GDP to bank profitability could be negative or positive ((Naceur et.al., 2003 and Panayiotis et al., 2005). Firstly, bank credit could decrease during economic down swings, since such periods are normally associated with increased risk and vice-versa. In absence of this variable however; it is also observed that this variable could be partly captured by bank-specific variables.

For inflation variable, the coefficient is negative and significant with expected signs according to theory. This is consistent with the finding by Panayiotis et al.(2005) on Greek banks that that the effect of inflation on bank profitability depends on the ability of inflation forecast by the bank management. If predictions become correct, such adjustments in interest rates could be incorporated inflation expectation, to achieve higher profits. Economic theory also argues that if the bank managers are able to predict inflation and incorporate in their cost structure the effect could be positive.

To check the consistency of the result by country income category, disaggregated regression is implemented including the dummies for lower and medium income category commercial banks. The results are consistent and efficient for the lower income category commercial banks with the results for the total sample signifying that the majority of the banks are from the lower income category of up to GDP per-capita of 750 US dollars as illustrated in annex III.

5. Conclusion and Policy Implications

5.1 Conclusions

The research is conducted to investigate the impact of bank level and macroeconomic factors on the profitability of commercial banks in Sub-Saharan Africa. Limiting empirical studies explain commercial bank performance in SSA motivated this study. The study utilizes unbalanced bank panel data of 216 group banks drawn from 42 countries spanning the period 1999 to 2006. The random effects panel methods are employed to estimate bank profitability. The findings call for a number of policy measures for improved competitiveness of SSA commercial banks in the financial intermediation services to the public. The findings show that.

The bank level variables such as capital adequacy, growth in bank deposits, have positive influence on bank profitability. Positive growth of in these indicators could be a result of banking sector liberalization that has been implemented in most of SSA countries since 1980s and 1990s. As result banks have been opened to foreign competition and ensured sustained capital and fund inflows to recapitalise the banks and increase their liquidity positions to supply private sector credit.

On the hand other hand, growth in bank assets, operational efficiency and bank liquidity indicators have negative effect on bank profitability. The negative effect of these indicators could be explained by disproportionate accumulation of assets through mergers and acquisitions of foreign based banks at high costs that has occurred in SSA in the last two decades (IMF, 2007). On the other hand, the negative effect of bank liquidity can be explained by low bank lending as banks hold more money than statutory required for precautionary purposes.

Because of high risk perceptions of private sector credit, SSA commercial banks tend to invest in risk free bearing assets such as treasury bills and bonds, with little attention to private sector lending. This could have a crowding out effect to private investment through high interest rates and a negative effect to long term economic growth.

For macro-economic variables, the findings show that both growth in GDP and inflation had a negative effect on bank profitability. Negative effect could imply very low and negative economic growth experienced by most of the Sub-Saharan countries over the study period and as is consistent with theory (Naceur et.al. 2003 and Panayiotis et al., 2005). The negative effect of inflation to bank profitability reflects the inability of bank managers to forecast inflation in their cost structure to realize profits (Panayiotis et al., 2005). As result the interest rate charged are lower than actual inflation, resulting into losses.

The key conclusions drawn from this study therefore are that: i) that the key bank variables such as capital adequacy, bank liquidity, asset quality, operational efficiency, growth in bank deposits; and ii) macroeconomic variables of growth in GDP and inflation have significant influence on bank profitability in Sub- Saharan Africa.

5.2 Policy Implications for Study

Profitability for SSA banks can only be achieved if bank managers and policy makers continue to pay particular attention to bank-specific as well macroeconomic factors that have influence on their profitability. Given the lower profitability indicator average at about 11 percent across all commercial banks over the study period, it would be important to implement second generation reforms of the banking sector to bring about the desired growth performance of the industry. These findings call for a number of policy interventions in SSA commercial banking industry for improved performance in profitability and factor productivity growth which are among the key measures of bank performance in the sub-region.

For bank profitability determinants, the study points out to the need for bank managers to gear towards optimum utilization of resources, observe prudent risk management procedures for sound and competitive services for better returns. There is also need for commercial banks in SSA to be responsive to risks associated with changing macroeconomic factors in a liberalised environment.

Results confirm the importance of bank level as well as macroeconomic factors to the bank profitability. This would suggest that banks should ensure efficient and effective supervisory and related service for optimum utilization of resources. This would include equitable investment of resource gains from different investments such as earning bonds and securities, prudent resource management to avoid high levels of liquidity risk, increased supervision to avoid high levels of non-performing loan ratios, ensure sound competitive environment and excellence in services to maintain competitive banking. Further, for improved profitability, bank managers should also endeavor to look for options that increase the levels of bank capitalization, employ innovative ways of reducing the proportion of non-interest bearing assets as well as investing resources in stock and capital markers which are less risk free ventures to bank business. At national level, there is need for governments to employ efficient regulatory frameworks that reduce concentration and spur competition and boost the development of equity markets to improve bank profitability as and stock market is found to be complementary in financial intermediation.

On the macro economic effects to bank profitability, there is also need for bank managers to be responsive to risks associated with changing macroeconomic factors such as GDP growth and inflation, among others. This would suggest that policies aimed at stabilizing inflation and GDP growth should be given priority in fostering financial intermediation. Since the output cycle matters for bank performance, fiscal and monetary policies that are designed to promote output stability and sustainable growth are good for financial intermediation.

This research is a springboard for policy improvement in the diverse financial sectors in SSA. The governments and other concerned financial management institutions need to take into account the main fabrics and other policy repercussions towards commercial bank profitability that have gained considerable importance in SSA financial sector. This could probably be achieved through undertaking comprehensive and rigorous stress testing to avoid risks associated with market failures in the sector.

In the final analysis, this study opens up areas for further research. One would be to investigate on how SSA commercial bank profitability, compares with other regions and continents. Two would be to explore other bank profitability measures and how they are they explain bank performance; to add on the existing literature for improving the sector. Three would be to explore other appropriate econometric methods that improve the understanding bank profitability for effective for effective policy decision making in dynamic banking sector

across the continent.

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Appendix

Appendix I. List of countries selected for the study

No.	Country	No.	Country
1	Angola	22	Rwanda
2	Benin	23	Senegal
3	Botswana	24	Tanzania
4	Burkina Faso	25	Uganda
5	Burundi	26	Zambia
6	Cameroon	27	Cape Verde
7	Ghana	28	Central African Republic
8	Democratic Republic of Congo	29	Chad
9	Ethiopia	30	Congo Brazzaville
10	Gabon	31	Equatorial Guinea
11	Gambia	32	Eritrea
12	Ivory Coast	33	Guinea
13	Kenya	34	Liberia
14	Lesotho	35	Niger
15	Madagascar	36	SAO.Tome
16	Mali	37	Zimbabwe
17	Mauritania	38	Togo
18	Mauritius	39	Swaziland
19	Mozambique	40	Sierraloen
20	Namibia	41	Seychelles
21	Nigeria	42	South Africa

Appendix II. Correlation matrix for bank profitability model

	roaa	ta	e_ta	td	nl_ta	ctir	gdpa	inf
Bank profitability	1							
Total banl assets	0.0717	1						
Bank capitalization	0.1518	-0.0429	1					
Total bank deposits	0.0727	0.9843	-0.0449	1				
Bank liquidity	-0.1255	-0.0521	0.0067	-0.0534	1			
Operational efficiency	-0.4073	-0.0423	0.1463	-0.0425	-0.1469	1		
Gdp	-0.06	-0.0396	0.1385	-0.0382	-0.011	0.0367	1	
Inflation	-0.0109	0.0302	0.0316	0.0283	-0.2263	0.0255	-0.0356	1

Appendix III. Random effects regression results for low and medium income category banks

Variable	FE Model		RE Model		FGLS Model	
Dependent variable = total factor profitability -(*roaa*)	**Coeff.**	**P.Value**	**Coeff.**	**P.Value**	**Coeff.**	**P.Value**
Growth in banks assets- (*lnta*)	-0.151	0.074*	-0.1858	0.200***	-2420	0.000***
Bank capitalization ratio - *(eta*)	-86	0.000***	-0.0045	0.000***	-0.0034	0.7
Growth in bank deposit - (*lntd)*	0.1533	0.001***	0.1808	0.000**	0.2422	0.000**
Bank liquidity- *(nlta)*	0.0021	0.031**	0.0064	0.000***	0.0017	0.003***
Operational efficiency - *(ctir)*	0.0023	0.000***	-0.0422	0.000***	0.0077	0.000***
Growth in GDP - *(lngdpa*)	-0.1121	0.13	-0.0372	0.008***	-0.0374	0.000***
Inflation- *(inf)*	-0.0024	0.431	-0.0061	0.023**	0.0012	0.000***
gdpcdummy	omitted		-0.083	0.000***	-0.063	0.000***
gdpcdummy2	0.2411	0.007***	omitted		omitted	
Constant	1.6451	0.011***	-1.55	0.000***	-1.7215	0.000***
No. of Obs.	953		953		953	
Group Banks	180		180		180	
R.sq:	0.28		0.49			
F-Statistics- F(8,765)= 70.31	F> 0.00					
Wald-Statistics			Prob>chi2			
-Wald chi2(8) = 738.25			= 0.000			
Wald-Statistics					Prob>chi2	
-Wald chi2(8) = 995.68					=0.00	
Log likelihood					-287.8534	

Source: Panel estimation, 1999-2006.

Note: 1. (Ln) = natural logs(log); 2. (***; **; *) = Significant at 0.01, 0.05 and 0.10, respectively; gdpcdummy=low income country category of GDP-per-capita of less or equal to USD 750 and gdpcdummy2=medium income country category of GDP-per-capita of equal or greater than USD 750.

International Journal of Economics and Finance; Vol. 5, No. 9; 2013
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Estimation of Natural Gas Demand in Industry Sector of Iran: A Nonlinear Approach

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Received: July 7, 2013 Accepted: August 6, 2013 Online Published: August 26, 2013

doi:10.5539/ijef.v5n9p148 URL: http://dx.doi.org/10.5539/ijef.v5n9p148

Abstract

This paper attempt to estimate the natural gas demand function in Industry Sector of Iran for the period 1971 to 2009 using a regime-switching model entitled Smooth Transition Auto-regression model (STAR). To this end, explanatory variables such as value added of industry sector, real price of natural gas, real price of oil products, and real price of electricity are employed as variables influencing natural gas consumption in industry sector of Iran. The results show that natural gas demand in industry sector follows an LSTR1 model as a two-regime nonlinear model if real price of oil products is assumed as transition variable. The estimation results show that the slope parameter equals a high value of 10 and the threshold extreme value stands at 50.29 Rials per each liter of oil products consumed (Note 1). The results also indicate that in both regimes, value added of industry sector and real price of electricity have a positive and significant relation, and real price of natural gas has a reverse and significant relation with natural gas demand in industry sector. Further, real price of oil products does not have any significant relation with natural gas demand.

Keywords: natural gas demand, industry sector, STAR Model

1. Introduction

Natural gas is considered as one of the key energy resources for industry sector and production of electricity in most of the countries. In fact, due to the fact natural gas, in comparison with other fossil fuels, emits less amount of CO2, its utility has taken an incremental trend in recent years and has been called the "better energy source of 21st century" (Apergis & Payne, 2010). That is the reason the global production level of natural gas has increased 1.7 times and US Energy Information Administration has predicted that this level will double by 2020 (Iman et al., 2004).

The subject of natural gas demand in industry sector of Iran is in some respects interesting. First, owning 15 percent of world's gas reserves, Iran is the second rich country in this respect. Second, the general policy of Iran's Energy Sector aims to replace other energy resources such as oil products with natural gas. To this end, the amount of natural gas consumed in industry sector has increased significantly from 1971 to 2009; the amount has increased from 3.34% in 1971 to 61.61% in 2009 (Energy Balance Sheet, 2009). Finally, due to the significant subsidy granted by government till 2009, natural gas has been supplied with a price lower than the global price. It is worth to note that, Iranian government has decided to remove the subsidy gradually. Therefore, evaluation of impact factors of natural gas demand in industry sector of Iran can be of much avail in regard with planning and policy-makings for this valuable energy carrier.

The literature on this subject covers two general spectrums of studies. One group of studies have dealt with natural gas demand function for residential sector or economy in general; among such studies, Balestra & Nerlove (1966), Bloch (1979), Herbert (1987), Maddala et al. (1997), Shukla et al. (2009), Bernestein & Madlener (2011), and Payne et al. (2011) can be mentioned. The other group has also studied gas demand function for residential sector or economy in general but their main effort has been focused on reducing the

estimation error. Among such studies, Liu & Lin (1991), Eltony (1996), Kaboudan & Liu (2004), Aras & Aras (2004), Forizanfar et al (2010) can be mentioned.

No major study has so far tried to estimate natural gas demand for industry sector. This may be due to the fact that natural gas plays a minor role in providing the energy for industry sector in most of the countries.

Despite the significance of natural gas share in energy provision for industry sector in Iran, only Azarbayjani et al. (2007) have estimated the natural gas demand function for industry sector in Iran using the Autoregressive Distributed Lag (ARDL). Their obtained results indicate that real price of natural gas and real price of electricity does not have any significant impact on gas consumption in industry sector and only value added of industry sector has a significant and positive impact on natural gas consumption. As natural gas demand in industry sector in Iran may follow a nonlinear and asymmetric pattern and since this issue has not been taken into consideration in Azarbayjani et al (2007) study, their obtained results may not be reliable and the issue must be re-studied. Moreover, many of studies such as Moral & Vicens (2005), Bessec & Fouquau (2008), and Joets & Mignon (2012) have shown the presence of a nonlinear and asymmetric behavior between energy carriers and impact variables.

The present study aims to estimate gas demand function for industry sector in Iran using the Smooth Transition Autoregressive model (STAR). STAR Model is considered as one of the most significant regime switching models which is able to model the nonlinear relation between variables sequentially using transition function. The STAR model is not only able to determine the number and time of regime switches, but also the speed of transition from one regime to the other regime. Therefore, to the knowledge of authors of this paper, no study has yet been focused on natural gas demand in industrial sector in Iran using STAR.

With regard to the structure of the paper, chapter 2 discusses the methodology and chapter 3 presents the data and the experimental results. The conclusions are presented in chapter 4.

2. Method

2.1 Methodology

Considering the limitations imposed by linear models, many of studies have recommended nonlinear models for specification of nonlinear behavior in time series. This paper uses STAR model developed by Ter¨asvirta & Anderson (1992) and Ter¨asvirta (1994 & 1998) for modeling the nonlinear behavior of natural gas demand in industry sector. In contrast to Threshold Auto-regression (TAR) models which use indicator function for controlling regime-switching mechanism, STAR models make use of exponential and logistic function for this purpose. These models are appropriate for analysis of asymmetric cycles of variables and many studies have shown that these models fit regime-switching mechanism properly for evaluation of nonlinear dynamics of variables (Van Dijk & Terävirta, 2002). In fact, STAR model is able to model the nonlinear relation between variables sequentially using transition variable and slope parameter. Smooth Transition Regression Models (Teräsvirta, 1994) are specified as a general regression equation as follows:

$$y_t=\pi' z_t+\theta' z_t F(s_t,\gamma,c)+u_t \quad (1)$$

Where z_t is a vector including exogenous variables of the model, π is the vector of linear parameters, θ is the vector of nonlinear parameters and u_t is part of residuals which is assumed to be evenly and independently scattered with an average of 0 and constant variance ($u_t \approx iid\ (0,\sigma^2)$).

The transition function $F(s_t,\gamma,c)$ can also be specified logistically and exponentially by following equations:

$$F(s_t,\gamma,c)=\left[\frac{1}{\left(1+\exp\left(-\gamma(s_t-c)\right)\right)}\right] \quad (2)$$

Or,

$$\mathrm{F}(s_t,\gamma,c)=\left[1-\exp\left(-\gamma\left(s_t-c\right)\right)^2\right] \quad (3)$$

Equation 2 displays the logistic transition function and equation 3 shows the exponential transition function. In above transition functions, s_t stands for transition variable; γ is the slope parameter and c is the threshold extreme or the point where the regime switch occurs. As Slope parameter γ, indicating the speed of transition from one regime to another, tends toward infinity, the SATR model turns into a 1TAR model; that is, if the transition variable is larger than threshold extreme ($s_t > c$), transition function equals 1 (F=1), in contrast, if $s_t < c$, then the value of transition function equals 0 (F=0). Also, as slope parameter tends toward 0, the SATR model turns into a linear model.

The estimation process of STR model starts with selecting the dynamic process of model or the number of optimal lags, then determining whether there is a nonlinear relationship between the variables under study and then selecting the transition variable and the number of regime switching. The next step is estimation of selected STR model using Newton-Raphson algorithm and maximum likelihood estimation method. Some specification tests are carried out in the final step to assess the reliability of the obtained results.

Although linearity test of STAR model can be performed by null hypothesis $H_0: \gamma = 0$ or $H_0: \theta = 0$, as STAR model contains unidentified nuisance parameters within the context of null hypothesis, the test statistic of both above hypothesis are considered as substandard. To overcome this problem, Luukkonen (1998) recommended using Taylor approximation of transition function. To this end, the third order Taylor approximation of transition function $F(S_t, \gamma, c)$ is used in terms of parameter γ at the point of $\gamma = 0$. Thus, the regressive equation 1 can be rewritten as below:

$$y_t=\pi' z_t+\theta' z_t\gamma F_\gamma(s_t,\gamma=0,c)+\theta' z_t\gamma^2 F_{\gamma\gamma}(s_t,\gamma=0,c)+\theta' z_t\gamma^3 F_{\gamma\gamma\gamma}(s_t,\gamma=0,c)+u_t \quad (4)$$

Replacing $\gamma=0$ value and simplification of first to third order derivatives of the transition function would yield the following auxiliary regressions depending on whether the transition variable s_t is included among z_t variables or not:

If the transition variable s_t is included among z_t variables, then the simplified version of equation 4 is as below:

$$y_t=\beta_0' \tilde{z}_t+\beta_1' \tilde{z}_t s_t+\beta_1' \tilde{z}_t s^2{}_t+\beta_1' \tilde{z}_t s^3{}_t+v_{1t} \quad (5)$$

Where $z_t = (1, \tilde{z}_t)'$.

If the transition variable s_t is not included among z_t variables, then the simplified version of equation 4 is as below:

$$y_t=\beta_0' z_t+\beta_1' z_t s_t+\beta_1' z_t s^2{}_t+\beta_1' z_t s^3{}_t+v_{2t} \quad (6)$$

The null hypothesis of the linearity of the relationship between the dependent and explanatory variables in contrast to the alternative hypothesis, i.e. presence of nonlinear relationship between variables, can be conducted as the following coefficients test:

$$H_{01}: \beta_1=\beta_2=\beta_3=0 \quad (7)$$

The statistic of the above test contains F distribution.

If the relation between variables is nonlinear, an appropriate nonlinear model must be selected. To select an appropriate model, three coefficients tests with the following null hypotheses are presented. The statistics of these tests contain F distribution.

$$H_{02}: \beta_1=0 | \beta_2=\beta_3=0 \quad (8)$$

$$H_{03}: \beta_2=0 | \beta_3=0 \quad (9)$$

$$H_{04}: \beta_3=0 \quad (10)$$

The statistics of above tests are shown as F_2, F_3, F_4 respectively. Rejection of H_{03} indicates that the optimum model is either logistic STR with two regime switches (LSTR2) or an exponential STR (ESTR), one of which can be chosen by test of $H_0: c_1 = c_2$ hypothesis. Rejection of the null hypothesis of this test signifies that LSTR2 is the optimum model. On the other hand, rejection of H_{02} and H_{04} hypotheses indicates that the optimum model is LSTAR with one regime switch (LSTAR1). To choose an appropriate transition variable among various candidates, a variable is chosen which is of the strongest F variable in rejection of null hypotheses. As mentioned before, the selected nonlinear model is estimated based on Newton-Raphson algorithm.

After fitting of the nonlinear model, specification tests including uneven variance test, serial autocorrelation test, no remaining nonlinearity test, and parameters constancy test were run in different regimes on residuals yielded by this model to assess the capability of the nonlinear model to fit the behavior and nonlinear relation between the variables.

2.2 Data

Although many factors influence the natural gas demand in industry sector, some important factors such as value added of industry sector, price of natural gas, and price of other energy carriers such as oil products and electricity can theoretically be mentioned. Of course, selection of these variables follows the demand law; that is,

selection of any commodity is subject to revenue, price of commodity, and price of rival commodities. Therefore, the above pattern can be specified in a linear equation as below:

$$lgas_t = ly_t + lpgas_t + lpoil_t + lpelec_t \quad (11)$$

Where $lpgas_t$ is natural gas consumption in industry sector in million cubic meter, ly_t is value added of industry sector as per fixed prices of 1999 in billion Rials, $lpgas_t$ is real price of natural gas in industry sector in Rials/cubic meter, $lpoil_t$ is the real price of oil products in industry sector in Rials/liter, and $lpelec_t$ is real price of electricity in industry sector in Rials/kilowatt-hour. It is worth to note that, all variables are used algorithmically and the period 1971 to 2009 is under study. The study also uses annual statistics.

3. Results

Before estimation of STAR model for natural gas demand in industry sector, it is necessary to determine the number of optimal lags for the used variables. As recommended by Pesaran and Smith (1998), Schwarz Bayesian Criterion (SBC), in comparison of other criteria, is of highest efficiency for samples with limited volume. Therefore, SBC is employed in this study for determining the number of optimal lags. Results indicate on lag for natural gas consumption variable and no lags for other variables. To select the transition variable, all variables existing in model include dependent variable lag, independent variable, and test case trend. Among above tested variables, the one with the highest probability of rejecting the null hypothesis of linearity will be chosen as the transition variable. It is also worth to note the proposed STAR model is selected by the transition variable as the optimum model for estimation of natural gas demand in industry. The results reflected in table 1 show that except transition variable of value added of industry sector (ly) which indicates a linear model, other tested transition variables strongly suggest the presence of a nonlinear relationship. Also, transition variable of lag of natural gas consumption in industry sector (lgas(1-)) of LSTR1 model, transition variable of natural gas price in industry sector (lpgas) of LSTR1 model, transition variable of oil products price in industry sector (lpoil) of LSTR1 model, transition variable of electricity price in industry sector (lpelec) of LSTR2 model and transition variable of trend of LSTR1 model are recommended. With regard to the fact that the least likelihood value of F statistic, which indicates the rejection of linearity null hypothesis in the strongest manner and relates to transition variable of lpoil, LSTR1 model and transition variable of oil products price in industry sector (lpoil) is selected.

Table 1. Linearity test, selection of transition variable and type of model

Proposed Model	Likelihood of Statistic F2	Likelihood of Statistic F3	Likelihood of Statistic F4	Likelihood of Statistic F	Transition Variable
LSTR1	1/4421e-02	1/2367e-01	2/8808e-01	2/8148e-02	lgas (-1)
Linear	2/5914e-02	1/9968e-02	-	-	ly
LSTR 1	3/4651e-02	6/4982e-02	2/0887e-01	2/0565e-02	lpgas
LSTR 1 *	6/8052e-04	2/9405e-02	2/1733e-02	1/0280e-04	lpoil
LSTR 2	5/2917e-02	4/7295e-02	4/4130e-01	4/6223e-02	lpelec
LSTR 1	1/6784e-03	1/7026e-01	3/3830e-01	1/8321e-02	Trend

In the next stage, natural gas demand function in industry sector is modeled using an LSTR1 model in which the price of oil products in industry sector is the transition variable. To this end, the initial threshold values of transition variable [C] and slope parameter (γ) are chosen and then using these initial values and Newton-Rafson algorithm, the parameters of the model are estimated using Maximum Likelihood. The results are shown in tables 2&3. The estimation results show that oil products price variable in industry sector and also in both linear and nonlinear parts as well as the lag of natural gas consumption in the nonlinear part of the model are not significant. Of course, other variables affect natural gas demand in industry sector as much as 5 percent and at a significant level in both linear and nonlinear parts.

Table 2. Estimation of LSTR1 Model (Linear part)

Variable	Coefficient	Statistic t	Likelihood
lgas (-1)	0.47	4.14	0.000
ly	0.67	3.66	0.001
lpgas	-0.32	-2.28	0.031
lpoil	0.09	0.52	0.60
lpelec	0.42	3.68	0.001
Constant	-3.33	-3.69	0.001

Table 3. Estimation of LSTR1 Model (Nonlinear part)

Estimation of the nonlinear part of the model			
Variable	Coefficient	Statistic t	Likelihood
lgas (-1)	0.47	0.97	0.34
ly	1.76	1.83	0.078
lpgas	-0.92	-2.07	0.043
lpoil	3.72	1.42	0.16
lpelec	2.11	3.17	0.005
Constant	-42.45	-2.10	0.046
Threshold Extreme (C)	3.91	74.75	0.000
Slope Parameter γ	10.69	3.24	0.003

As shown in table 3, the slope parameter, which stands for the speed of transition from one regime to another, is estimated to be 10.69 which signify the rapid transition of regimes. Threshold extreme is estimated as being 3.91 logarithmically and its anti-logarithm equals 50.29 Rials/liter for real price of oil products indicating that if, considering the transition speed determined by the slope parameter, the real price is higher than 50.29 Rials/liter, then we enter the second regime. As illustrated, the model is of two different extreme regimes, one belonging to the condition when transition variable value (lpoil) is smaller than the extreme threshold 3.91 and the second regime belongs to the condition when transition variable value (lpoil) is larger than the extreme threshold 3.91. Thus, the transition function $F(S_t, \gamma, c)$ is specified as below for the two extreme states, G=0 and G=1:

The first extreme regime G=0:

$$lgas=-3.33+0.47lgas(-1)+0.67l_y-0.32lpgas+0.09lpoil+0.42lpelec \quad (12)$$

The second extreme regime G=1

$$lgas=-45.78+0.94lgas(-1)+2.43l_y-1.24lpgas+3.81lpoil+2.53lpelec \quad (13)$$

The results of both above extreme regimes show that the value added of industry sector in both extreme regimes has a positive impact on natural gas which is according to theoretic expectations. That is, along with increase in the value added of industry sector, demand natural gas as a production input increases. The impact level is highest in the second extreme regime. In fact, the impact level is 0.67 and 2.43 in the first and second extreme regimes respectively. The real price of natural gas has an inverse relation its demand in both extreme regimes which conforms to theoretic expectation of demand laws. That is, increasing the price of this energy carrier will lead to an increase in its demand. It is worth to note that the coefficient of natural gas price is larger and of more impact in the second extreme regime. The price coefficient in the first and second regime is -0.32 and -1.24 respectively. Although the real price of oil products has a positive impact on natural gas demand, it is not significant. Real price of electricity coefficient in industry sector and first & second extreme regimes is 0.42 & 2.53; thus conforming to the theoretic expectations, it has a positive and significant impact on natural gas demand in industry sector. Demand for other energy carriers such as natural gas as a production input was expected to rise as the price of electricity increased. This results from the substitution characteristic of energy carriers. Finally, the lag in natural gas consumption in the first extreme regime has a significant impact on natural gas demand. Natural gas demand in industry sector thus seems to be affected by last year lag. It is worth to note that the provided coefficients are extreme, and the value of transition variable and slope parameter is between the two extreme regimes in reality.

The diagrammatic view of threshold extreme of 3.91with transition variable, i.e. real price of oil products in industry, can display the difference between the two extreme regimes more effectively (Figure 1). As illustrated in the diagram, the second extreme regime, that is the real price of oil products which is more than 3.91 (anti

algorithm of 50.29), relates to the years before 1980 and the first extreme regime relates to the years after 1980. This is mainly due to the fact that after the Islamic revolution of 1978 in Iran, government granted a large amount of subsidy to energy carriers, and as a result natural gas was supplied with a price much lower than the global price. Also, as the nominal price of oil products has increased much less than the consumer price indicator, the real price of oil products has followed a downward trend during the period under question.

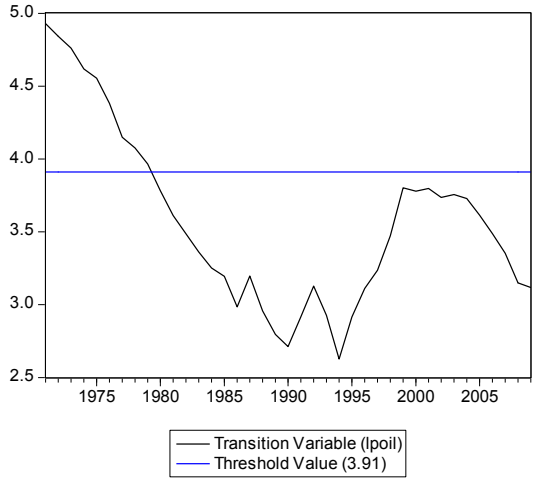

Figure 1. The trend of transition variable of real price of oil products and threshold value of 3.91

Tables 4 and 5 report the results of specification tests of uneven variance test, serial autocorrelation test, no remaining nonlinearity test, and parameters constancy test. As shown, there is no correlation and uneven variance error in LSTR1 model. The no remaining nonlinearity test also shows that LSTR1 model specifies all existing nonlinear relations in the model. The results of Parameters constancy test in different regimes also shows that the null hypothesis of test based on the constancy of coefficients and parameters of the mode is rejected in both regimes and the result that the coefficients of explanatory variables are different in the two regimes and have asymmetric impacts on dependent variable, i.e. natural gas consumption, is confirmed. Therefore, according to the results of the estimation model and specification tests, LSTR1 proves to be an appropriate model for identifying the behavior of natural gas demand in industry sector of Iran. The results yielded by the model prove to be reliable.

Table 4. Auto correlation test

Testing for Auto Correlation				
p-value	df2	df1	F-value	lag
0.68	22	1	0.17	1
0.67	20	2	0.39	2
0.81	18	3	0.31	3
0.94	16	4	0.18	4

Table 5. Results of specification tests

Test	F-value	P-value
ARCH LM-test	0.32	0.94
No remaining nonlinearity test	-	0.57
Parameters constancy test	2.98	0.038

4. Discussion

This paper studied the natural gas demand function in industry sector of Iran using STAR model as one of the

most significant regime-switching models. To this end, various variables including value added of industry sector, real price of natural gas, real price of oil products and real price of electricity have been employed as factors impacting natural gas consumption in industry sector of Iran for the period extending from 1971 to 2009.

The estimation results strongly indicate that there is a nonlinear relation between the variables under study. To this end, real price of oil products was chosen as the best transition variable and LSTR1 model with two extreme regimes was recommended for the specification of the nonlinear model of natural gas demand function in industry sector. The slope parameter, as the indicator of speed of transition from one regime to another, was estimated to be 10.69 and the value of extreme threshold, where the regime switching occurs, was estimated to be 50.29 Rials/liter of real price of oil products by LSTR1 model. The coefficient of value-added of industry sector variable was positive in both regimes; however, the impact level was different in the two extreme regimes, being 0.67 and 2.43 highest in the first and second regimes respectively. Real price of natural gas also has an inverse and significant relation with natural gas demand in industry sector in both regimes, being -0.32 in the first regime and -1.24 in the second. The coefficient of real price of electricity stood at 0.42 in the first regime and 2.53 in the second. Price of oil products variable does not have a significant impact on natural gas demand in industry sector.

It can thus be concluded that electricity and natural gas, as production inputs, can be substituted with one another; that is, increasing the price of electricity, the demand for natural gas also increases accordingly. Also, revenue increase in industry sector has a considerable impact on the increase of natural gas demand in this sector.

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Note

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