

The relationship between exchange rate volatility and portfolio inflow in South Africa

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Dissertation submitted in **partial** fulfillment of the requirements for the degree *Magister Commercii* in **Risk Management** at the Potchefstroom Campus of the North-West University

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May 2015

Acknowledgement

First of all, I would like to extend my gratitude to everyone who has helped me in any way or form during this journey, whether it was in a big or small way.

A special word of thanks goes to:

To my supervisor Prof. Andrea Saayman that walked with me through this whole journey, I really appreciate your advice, but more importantly your guidance and patience, you are a remarkable supervisor. I could not have asked for someone better.

To my family and friends for all your love and support, especially when I needed it the most, this dissertation would not have been possible without you guys.

To Malcolm Ellis specifically for assisting me with the grammatical and final editing.

ABSTRACT

South Africa has become more dependent on portfolio inflow to finance investment and consumption due to the low rate of government and household savings. Therefore, it is important from South Africa's perspective to maintain a stable portfolio inflow in order to ensure that the current account deficit does not reach unsustainable levels. However, portfolio inflow is anything but stable in South Africa. The risk associated with this is that when foreigners' expectations of South Africa shift, due to any form of instability or risk within the country or even internationally, it leads to massive withdrawals or outflow of funds, which in turn causes the currency to depreciate. The portfolio balance theory on the other hand states that an increase in portfolio inflow leads to the appreciation of the nominal exchange rate, and that this is perceived to work against economic growth.

The main objective of this research is to determine the nature of the relationship between exchange rate volatility and portfolio flows, and the extent to which volatility in the exchange rate affect South Africa's portfolio inflow. The research uses Vector Autoregressive (VAR) models and quarterly data, ranging from 1995 to 2012 to investigate this relationship. From the VAR models a Granger causality test, as well impulse response functions is used to shed light on the influence of a one-unit shock in both foreign portfolio inflow and exchange rate volatility on the other variables in the model. Exchange rate volatility is measured using both Autoregressive Conditional Heteroscedasticity (ARCH) family models and the conventional standard deviation, in order to control for possible biasness caused by the choice of instrument of volatility.

The results showed the nature of the relationship between exchange rate volatility and foreign portfolio inflow to South Africa's capital markets can be described as country-dependent and time-varying. South Africa's portfolio inflow exhibits high volatility and low persistence that are characteristics normally associated with "hot money", which is largely driven by foreign investors' appetite for short-term speculative gains. The study identified the consistent presence of bidirectional causality between the exchange rate volatility and foreign portfolio inflow to South Africa, irrespective of the measurement of exchange rate volatility. The results also

revealed that net portfolio flows are associated with exchange rate appreciation and that foreign portfolio inflow react much stronger to changes in exchange rate volatility than *vice versa*.

Key words: exchange rate, exchange rate volatility, portfolio inflow, ARCH models, VAR models, Granger causality test.

TABLE OF CONTENT

LIST OF FIGURES AND TABLES.....	vii
1. INTRODUCTION AND PROBLEM STATEMENT	
1.1 Background	1
1.2 Problem statement	4
1.3 Research Question and Objectives	5
1.4 Goals	6
1.5 Methods and data.....	6
1.6 The significance of this research	8
1.7 Chapter outline	9
2. FOREIGN PORTFOLIO INFLOW	
2.1 Introduction	11
2.2 Foreign portfolio inflow defined	12
2.3 Factors influencing the inflow of foreign portfolio investments	13
2.3.1 Push-factors.....	13
2.3.2 Pull-factors	16
2.4 Portfolio investment inflow into developing countries	21
2.4.1 Portfolio investment in South African equities	23
2.4.2 Portfolio investment in South African debt securities	28
2.5 The trend of portfolio inflow into Johannesburg Stock Exchange (JSE) and South Africa’s Bond Market (BESA).....	30
2.6 Advantages and disadvantages of foreign portfolio inflow.....	32
2.7 Potential policy framework to manage capital flows.	35
2.7.1 Macroeconomic policies.....	35
2.7.2 Capital flow management (CFM)	37
2.8 Conclusion	39
3. EXCHANGE RATE VOLATILITY	

3.1 Introduction	42
3.2 The History of South Africa's exchange rate regime	43
3.2.1 The period 1970 to 1979	43
3.2.2 The period 1979 to 1985	44
3.2.3 The period 1985 to 1994	46
3.2.4 The period 1995 to 1999	47
3.2.5 The period 2000 to 2010	48
3.3 Exchange rate volatility and portfolio inflow	50
3.4 The determinants of supply and demand of foreign currencies	52
3.4.1 Interest rates	53
3.4.2 Inflation	54
3.4.3 National income	55
3.4.4 Capital account	55
3.4.5 Monetary and fiscal policy	56
3.5 Measures of exchange rate volatility	57
3.5.1 Standard deviation	57
3.5.2 ARCH family models	58
3.5.2.1 Autoregressive conditional heteroscedasticity (ARCH)	60
3.5.2.2 Generalized autoregressive conditional heteroscedasticity (GARCH) ...	61
3.5.2.3 Exponential generalized autoregressive conditional heteroscedasticity (EGARCH)	62
3.5.2.4 Threshold GARCH (TGARCH)	63
3.6 Conclusion	64
4. EMPIRICAL INVESTIGATION	
4.1 Introduction	66
4.2 Determinants that drives portfolio investments	66
4.3 Empirical studies on the relationship between exchange rate volatility and foreign portfolio inflow	68

4.4 Modelling procedure.....	70
4.4.1 Unit root test.....	71
4.4.2 Granger Causality test	73
4.5 Sampling, data collection and variables selection.	73
4.5.1 Data description	74
4.5.2 Ensample volatility measurement	75
4.6 Model specification.....	78
4.7 Unit root test results	81
4.8 Selection of the Lag Length.....	82
4.9 Structural breaks results.....	83
4.10 Estimation and Model Results	86
4.11 Granger causality test results	92
4.12 Impulse response analysis	95
4.13 Summary	97
5. CONCLUSION AND RECOMMENDATION	
5.1 Introduction	99
5.2 Conclusions.....	101
5.2.1 Conclusions with regard to portfolio inflow in South Africa.....	101
5.2.2 Conclusions with regard to exchange rate movements.....	102
5.2.3 Conclusions with respect to the empirical relationship between exchange rate volatility and portfolio inflow	104
5.3 Recommendations	106
5.3.1 Policy recommendations	106
5.3.2 Recommendations for further research.....	107
APPENDIX.....	109
REFERENCES	119

LIST OF FIGURES

Figure 1.1: Republic of South Africa Current Account and Portfolio Flows.....	3
Figure 1.2: Private, Public and Foreign savings, 1995-2009	4
Figure 2.1: Composition of foreign capital inflow, % of GDP	23
Figure 2.2: Foreign portfolio investments, equity versus debt, as a percent of GDP	25
Figure 2.3: Estimated of average holding periods for bonds versus equities	Error!
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Figure 2.4: Non-resident net purchases of share and bonds (in R billion).....	31
Figure 2.5: Coping with Capital Inflows: Policy considerations.....	37
Figure 4.1: Exchange rate volatility measured by GARCH (1,1), EGARCH(1,1) and standard deviation.	77
Figure 4.2: Scatter plot of the basic relationship between exchange rate volatility and foreign portfolio inflow	80
Figure 4.3: Line plot of foreign portfolio inflow over time	80
Figure 4.4: CUSUM structural break test.....	84
Figure 4.5: One-Step structural break test	84
Figure 4.6: Impulse responses of one variable to a one unit shock in error terms of the other variable	96

LIST OF TABLES

Table 4.1: Results from the ADF unit root test	Error! Bookmark not defined.
Table 4.2: Chow structural break test.....	85
Table 4.3: Results of the VAR (reporting the FPI equation only).....	89
Table 4.4: VAR Granger Causality/Block Exogeneity Wald Tests.....	93

CHAPTER 1

INTRODUCTION AND PROBLEM STATEMENT

1.1 Background

South Africa is a country with a long and interesting history, especially when it comes to developing and transforming the economy. Even though balance of payment equilibrium is not the most important objective of economic policy, the balance of payment (BoP) statistics remains essential since they engage with the determination of economic policy. This is because the balance of payment provides an early signal of any untenable development within the country. In this regard, the current account balance of the balance of payment is of prime importance, because it acts as an indicator in determining under or excess spending. In the case of South Africa, it is generally used as an indicator to measure excess spending, rather than indicating whether domestic savings are being fully employed to finance much-needed investment (SARB, 2002:2-3).

During the Bretton Woods era (1944-1974), imbalances in the current account were not examined in detail, mainly because capital inflows were strictly limited throughout this period. When imbalances occurred, South Africa generally experienced capital inflow, accompanied by a deficit in the current account. In the 1980s, South Africa's current account experienced a turnaround and progressively shifted from a deficit to a surplus. However, this surplus accompanied by large amounts of capital outflow (Freytag, 2008:6) due to the country's political dispensation. In 1985, South Africa's economic circumstance deteriorated when a foreign debt standstill was announced by South Africa. This occurred when South Africa imposed repayment restrictions on its foreign debt after certain foreign banks (mainly those in U.S.) refused to roll over short-term loans. This meant that some 10 billion dollars in payments to foreign creditors were frozen (Schultes & Khasawneh, 2009).

These actions, combined with oppressive measures taken at home against those fighting for the dismantling of apartheid, plunged South Africa's reputation to an all-time low (Summa, 1988). Preceding the change to democracy in 1994 and after several years of political and economic struggle, South Africa was able to redeem its

reputation as economic leader on the continent of Africa. This was a result of lower inflation, more stabilised public finance and a better credit rating. South Africa's good reputation slowly but surely led to an increase of substantial amounts of foreign capital investment.

Since 2004 portfolio investment, however, has dominated South Africa's financial account rather than foreign direct investment (FDI). The difference between portfolio investment and FDI is that portfolio investment includes both debt flows (which consist of corporate bonds and other private debt securities) and non-debt-creating portfolio equity flows (such as foreign purchases of equities of domestic companies). On the other hand, FDI is more stable than portfolio investments and can be defined as net inflows of investment to acquire a lasting management interest in a foreign enterprise (Kielmas & Media, 2012). To bring the growing dominance of portfolio investment in South Africa into perspective, South Africa attracts three times more portfolio investments, as a percentage of GDP, than any other emerging markets (Funke, 2005:4).

The growing inflow of portfolio investments can be contributed to South Africa's strong economic performance, infrastructure and excellent financial markets that are easy to access and are very liquid. This makes South Africa very attractive to foreign investors. As a result, the current account deficit started to increase from 2004. The deficit gap continued to increase over the four years and in the first quarter of 2008 it ultimately reached a new record of 8.8% of South Africa's GDP, a level not seen before (Draper & Freytag, 2008:10), as illustrated in Figure 1.1.

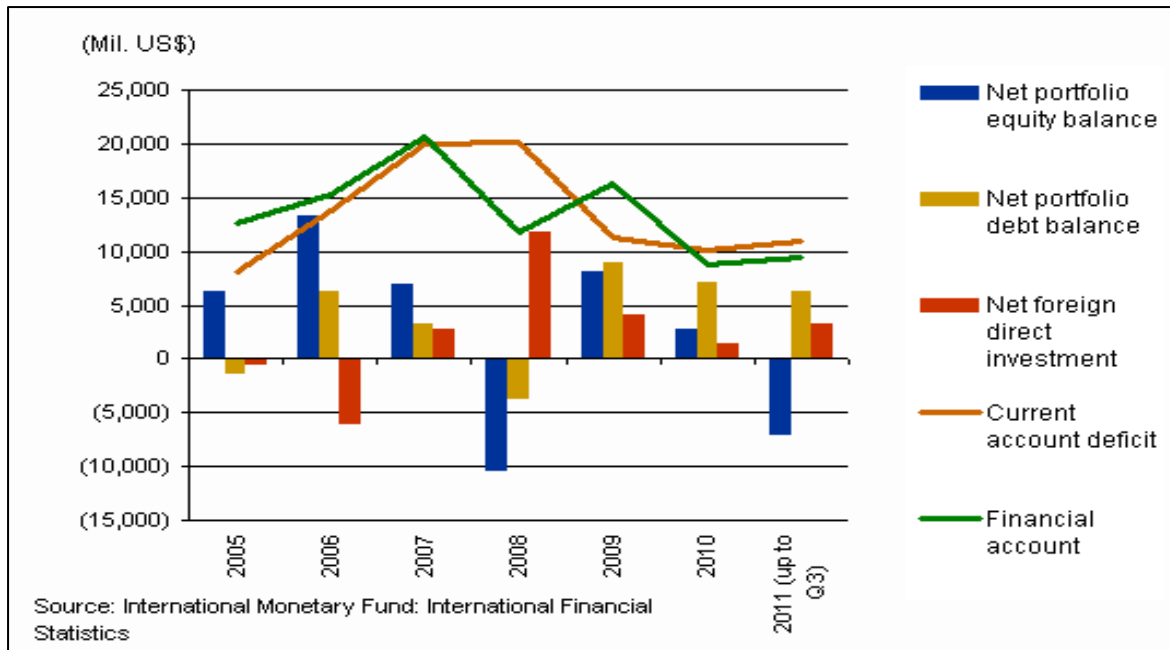


Figure 1.1: Republic of South Africa Current Account and Portfolio Flows
 Source: Standard & Poor's (2012)

The main reason for South Africa's large current account deficit is due to the absence of a sufficiently large domestic savings base, since the current account balance comprises the difference between a country's domestic savings and investments. Domestic savings are the sum of government savings and private savings, while domestic investments are the sum of private investments and government infrastructure expenditure (Higgins & Klitgaard, 1998). Traditionally, South Africa's net portfolio inflow has been utilised to finance a significant proportion of its current account deficit.

However, during the period 2004 to 2008, the level of domestic savings decreased substantially in South Africa. In 2012, it fell to less than 13% of gross domestic product (GDP), from an already low level of 18% of GDP at the end of 2010. This was because of the deterioration in both the government and the private sector's savings rates. Over the past decade, South Africa's savings rate has been weak despite the sharp increase in the country's terms of trade and its booming export commodity prices. These factors usually lead to an improved savings rate; yet that has not been the case, instead the extra gains have been consumed (Bisseker, 2013)

Furthermore, since South Africa invests more than it saves, it experiences a current account deficit. The low level of aggregate savings made South Africa reliant on foreign capital inflows to fund the higher levels of investment that underpinned these higher rates of growth (Linde, 2009:2), as illustrated in Figure 1.2.

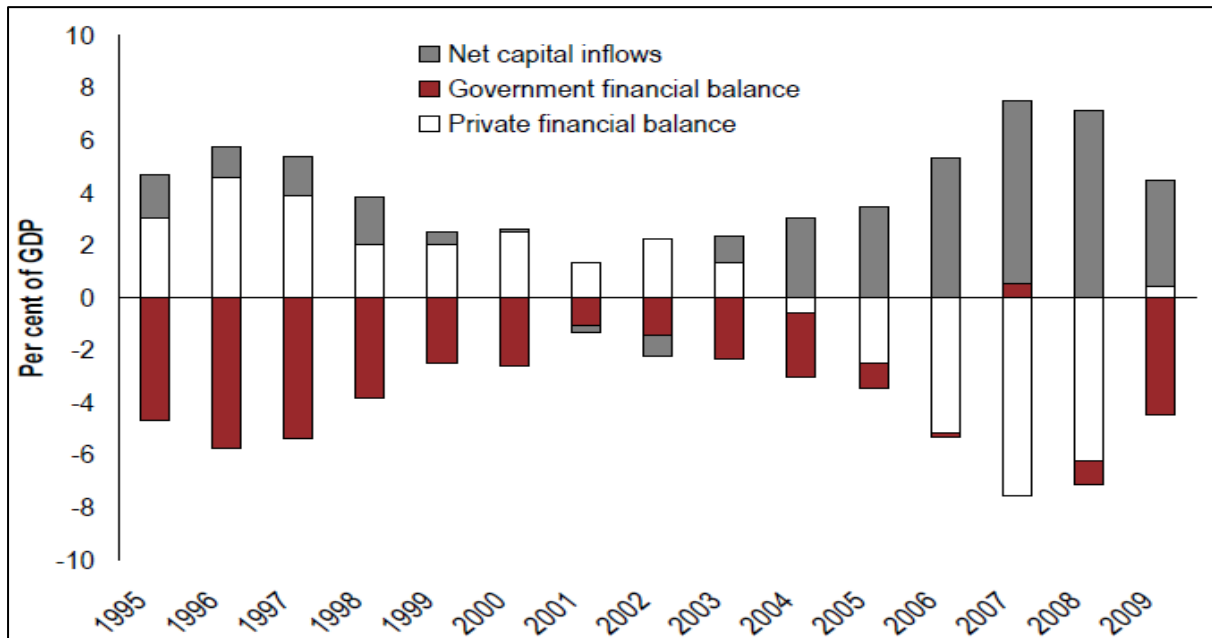


Figure 1.2: Private, Public and Foreign savings, 1995-2009
 Source: National Treasury of South Africa: Budget Review (2011)

1.2 Problem statement

South Africa has become more dependent on portfolio inflow to finance investment and consumption due to the low rate of government and household savings, which have always been on the low side. Therefore, it is important from South Africa's perspective to maintain a stable portfolio inflow in order to ensure that the current account deficit does not reach unsustainable levels. However, portfolio inflow is anything but stable in South Africa.

According to Hanival & Maia (2008:25), portfolio inflow in South Africa is mostly composed of short-term investments, as traded on the Johannesburg Stock Exchange (JSE), and in South African government bonds. By definition, these are highly unstable. This is because portfolio investments are easily reversible, which explains why financing the current account deficit in this way may not be sustainable in the long-run, and accordingly, prevents the country from achieving higher and

sustainable economic growth. The risk associated with this is that when foreigners' expectations of South Africa shift, due to any form of instability or risk within the country or even internationally, it leads to massive withdrawals or outflow of funds, which in turn causes the currency to depreciate. Such events are not unknown to South Africans, as the country has experienced just such depreciations in 2001 when Eskom embarked on load-shedding, during the 2007- 2008 global financial crisis, and yet again in 2011 with the European debt crisis (Segall, 2012:9).

Furthermore, Ncube, Shimeles and Verdier-Chouchane (2012:22) state that short-term investments are subjected to speculation in South Africa's currency movements from foreign investors. This causes the volatility of the exchange rate to increase further. This then may be perceived as a risk signal for portfolio inflow, as the profitability and cost of investment activities are harder to predict for foreign investors. Consequently, it could have a negative impact on South Africa's economy, causing South Africa to deplete its reserves in order to finance the current account deficit, as well as to promote desired economic growth.

Given the importance of portfolio inflow for both macroeconomic policy in South Africa and the enhancement of economic growth, there have been surprisingly few empirical studies completed on the relationship between exchange rate volatility and portfolio inflow. Being able to define accurately the nature of the relationship may be beneficial to policy-makers seeking to formulate and implement policies to attract and, at the same time sustain, greater portfolio inflow into South Africa.

1.3 Research Question and Objectives

Based on the discussion above, the following research question is formulated: How does volatility of the exchange rate affect South Africa's portfolio inflow? The main objective of this research is to answer the question stated above by determining the nature of the relationship between exchange rate volatility and portfolio flows, and the extent to which volatility in the exchange rate affect South Africa's portfolio inflow. A secondary objective is to determine whether it is possible for macro-economic policy-makers to establish policies that reduce potential portfolio inflow volatility, which could then have a spillover effect on the exchange rate.

1.4 Goals

In order to reach the objective of the study, a number of goals were set. These goals were:

- To define portfolio inflow in South Africa's context.
- To explore the characteristics of portfolio inflow concerning the following:
 - The benefits and consequences' of portfolio inflows.
 - The trend of portfolio inflow into South Africa's equity- and bond markets.
- To investigate the unique push-and pull-factors of portfolio inflow.
- To evaluate the transformation of South Africa's exchange rate regime since the abolishment of the Bretton Woods era in 1974.
- To establish the relationship between the exchange rate and portfolio inflow.
- To identify and evaluate different measures of exchange rate volatility.
- To model the relationship between portfolio inflow and exchange rate volatility in South Africa.
- To explore policy suggestions that might attract and sustain greater portfolio inflow into South Africa.

1.5 Methods and data

Firstly, a literature study was conducted regarding previous studies on the volatility of the exchange rate and portfolio inflow. This included research into what portfolio inflow and exchange rate entail and a brief history as to what determines them. Secondly, an empirical investigation will follow the literature study with the aim of understanding how volatility is measured, which factors had a significant impact on foreign portfolio inflow and the nature of the relationship between exchange rate volatility and foreign portfolio inflow.

According to Kodongo (2011:171), understanding the dynamic interaction between portfolio inflow and exchange rate fluctuation requires that a vector autoregressive model (VAR) be developed. VAR models can examine the inter-relationship between several economic variables making very few assumptions about the underlying structure of the economy. Furthermore, VAR models can be used to explain whether

variable X_t predicts changes in variable Y_t , in addition to the predictions already presented by lagged values of X_t , and *vice versa* (Asteriou & Hall, 2011:320-322).

From there, a Granger causality test can be conducted. This is a method for determining how much of the current value of a variable, Y_t , can be explained by past values of X_t (Granger, 1969). Moreover, it seeks to explain whether adding lagged values of another variable X_t , can improve the explanation, in this case, that concerning the relationship between the exchange rate volatility and South Africa's portfolio inflow.

Variables such as the real exchange rate, an exchange rate volatility measurement and other variables that have a significant impact on South Africa's portfolio inflow (as defined by theory) are included in the VAR model. The volatility of the exchange rate may be estimated and examined by (G)ARCH family models and the conventional standard deviation. Each one of these volatility measurements can then be separately included in a VAR model as a variable; therefore there may be more than one VAR model estimated (Khosa, 2012:84-90).

The research will apply both standard deviation and (G)ARCH models since, according to McKenzie (1999), the results of the relationship between the exchange rate volatility and portfolio inflow could be influenced by the measure of exchange rate volatility.

Therefore, using different VAR models will provide the additional advantage of being able to establish if the measure of volatility influences the magnitude and direction of the relationship between exchange rate volatility and portfolio inflow. Further, it allows the determination of the extent of deviation, if any, of the results based on the different measures of volatility. The data that will be used in this study was obtained from the South African Reserve Bank as well as that obtained from the International Monetary Fund's IFS database.

1.6 The significance of this research

The study contributes to the current discussions by exploring the relationship between exchange rate volatility and South Africa's portfolio inflow. There is strong debate in economic literature concerning whether or not portfolio inflow has a negative or positive impact on the growth prospects of emerging countries. Related literature regarding portfolio inflow include those by Ghosh and Ostry (2010:4), Combes, Kinda and Plane (2011:3-5), Sethi (2012:97-100), who all opine that an increase in portfolio inflow leads to the appreciation of the nominal exchange rate, and that this is perceived to work against economic growth. The literature of these researchers supports the portfolio balance theory's predictions that portfolio flows exert an influence on real exchange rates. On the other hand, and according to Aron, Leape and Thomas (2010:2), portfolio inflow is essential for both developing and for emerging markets. Portfolio inflows from foreign investors contribute by financing a low savings rate and thus ensure potential long-term economic growth by managing the current account deficit.

These contrasting views create a dilemma for policy-makers on how to manage portfolio inflow in order to exploit economic benefits. By merely investigating the economic indicators without thorough analysis, it is difficult to determine the nature of the relationship between exchange rate volatility and the performance of variables such as portfolio inflow. The lack of knowledge related to this issue could possibly increase the risk of higher instability in the current account deficit and portfolio inflow, as well as leading to the implementation of sub-optimal economic policies that could lead to macroeconomic instability.

This research will be informative to South Africa's policy-makers by providing detailed analysis pertaining to the relationship between the exchange rate volatility and the performance of South Africa's portfolio inflow, and so limiting the risk exposure. The study will apply econometric techniques, which will also be helpful to academics and analysts by contributing to the existing knowledge of the topic and by providing a foundation for future research in this area.

1.7 Chapter outline

In order to reach the main aim of this research, it is firstly necessary to understand the background and history behind exchange rate movement and portfolio inflow in South Africa. Chapter 2 will define portfolio inflow and will analyse how it has developed over the years to become an important factor for developing countries' economies. Furthermore, it will examine the benefits and the consequences that portfolio inflow holds for these countries, especially when dealing with massive inflow of portfolio investments.

Chapter 2 will continue by providing valuable insight about the recent trends in portfolio inflow, as well as those subcategories of portfolio inflow that will be studied namely, foreign equity and bonds. This includes portfolio investment in debt securities, the growing dominance of foreign investments on the JSE and, lastly, the stability of portfolio inflow. Different push-and pull-factors that have an influence on developing countries portfolio inflow will be explored and, finally, an examination of different methods to manage capital inflows will be undertaken.

Chapter 3 will address the topic of exchange rates. This will include the history of the exchange rate regime of South Africa and will examine how the volatility of the exchange rate influences portfolio investments. Chapter 3 will then continue with an in-depth analysis regarding the different measures of modelling the exchange rate volatility. Further, context will be created as it refers to relevant research in the history of this particular field and how this history led to the increase in the fluctuation of the exchange rate.

Chapter 4 will contain the empirical analysis and will provide an overview of the empirical literature. From there, a description of the data that will be used to model the relationship will be discussed, followed by a statistical description of the data. The method will explain the various econometric models and techniques to be used in the analysis. This includes different models, such as (G)ARCH family models and the standard deviation, which are specifically designed to measure the volatility of the exchange rate. This will be followed by different VAR models estimations, using different measures of exchange rate volatility. After estimating various VAR models, the process to test causality can be performed through a Granger causality test, as

well by using an impulse response, pertaining to the magnitude of a one-unit shock in both foreign portfolio inflow and the exchange rate volatility. The empirical result obtained and the explanation and interpretation of these results will thereafter be presented at the end of the chapter.

Chapter 5 will conclude with references to the aim of this study and will summarise each chapter contained within this research project. This chapter will provide concluding remarks regarding policy recommendation and will offer suggestions for future research on related topics.

CHAPTER 2

FOREIGN PORTFOLIO INFLOW

2.1 Introduction

In chapter 1, South Africa's dependence on portfolio inflow, in order to finance much needed investment and consumption due to the low savings rate, was introduced. Chapter 1 further showed that portfolio inflow into South Africa has dramatically increased over the years since 1994. The increasing dominance of portfolio inflow is also evident in many other developing countries since the early 1990s, with net private capital inflow reaching approximately 190 billion dollar in most Asian and Latin American countries (Lopez-Mejia, 1999). However, there remains a lack of knowledge surrounding the inflow of foreign portfolio investment and its characteristics. Although this topic has received increasing attention in the literature, understanding the characteristics of portfolio inflow is still a debated subject amongst researchers.

In order to reach the main objective of this study, which is to determine the nature of the relationship between exchange rate volatility and portfolio flows, first there is a need to understand the background and features of foreign portfolio investment inflow. This chapter will commence with an investigation into what foreign portfolio inflow is and of what this consists. This will be followed by related research done on several push-(global)-and pull (domestic)-factors that may explain the behaviour of foreign portfolio inflow to developing countries, including South Africa. Why developing countries started to experience large amounts of portfolio inflow from the early 1990s onward and how the risk appetite of foreign investors shifted from developed countries to developing countries will be then addressed. This will be followed by an examination of the South African experience, which saw a surge of foreign portfolio inflow over the years from 1994 to 2008, by examining the events that had a significant impact on South Africa's portfolio inflow. South Africa's portfolio inflow, as documented on the financial account of the balance of payment, consists of both equity and bond investments, which is incurred by foreigners and these concepts will be further analysed.

Equities and bonds are equally important to take into consideration, because they each have unique characteristics. Investors in equity securities appear to have a different pattern of behaviour compared to investors in domestic debt securities. This chapter will provide insight in the recent trend in portfolio inflow into the Johannesburg Stock Exchange (JSE) and South Africa's Bond Market (BESA), will assist in understanding the advantages, and disadvantages that foreign portfolio inflow hold for developing countries. Finally, when considering these advantages and disadvantages, the chapter determines how developing countries could approach large amount of portfolio inflow by studying several policy frameworks to manage capital flows,

2.2 Foreign portfolio inflow defined

Foreign portfolio inflow can be defined as foreign investors purchasing commodities, stocks, money market instruments or bonds in another country (World Bank, 2013). These investments can either be long-term or short-term in nature. Short-term investments are normally defined as speculative investments that entail buying and selling of assets with the goal being to take advantage of favorable exchange rate movements (World Bank, 2013). Long-term foreign portfolio investments are made by foreign investors with the aim of holding the assets for an extended period. Foreign investors base their decision on personal profile or appetite, as well as by taking financial and market conditions into consideration. These conditions are generally affected by both push (external)-and pull (internal)-factors that occur in the global economy. Pull-factors refer to the improvement of private risk return characteristics for foreign investors, while push-factors consist of both cyclical and structural forces. Both push-and pull-factors were the reasons behind the surge of capital inflow that developing countries experienced the last two decades, according to Calvo, Leiderman and Reinhart (1994). The following section focuses explicitly on the significance of push-and pull-factors that help explain this surge of portfolio inflow to developing countries.

2.3 Factors influencing the inflow of foreign portfolio investments

The surge of capital inflow to developing countries led to an on-going debate between policy-makers and economic experts whether pull (also referred to as domestic or internal) factors outweigh push (also referred to as global or external) factors in encouraging foreign portfolio investment inflow into developing countries, which include South Africa. Studies of the debate which of the push-or pull-factors were the most significant, started in the early 1990s. Each one of these studies completed by academics presented new findings. It is important to examine these findings to determine the factors (push and pull) that are significant in explaining the inflow of foreign portfolio investments to developing countries.

2.3.1 Push-factors

In total, the literature identifies three push-factors and six pull-factors that have the potential of determining the inflow of foreign portfolio investments. The following push-factors are considered as explanatory variables for foreign portfolio investment; global liquidity, risk aversion and interest rates differentials. Each of these factors is subsequently described in terms of what it entails, its impact on portfolio inflow and the related empirical findings regarding these factors.

a) Global liquidity

The term global liquidity remains without an established, generally-accepted definition. In general, it is known as the availability of funds for purchasing goods or assets, from a global perspective. According to Eickmeier, Gambacorta and Hofmann (2013), it is the spill-over effects of accommodative monetary conditions from the developed countries to emerging market economies. Global liquidity is related to the monetary policy cycles in developed countries, particularly in the United States (US). According to Bhaskaran, Sundararajan and Kohli (2005), monetary policy cycles of the US appear to have a powerful impact on net flows of portfolio equity capital to developing countries.

Firstly, easy monetary condition in the U.S. and any other developed country tends to create an environment where there is an excess of liquidity. This may then be channelled to other developed countries, in the first instance, in the form of financial assets. However, some quantity of portfolio capital tends to flow to developing countries instead. Secondly, the continued ease of monetary policy in developed countries (especially the U.S.), usually causes the market-determined yields on financial assets to fall, causing foreign investors to reallocate their asset, and to pursuing higher-yielding assets in developing countries. Furthermore, if the global economy is growing simultaneously, foreign investors' risk tolerance will also increase. This often causes foreign investors to price their risk less strictly, which leads to an inflow of portfolio capital into riskier assets. These include equities and bonds in developing countries and as a result, raising equity valuation or depressing yields (Bhaskaran, Sundararajan and Kohli, 2005).

Antzoulatos (2002) did a study on the flow of bonds to Latin American countries, assessing the prospects of portfolio inflow to developing countries. He found that the empirical evidence supported those of push-factors of portfolio inflow to developing countries. He mentioned that market participants and policy makers should focus on the global supply of funds as a measure of global liquidity and not only on international interest rates. The study revealed that other conditions also influenced the supply of global funds, for instance, the trend towards more international portfolio diversification, the advancement of communication and technology, financial innovation, the reduction in the budget deficit and financial deregulation in the industrial world. He concluded that an increase in global supply of funds might facilitate the flow of bonds to Latin American countries.

It is difficult to measure the notion that low interest rates in developed countries push the flow of capital to developing countries. As an alternative, liquidity can be taken as a unit of measurement, as a potential determinant in explaining the flow of foreign capital. This is in accord with the findings of Bhaskaran, Sundararajan and Kohli (2005). According to the IIF (2013), the most significant proxy to measure global liquidity conditions, is the U.S. financial sector liabilities. Moreover, this has the advantage of accounting for the effect of unconventional monetary policy, such as quantitative easing.

b) Risk Aversion

According to Bernoth, Hagen and Schuknecht (2006), investors in general focused their attention on regional development in developing countries in periods when market tension was building up. However, extreme tension generated a higher degree of uncertainty and panic, which meant portfolio investments flow was driven by risk aversion, while regional developments played only a marginal role. Finally, Bernoth *et al.* (2006) revealed that there was a significant flight-to-quality effect, in the sense that the spread-over US government bond yields responded positively to an increase in the spread between low-grade US corporate bonds and US Treasury bonds. Therefore, according to Bernoth *et al.* (2006), the US corporate BBB spread over US Treasuries could be a significant proxy for measuring the general degree of risk aversion in international bond markets.

Egly, Johnk and Liston (2010) examined the relationship of foreign portfolio inflow, with a focus on two factors, namely, foreign investors' risk aversion and the US equity (stock) market. Using a vector autoregressive model (VAR), they found that when there was a positive shock to the US stock market, corporate bonds would experience an insignificant response, in contrast to net corporate stock, which has a significant short-term positive response. Net corporate stock, on the other hand, did not respond to any risk aversion, whereas bond inflows showed some significant evidence of a mid-term response to an increase in risk aversion. Finally, they also reported some results indicating that domestic factors may influence foreign portfolio inflows, which strengthened their argument that pul-factors were the main determinants for the surge of portfolio inflow to developing countries (discussed in section 2.3.2).

c) Long-term interest rate differentials

Interest rate differentials are perhaps one of the key factors that have a significant effect on the composition and the volume of portfolio inflow. Various studies conducted by Moore, Sunwoo, Myeongguk and Tepper (2013), Bhaskaran, Sundararajan and Kohli (2005), Montiel and Reinhart (1999) and Brink and Viviers (2003), all emphasise the potential impact that foreign interest rates have on the

inflow of foreign capital. As mentioned above, foreign interest rates have the potential to alter the flow of capital. In other words, when there is a rise in US interest rates, this has the tendency to decrease the share of short-term and portfolio inflows to other countries (Montiel & Reinhart, 1999). This is because Interest rate differentials influence the expected rate of return on the investments of foreign investors. According to the International Monetary Fund (IMF) (2011), the most significant proxy to measure interest rate differentials is the spread between the US 10-Year Treasury bond yield and a developing country's 10-Year Treasury bond yield. In this case, it would be South Africa's 10-Year Treasury bond yield.

A study conducted by the IMF (2007) analysed the sensitivity of capital inflow into 48 developing economies to an increase in the US 10-year Treasury bond yield. The IMF found that a rise in the US interest rate would lead to a decline in all types of capital inflows to developing economies. Moreover, it was found that a 1% point rise in the US Treasury yield was associated with a decline of an average of 31% in net bonds inflow to developing countries. The IMF (2007) also revealed that a 1% point rise in the interest rate differentials (that is, a fall in the US Treasury rate) was associated with an increase in the ratio of capital inflows of 0.1% point to developing countries' economies GDP.

2.3.2 Pull-factors

As with push-factors, the following pull-factors are considered just as important in determining the inflow of foreign portfolio investments. These factors include real GDP, inflation, turnover ratio, stock market capitalisation, bank credit to private sector and law and order of an individual country.

a) Real GDP

The real gross domestic product (GDP) is one of the primary indicators used to gauge the condition of a country's economy. It represents the total value of all goods and services produced over a specific period. The real GDP provides more accurate figures than does the standard GDP, since it accounts for changes in the price level (inflation), according to Abel, Bernanke and Croushore, (2008:27). Countries with a higher domestic growth are likely to attract larger amount of foreign capital inflow as investors take advantage of higher return, as well as higher productivity projects in

the economy. A positive relationship between foreign portfolio inflow and the real GDP of a country may thus be expected. The proxy also illustrates the degree of economic fundamentals, which should have a significant effect on all types of capital flows, including portfolio inflow to the country (Sompornserm, 2010:12).

Ekeocha, Patterson and Chukwuemeka (2012) conducted a study in which they modelled the long-run determinants of foreign portfolio inflow (FPI) to Nigeria over the period of 1986 to 2006 on a quarterly base. Firstly, they found that real GDP was positively related to FPI and secondly, by utilising a Granger causality test, they proved that there was a unidirectional causality between real GDP and FPI, with the causality relation flowing from real GDP to FDI.

b) Inflation

Inflation has a similar effect to a tax, as it reduces investors' capital return. In other words, when prices rise (because of inflation) inflation reduces the purchasing power each unit of currency can buy. Rising inflation has an insidious effect, which results in higher input prices, and so consumers can purchase fewer goods. The end result is that revenues and profits decline, and the economy slows for a time until a steady state is reached. Therefore, inflation can often be used as a proxy for macroeconomic instability (Muritala, 2011).

Inflation is particularly harmful in portfolios that consist mainly of fixed income investments. Return on these investments comes in the form of interest or coupons and these remain fixed until maturity, while the purchasing power declines as inflation rises. In the end, companies' earnings and revenue moves in line with the rate of inflation. Inflation, however, can discourage foreign investors' investment decisions, due to a lack of confidence in the country and to stock returns that are overstated. For example, with bonds, foreign investors base their decision on future interest rates. The expected future interest rates are equal to the short-term interest rate plus a risk premium, which must include inflation. The risk premium of a bond increases when the expectations of future inflation and interest rates (bond return fundamentals) increase. This expected increase in the inflation rates and future foreign interest rates, depresses the current period's excess bond return, whereas

the higher risk premium depresses the current period's excess currency return for foreign investors (Sturges, 2000).

Amongst the early studies done on the pricing of economic variables in bond markets were that by Ibbotson *et al.* (1982). The study was carried out between 1960 and 1980, using the return data from bonds and stocks of eighteen countries drawn across Asia, North America and Europe. One of their findings revealed that inflation has a negative effect on both the stock and long-term bond markets in most countries. These findings emphasise the importance of the inflation rate as a determinant of portfolio investment when foreign investors make investment decisions.

c) Turnover ratio

The turnover ratio is a significant indicator for measuring the development of a country's stock market. The turnover ratio measures the liquidity of the stock market, which is equal to the value of the total shares traded divided by the market capitalisation. In other words, it measures the trading volume of stock market relative to its size. Although, the turnover ratio is not a direct measure of theoretical definition of liquidity, a high turnover ratio is often used as an indicator of low transaction costs for a foreign investor. The turnover ratio complements market capitalisation, in the sense that large inactive markets will have a large market capitalisation ratio but a relatively small turnover ratio. Some models predict countries with less liquid markets will produce disincentives to long-run investments, because it is comparatively difficult to sell owned shares in the investments. On the contrary, liquid stock markets will mitigate disincentives, which can foster more efficient resource allocation and faster growth (Levine, 1991; Bencivenga, Smith & Starr, 1995).

According to Bhaskaran, Sundararajan and Kohli (2005), market liquidity, also known as the turnover ratio, is a key determinant that influences the inflow of portfolio capital to developing countries. Foreign investors are attracted to high trading markets, because they enable investors to buy and sell their assets with ease. The turnover ratio is also a good indicator in measuring the quality of the micro-structure of countries markets, including the investment trading systems. Given the above, the

liquidity of countries security markets and its efficient trading systems, are essential in attracting both domestic and foreign investments.

d) *Financial development: Stock Market Capitalisation*

Stock market capitalisation is the value of listed shares divided by the GDP of a country. The stock market capitalisation ratio measures the overall market size. Further, it is a proxy for measuring the financial development of a country. The proxy does not measure the efficiency of the overall market; observers only use this ratio as an indicator of the stock market development with the assumption that the stock market size of a country is positively correlated with the ability to diversify risk and mobilise capital (Levine & Zervos, 1998).

Empirical studies done by, amongst others, Errunza (1986), Tamirisa (1999) and Saborowski (2009) suggested that financial development and efficiency were important determinants for a country's success in attracting portfolio flows. Portes and Rey (2000) used panel data to measure the bilateral gross cross-border equity flows between fourteen countries from Asia and Europe during the period 1989 to 1996. They found that a country's market efficiency, the overall market size and the friction of information were some of the key determinants in the surge of portfolio inflow into a country.

e) *Financial development: Bank credit to private sector*

Similar to the stock market capitalisation ratio, observers identify the domestic private credit sector as an indicator of the level of a country's domestic financial development (Binici *et al.*, 2009). The private credit ratio is equal to claims on the private sector by financial institutions divided by GDP. While private credit does not directly measure advancement of information and transaction costs, it illustrates the level of financial services and therefore greater financial intermediary development (Levine, 2000:411).

Levine, Loayza and Beck (1998), studied whether exogenous components of financial intermediary development influenced economic growth. These exogenous components entail liquid liabilities, commercial-central bank and private credit. Using dynamic panel techniques for 74 countries, they found that these exogenous components of financial intermediary development were positively associated with economic growth. According to Levine, Loayza and Beck (1998) these components were linked to financial development (including private credit) and therefore, were capable of explaining the differences in the level of countries' financial development.

According to De Santis and Lührmann (2009), financial development is a key determinant in explaining the flow of foreign capital. De Santis and Lührmann (2009) investigated factors such as money, population ageing, institutions, and deviations from the Uncovered Interest Parity (UIP) that influence the development in net capital flows. Using a panel data for a number of countries from 1970 to 2003, one of their findings revealed that better equipped and developed financial intuitions favoured net capital inflows. Their findings are in line with those of Brink and Viviers (2003), who opine that well-developed and healthy financial institutions facilitated increasing flows of foreign investment to a country.

f) *Quality of institutions: Law and order*

Theoretical and empirical findings regarding the quality of institutions revealed that good and effective institutions also help to promote capital inflows (Wei & Wu, 2001). The index of law and order indicator can be used as a proxy to measure the quality of institutions. According to Alfaro, Kalemli-Ozcan, and Volosovych (2003), countries that rank high in terms of law and order tend to attract more capital inflow. One of the reasons for this phenomenon is that well-functioning legal system (law and order) facilitate the operations of both intermediaries and markets. Moreover, it influences the overall performance (quality and level) of the financial sector that, in turn, facilitates both economic growth and the efficient allocation of resources.

Section 2.4 will draw on this section and will attempt to explain why developing countries started to experience large amounts of portfolio inflow from the early 1990s onward and how the risk appetite of foreign investors shifted from developed

countries to developing countries. This analysis will be followed by a discussion of the South African experience, which saw the surge of foreign portfolio inflow over the years from 1994 to 2008. This will be facilitated by examining the events that had a significant impact on South Africa's portfolio inflow.

2.4 Portfolio investment inflow into developing countries

During the 1990s, developing countries started to receive large amounts of capital inflow. This is evidenced by net private capital inflow reaching 190 billion U.S. dollar in 1998, which was nearly four times larger than at the beginning of 1990. These large inflows of private capital were mainly concentrated in Asian and Latin American countries and accounted for more than 75% of the total inflow (Lopez-Mejia, 1999). Aljandro (1999) stated that this growing increase of capital inflow could be ascribed to both external and internal factors (see section 2.3)

In terms of internal (pull) factors, Chea (2011:3-4) identified three elements that contributed to growing portfolio inflows in developing countries. Firstly, developing countries' credit ratings started to improve over the years due to external debt restructuring, which most of these countries endured. Secondly, productivity gains were achieved as developing countries established better macroeconomic management by implementing successful and efficient stabilisation programmes and structural reforms. Finally, investors became more attracted to developing countries that adopted a fixed exchange rate regime, most notably Latin American and Asian countries, because this enabled investors to hedge themselves against exchange rate volatility (Chea, 2011:3-4). In relative terms, developing countries that boast highly liquid financial markets also attract larger amount of capital inflows, such as those recorded by the Johannesburg Stock Exchange (JSE) of South Africa (see section 2.3).

External (push) forces can be divided into cyclical and structural forces, which also play a significant role in attracting foreign capital to developing countries. From a structural point of view, the global financial crisis that unfolded in 2008 and the more recent debt crisis in Europe are examples of these. Because of exposed balance sheet vulnerabilities in developed countries, foreign investors started to shift their

portfolios more towards developing countries. Many of these countries experienced lower debt to GDP ratio and better credit rating as mentioned by Chea (2011:3), which then made them more resilient to economic shocks (IMF, 2011:3).

From a cyclical perspective, the on-going global recovery since 2008 will keep interest rate differentials between developed and developing countries wide for a long period, according to McKinnon and Liu (2012). The increase in commodity prices is an additional cyclical force that drives capital towards more commodity exporting countries, for instance, Peru and Brazil. According to Reisen (1996:48), cyclical forces were the main catalyst in the early 1990s that have drawn investors to developing and emerging markets.

Together with better and sounder policy regimes, developing countries experienced large inflow of capital. Overall, the foundation appears to have been set for an on-going inflow of capital to developing countries, which could be important for investments and growth prospects.

South Africa, on the other hand, only started to experience substantial capital inflow following the transition to universal democracy in 1994. Furthermore, South Africa's government implemented a sequence of policy reforms, with the objective of normalising international financial relations and the foreign exchange market in general. This started after the final resolution of the foreign debt standstill; a moratorium on the repayment of foreign loans that had been imposed by the previous government following the South African debt crisis of 1985. As a result, capital inflow improved in the second quarter of 1994 from an outflow of –R3.8 billion in 1993 to an inflow of R10.2 billion in 1994 (Moolman, 2004:25).

The inflow of capital to South Africa continued to increase after many exchange controls on foreign investors were removed by the end of March 1995. The financial rand had been abolished with the unification of the exchange rate after the dual exchange rate regime had been in place for substantial periods since 1961 (Chapter 3 will discuss this topic in more detail). Following financial liberalisation, capital inflow into South Africa increased dramatically in the second quarter of 1995, reaching R32.4 billion (Mohamed, 2003). Portfolio inflow has primarily dominated the

composition of net capital inflow into South Africa since 1994 (see Figure 2.1). According to Kiat (2008:69), portfolio inflow is preferred by foreign investors because of South Africa's sophisticated and successful financial markets, which allows investors easy access into South Africa with relatively low risk.

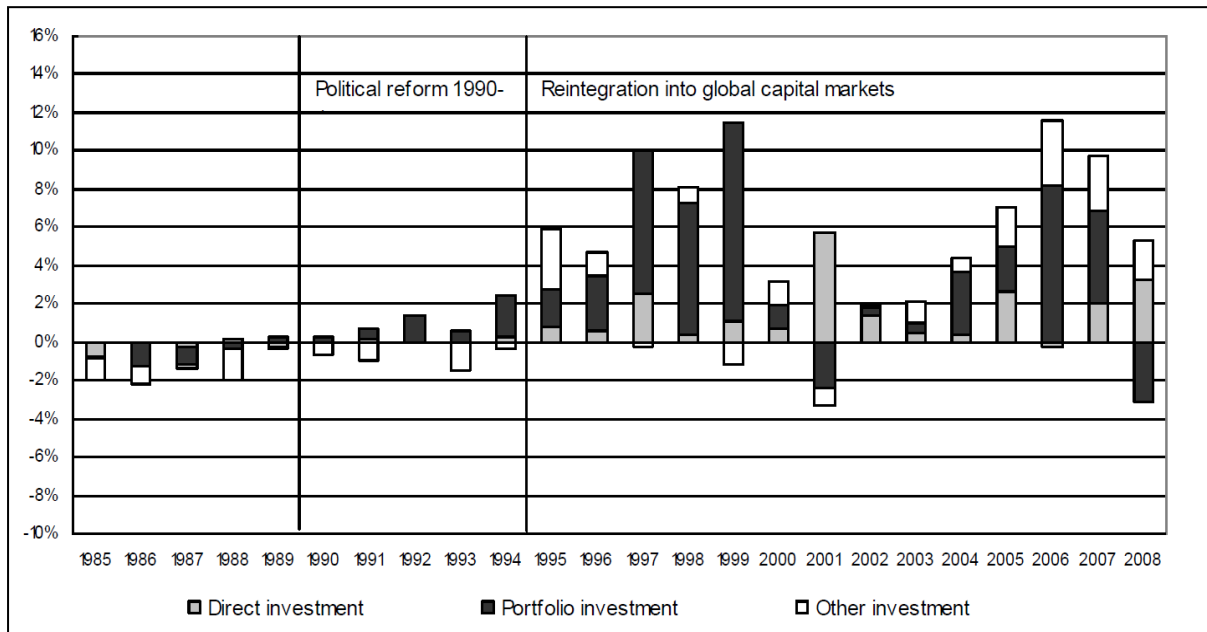


Figure 2.1: Composition of foreign capital inflow, % of GDP

Source: Quarterly Bulletin, December 2009, South Africa Reserve Bank

Figure 2.1 illustrates South Africa's portfolio investment, which has experienced periods of upswings (1997-1999; 2004-2006) and downswings (2000-2003; 2008), as will be discussed further in the following sections. Section 2.4.1 and 2.4.2 will examine South Africa's portfolio investment separately, in terms of equity and bond investments, since investors in equity securities appear to have different patterns of behaviour than do investors in domestic debt securities.

2.4.1 Portfolio investment in South African equities

According to Frankel, Smit and Sturzenegger (2006:8), well developed and world-class capital markets in South Africa have maintained high volumes of private portfolio investments since the mid-1990s. In 2013, the amount of South Africa's debt and equity portfolio liabilities held by nonresidents was US\$140 billion (about 40% of South Africa's GDP) (IMF, 2013). Particularly noteworthy is portfolio equity investment, which has become an important source for South Africa's long-term

external financing. As mentioned in chapter 1, South Africa's economy is characterised by a very low level of domestic savings (since 2004) in relation to its GDP. South Africa's savings rate is low even when compared to other emerging markets. These other countries also experience higher economic growth rates, for example, China that has a gross savings rate of over 50% (Tong, Wei & Bayoumi, 2010). This indicates the dependency on foreign savings of the South African economy in order to achieve long-term economic growth and prosperity

The main reason for the popularity of South Africa's equities is that South Africa's equity market is the equity market that is substantially larger than the average developing economy's. South Africa's equity market is also technologically advanced, well regulated and very liquid (Aron, Leape & Thomas, 2010:7). According to Aron, Leape and Thomas (2010), the total market capitalisation of all the securities listed on the Johannesburg Stock Exchange (JSE), was equivalent to 289% of GDP, at the end of 2006 (including both non-resident and resident companies). This amount is far greater than those of other developing countries, which at that time averaged 80% of their GDP. In addition, the value of shares traded in 2006 in South Africa was equivalent to 122% of GDP, compared to 40% on average across developing economies.

The only downside was the low turnover ratio of South Africa's equity market, which was only 50% in 2006, compared to the average for developing economies of 73% (Onyuma, Mugo & Karuiya, 2012:93-95). South Africa's turnover ratio is still reasonable if considerate is considered that it has progressively improved since the mid-1990s. The main reason for this low turnover is that the total equity market capitalisation includes a number of large non-resident companies, which are listed, primarily, on the London Stock Exchange. Foreign portfolio equity investment has also been facilitated by the cross-listings on major international stock exchanges of several South African companies, such as Impala platinum and SAB Miller (Tswamuno, Pardee & Wunnava, 2007:75-76).

Figure 2.2 illustrates periods of up- and downswings in South Africa's private portfolio investments. The abolishment of the financial rand in 1995 together with South Africa's integration into global financial markets encouraged foreign investors

to increase exposure to South African companies in their portfolios. During the first surge from 1997 to 1999, portfolio rebalancing¹ effects were undertaken by both resident and non-resident investors.

This was largely due to the Asian crisis in 1998 which led to a demand for capital by other developing countries, such as South Africa, so maintaining high levels of investment during a period when profits were falling dramatically. According to Mohamed (2003:12), the reduction in South Africa’s real lending rates from 1998 onwards encouraged capital inflow even further, which seemed to have been a process where increased net capital flows led to more liquidity and so reduced the real cost of capital.

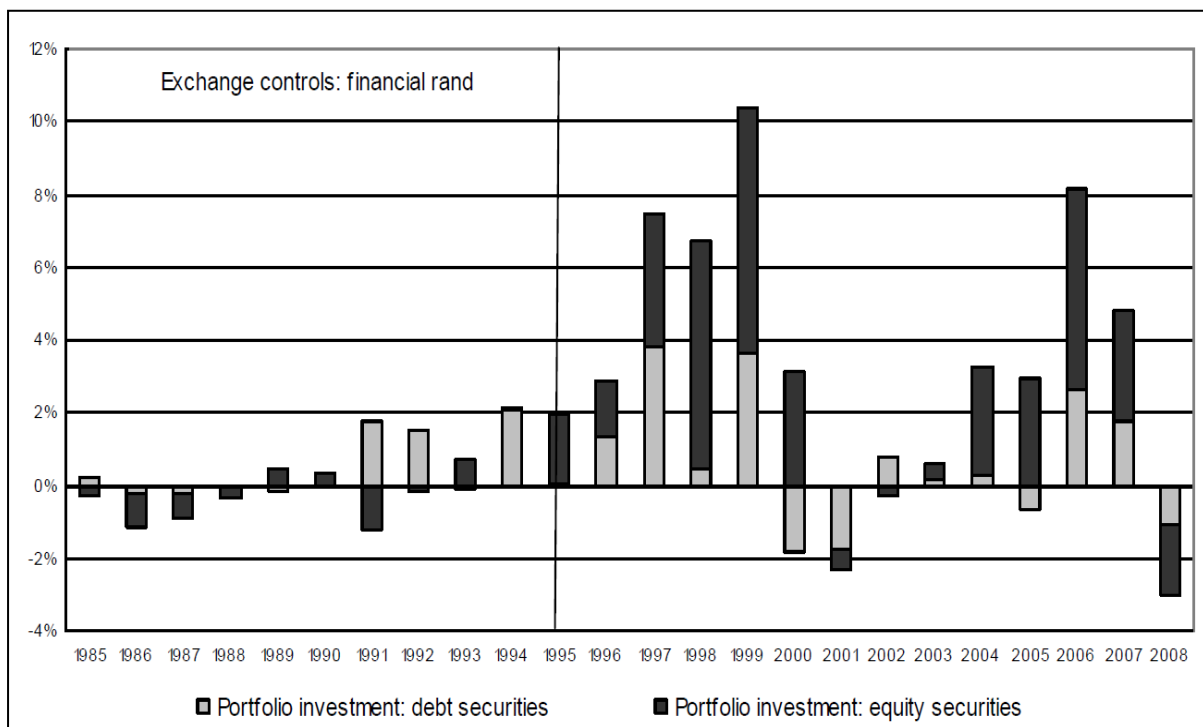


Figure 2.2: Foreign portfolio investments, equity versus debt, as a percent of GDP

Source: Calculated from Balance of Payments Statistics, IMF and Quarterly Bulletin, South Africa Reserve Bank

The surge of inflows during 1996 to 1999 can also be explained by an “asset swap” mechanism. Asset swaps enabled institutional investors in South Africa to swap

¹ Periodically adjusting the holdings in an investment portfolio to maintain a certain asset allocation.

domestic assets for foreign assets (to a certain limit), which were held by non-resident (foreign) investors.

The growing dominance of asset swaps increased and became more popular as the limit of obtaining foreign assets by an investor increased each year. The initial limit was set at 5% of total assets; in 1996 it increased to 10% and then to 15% 1998 (Leape & Thomas, 2011:32). Consequently, due to the growing dominance of asset swaps, the South African government introduced the first major reform of exchange controls for the South African institutional investor sector (subjected by long-term insurance and retirement funds).

In fact, the main motive behind reforming exchange controls was to support foreign diversification of portfolio investments, while protecting and maintaining the balance of payments over the long-term. In contradiction, swaps helped to mitigate the impact of inward investment and to facilitate significant portfolio rebalancing (Leape & Thomas, 2011:32). Even though the demand for South African assets exceeded the supply of the asset swap channel, South Africa's portfolio inflow was still able to reach 4.6% of GDP in 1997, 2.7% in 1998 and 6.3% in 1999. The inflow of equity investment was still strong during this period, despite a moderate decline in the volume of foreign portfolio investment (denominated in US dollars) in several developing countries following the Asian crisis in 1998 for the reasons described above (Poon, 2009:11).

During the period of 2001 to 2003, portfolio rebalancing occurred, whereby portfolio equities experienced a downswing. This was a result of the abolishment of the asset swap mechanism in 2001, as well as other external factors, for example the 9/11 incident in U.S. which contributed to the increase of uncertainty amongst investors. Additional factors include empowerment policies in South Africa concerning their structure and their impact on the mining sector, as well as the sharp depreciation in the rand at the end of 2001 that worsened the domestic situation (World Bank, 2008).

During this time, capital inflow to all developing countries declined. Net portfolio equity flow (US dollar) to developing countries during 2001 to 2002 was at its lowest

level since the early 1990s. This was a reflection of investors' low confidence in both developing and developed markets. Equity investments started to recover in South Africa during 2004 to 2005 and continued to improve until 2006, reaching 5.7% of GDP (World Bank, 2008). This increase was in line with that of other developing countries, which also experienced a substantial amount of foreign portfolio equity investments (that is push-factors). These high portfolio equity investments were caused by the increase in global liquidity, growing commodity prices and strong economic growth in general. This substantial amount of inflow consequently supported an increase in the current account deficit of South Africa and many other developing countries (United Nations, 2010). Towards the end of 2007, equity investment started to slow down and when the global financial crisis unfolded in 2008, large capital outflows were recorded. This was a result of "flight to quality" amongst investors and de-leveraging, which led to a large-scale outflow of capital from developing countries. This outflow of equity investments was only temporary, however, and inflow started to recover in the first quarter of 2009, reflecting a positive reassessment in the midst of investor confidence in South Africa's and the emerging markets risk (United Nations, 2010).

Although the quantity of equity inflow varied over the years, the outcome has been a significantly long-term accumulation of portfolio equity investments by non-residents. Equity stock held by foreigners has grown from 7% of GDP in 1994 to 38% in 2007, before a decline in 2008 because of the global financial crisis. What is most important is the fact that investors tend to hold South African equities for a reasonably long period. Illustrated in Figure 2.3 is a comparison of foreign sales and purchases in South Africa's equity market against the total stock of equities held by foreigners. It is shown that the average holding period is one year or longer between the years of 1999 and 2008. This is in contrast with the frequent characterisation of portfolio investment as short-term and volatile, which will be discussed in more detail in section 2.5.

	Bonds			Equities		
	Turnover (Rmns)	Stock (Rmns)	Holding period (months)	Turnover (Rmns)	Stock (Rmns)	Holding period (months)
1999	384.977	57.172	1.8	123.662	132.756	12.9
2000	565.881	64.328	1.4	149.086	166.946	13.4
2001	513.824	57.302	1.3	192.167	186.031	11.6
2002	534.019	45.372	1.0	209.530	201.202	11.5
2003	365.730	33.587	1.1	166.340	209.571	15.1
2004	319.869	30.425	1.1	207.154	242.447	14.0
2005	487.432	36.371	0.9	258.951	346.552	16.1
2006	699.192	46.116	0.8	443.696	508.277	13.7
2007	-	52.876	-	617.405	670.225	13.0
2008	-	64.045	-	614.206	670.148	13.1
1999-2006			1.2			13.6

Figure 2.3: Estimates of average holding periods for bonds versus equities

Source: Quarterly Bulletin, December 2009, South Africa Reserve Bank

Improved macroeconomic stability, as well as South Africa's growth prospects since 1994 should have encouraged the accumulation and sustainability of portfolio equity investments in South Africa. The pattern of up- and downswings suggests that risk preferences as well as international factors determining global liquidity have played a key role. However, South Africa still struggles with political and labour market instability and certain macroeconomic instabilities such as exchange rate volatility and high inflation. These prevent a sustainable inflow of portfolio investments into South Africa, especially bonds that are already considered more volatile than equity investments.

2.4.2 Portfolio investment in South African debt securities

Debt securities of foreign portfolio investment in South Africa have been seen as more volatile when compared to equity investments. Figure 2.2 show more volatility in monthly and quarterly flows, as well as the gap difference between the volume of net and gross transactions in the domestic bond market. On a number of occasions, net portfolio investment in debt securities (on a quarterly basis) has been negative in South Africa. This does not necessarily mean there is an outflow of capital from South Africa, but rather signifies investors whose risk appetite changed and subsequently preferred to invest in alternative South African assets or investment classes in order to diversify their portfolios (IMF, 2011:18).

Portfolio debt investment in the balance of payments includes flows that are associated both with South Africa's entities issuing and repaying international bonds, as well as foreign purchases and sales of domestic bonds, which is rand dominated (Kock, Coetzer & Motsumi, 2008). A large portion of the fluctuation in portfolio debt investment is accounted for by foreign investment in local debt securities. According to Leape and Thomas (2009), this can be explained by South Africa's debt market being highly liquid and providing foreign investors with a quick turnover of their interest rate position. Although foreign portfolio debt securities have been much more volatile the local bond market has historically enabled South Africa to maintain a low level of external (or foreign currency) public debt (Kahn, 2005).

In contrast to equity investments, there has been no long-term sustained and persistent increase in the stock of domestic bonds held by foreign investors. South Africa's foreign debt liabilities in the form of rand-denominated bonds have fluctuated over the years. Figure 2.3 suggests that there is a high frequency of trading by foreign investors in the domestic bond market. The fact that annual gross sales and purchases are significantly larger than the stock of bonds held by foreign investors indicates an average short-term holding period by foreign investors.

Figure 2.3 also illustrates an average holding period of approximately one month, while long-term investment in equities has an average holding period of more than one year. This means that short-term fluctuation or price movement can be determined by foreign investment in South Africa's local domestic bond market (BESA). This assumption is, however, only based on Figure 2.3, which includes data from 1999 to 2008. After the credit crisis in 2008, foreign investors began to reallocate their portfolio investments into many different countries and investment securities. Section 2.5 continues this discussion by examining the latest trend in portfolio inflow after 2008, with the focus on South Africa's equity and bond market.

2.5 The trend of portfolio inflow into Johannesburg Stock Exchange (JSE) and South Africa's Bond Market (BESA)

Gidlow (2010) agrees with Kahn (2005) concerning the selling and purchasing of bonds, which are generally of short-term nature. In contrast to equities, Gidlow (2010:84-86) discusses several factors which could account for the short-term nature of investing in bonds. Since the mid-1990s, South Africa has experienced a significant weakness in the rand, which generally affected bonds negatively. This is because the increase in local inflation infers the consequent risk of a decline in the bond's price (in terms of rands), as well as a decline in the external value of bonds in the foreign exchange market (Stivers & Sun, 2002). At the same time, South Africa's bond market has become very liquid, which facilitates foreign investors being able to sell off their bonds at a time when the rand is underperforming. On this basis, there has been continuing selling of South Africa semi-gilts and gilts², once the rand is under pressure (Gidlow, 2010:84-86).

South Africa's bond market has experienced a large amount of foreign investment inflow since the global financial crisis in 2008, with investors reallocating their portfolios to developing countries to obtain positive real interest rates. This was particularly true in 2010, when bond inflows amounted to R74.3 billion in October compared to R4.2 billion during the same period the previous year, as illustrated in Figure 2.4. This can be explained by foreign investors' profit-taking behaviour, which perceived the end of a monetary policy easing cycle, as well the change in risk tolerance following Europe's debt crisis. Moreover, the rebalancing of portfolio investment flows has been driven by a search for yields due to a weaker growth outlook for South Africa (IMF, 2011).

² Gilt-edged securities are bonds issued by certain national governments. The term is of British origin, and originally referred to the debt securities issued by the Bank of England, which had a gilt (or gilded) edge. Hence, they are known as gilt-edged securities, or gilts for short. Today the term is used in the United Kingdom as well as some Commonwealth nations, such as South Africa.

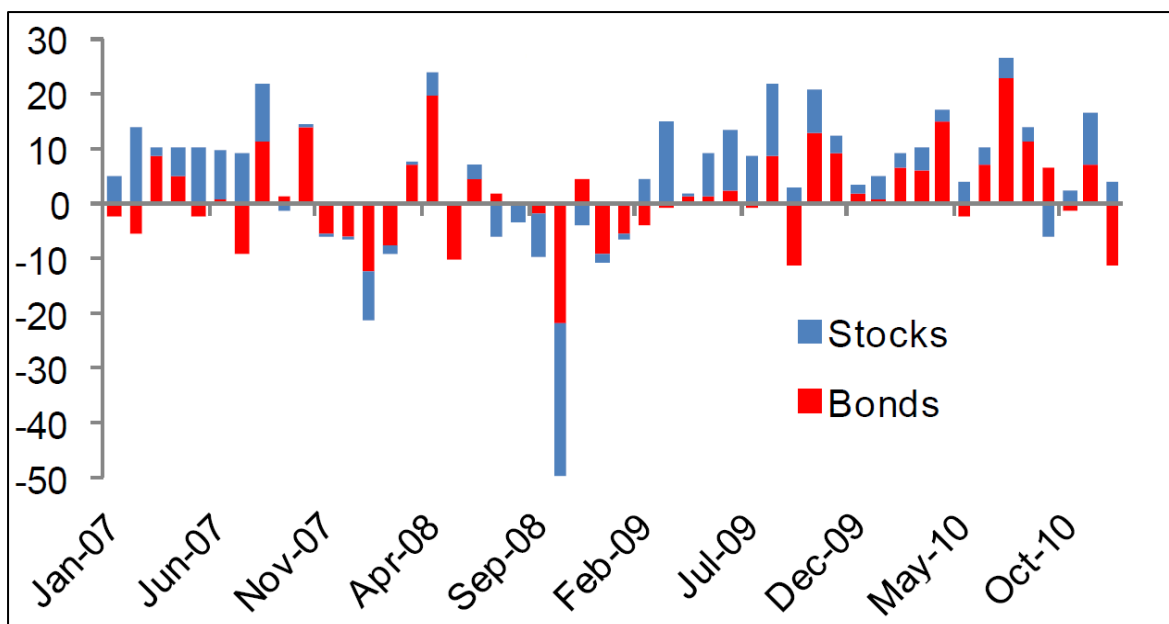


Figure 2.4: Non-resident net purchases of share and bonds (in R billion)

Source: IMF (2011)

Even though portfolio inflow into South Africa is expected to remain strong, the composition of the inflow may alter. According to the IMF (2013), developed countries' accommodative policies are likely to remain unchanged in the near future. These include countries such as Japan, which struggles with a sufficient fiscal consolidation policy, the U.S., which has a restricted policy space and high private sector debt and Europe that has an insufficient institutional development problem.

Portfolio inflow will possibly continue to flow into developing countries, including South Africa. Nonetheless, the nature of these inflows into South Africa may change, with equity inflows becoming more dominant than bond inflows. This shift can be explained by a number of developments in the bond market. For instance, bond investors may have reached their exposure limits in South Africa, while bonds are becoming more expensive after an extensive period in the demand for higher yields (IMF, 2011).

South African equities, on the other hand tend to be much more stable. One of the reasons for this phenomenon is that many of South Africa shares have significant rand hedge qualities attached to them, which can provide some protection against a declining rand. South Africa's equities are also very popular with foreign investors

due to their potential growth prospects. Foreign investors have a tendency to have a greater medium- or long-term investment perspective concerning South Africa's equities. Even though the share prices have been volatile on the JSE, foreign investors have welcomed the introduction of financial derivatives in South Africa (Poon, 2009:10). These derivatives (in rand and share indices) have taken the form of both options and futures, that reduced the need of foreign investors to sell off their shares outright.

It is necessary to bring the importance and dominance of equity inflows in to South Africa into perspective. As noted in chapter 1, traditionally portfolio inflow finances the current account deficit of South Africa (Linde, 2009:2). In 2004, the deficit in South Africa's current account reached R47.6 billion. The equity inflows into the JSE were able to finance an equivalent of 69% of the current account deficit in 2004 and 75% in 2005. In 2006, a very large deficit was again covered substantially by net foreign inflows to the JSE (Gidlow, 2010:87).

According to Statistics South Africa (Stats SA) (2008:14), it can by no means be assumed that portfolio inflow into South Africa will be large enough to continue supporting the deficit on a sustainable basis. The deficit has been escalating since 2003, primarily because of the increase in infrastructure development, high domestic demand and the increase in tax burden on the wealthier segment of the society in South Africa. Portfolio inflow might no longer be large enough to support the deficit on a sustainable basis; nevertheless, it still contributes significantly to other parts or sectors of the economy. Section 2.6 will examine a number of advantages and disadvantages that foreign portfolio inflow holds and its potential impact on South Africa's economy.

2.6 Advantages and disadvantages of foreign portfolio inflow

Gossel and Biekpe (2012) studied the potential impact capital inflows have on South Africa's macro-economy and the transmission mechanism of household expenditure, credit extensions and asset prices. These capital inflows consisted of portfolio inflow, FDI and other inflows. Gossel and Biekpe (2012), found that capital inflows could lead to an appreciation in the exchange rate, due to an increasing demand for South

Africa's currency, which could have negative consequences for exporting firms. Gossel and Biekpe (2012), state that in a floating exchange rate environment, the central bank may decide to intervene by buying foreign currencies and thereby increasing the central bank's reserves. By doing so, the central bank is able to mitigate the appreciation in the exchange rate by approximately 2% in the long-run, because of the initial impact that portfolio inflow would have had on the exchange rate.

Concerning the impact that capital inflow has on the transmission mechanism, Gossel and Biekpe (2012) confirmed that all capital inflows have a positive impact on credit extensions to the private sector and to asset prices. However, when considering all capital inflows, only portfolio inflow has a positive impact on both mortgage extensions and credit card extensions, which in effect increases domestic investments. Gossel and Biekpe concluded that South Africa must encourage other capital flows (such as FDI) and mitigate portfolio inflow because these results show that portfolio inflow is negatively associated with boom-bust cycles (2012).

Boom-bust cycles refer to alternating periods of credit and asset growth within a country. According to the IMF (2011), there is no actual confirmation of equity bubbles in developing countries; These bubbles are not a concern in several developing countries, nor in property markets in countries that include South Africa, where the property markets remain subdued (IMF, 2011).

Cardarelli, Elekdag and Kose (2010), Reinhart and Reinhart (2009), in addition to Gossel and Biekpe's (2012), show that capital inflow, especially portfolio inflow is sometimes seen as a disadvantage, in the sense that it leads to macroeconomic volatility and monetary policy difficulty. Cardarelli *et al.* (2010) explained how capital inflow has the potential to complicate monetary policy by placing downward pressure on the yield of long-term bonds. Lower yields on long-term bonds, however, undermine domestic conditions, which makes potential interest rate policy less efficient. Another benefit of capital inflow is that it can help to facilitate lower capital cost. Lower government borrowing cost may also result in a looser fiscal discipline, even though in some developing countries this may be acceptable with superior debt

dynamics. This includes developing countries such as South Africa, Indonesia, Thailand, Brazil and Peru.

As mentioned above, the surge of portfolio inflow (in fixed income market) into government securities reduces the cost of public borrowing by pushing down the yield of longer-term bonds (IMF, 2011). Lower costs of capital for both the corporate and public sector can help encourage investment and consumption, as well as finance much needed investments. Capital flow can also promote the development of financial markets by introducing the latest investment instruments and increase absorption capacity (Egger, Falkinger & Grossmann, 2005:23). One of the conclusions that can be drawn is that portfolio inflow has the potential to reduce capital cost and to encourage more investments and consumption. In turn, these will contribute to much-needed higher economic growth; will finance the deficit on current account balance and will increase absorption capacity in financial markets. It will have a positive impact on domestic investments through the increase of mortgage extensions and credit card extensions.

However, an increase in mortgage extensions and credit card extensions are perhaps positively associated with domestic investments, but can also be associated with boom-bust cycles in the form of credit and asset price booms. Portfolio inflow can also increase the exposure of foreign currency liabilities to developing countries' economies; can lead to an appreciation in the exchange rate and can increase macroeconomic volatility and monetary policy by putting downwards pressure on the yield of long-term bonds. Finally, the fact that portfolio investments are characterised as "hot money"³, meaning that foreign investors can withdraw their funds easily out of a country, emphasises the importance of investing these funds efficiently. If these funds are invested efficiently, however, foreign capital can supplement domestic savings, thus contributing to economic growth. Nevertheless, if these funds are invested inefficiently, foreign portfolio inflow may have no effect, or it may even have a negative effect on the prospects of long-term economic growth (Brink & Viviers, 2003:214). By managing portfolio flows, countries can potentially regulate these

³ Money that is moved by investors quickly from one form of investment to another, as to take advantage of changing international exchange rates or gain high short-term returns on investments.

funds more efficiently and, perhaps, on a more sustainable basis. Section 2.7, will examine capital flow management (CFM) as a possible framework to manage capital flows, which is an appropriate policy response when managing capital inflows.

2.7 Potential policy framework to manage capital flows

Throughout this chapter, it has been shown that capital flows to developing countries have increased over the past two decades. The IMF (2011:39) therefore, has proposed a specific framework to ensure that an appropriate policy response is conducted when managing capital inflows. However, there are certain conditions that should be met before countries can consider utilising measures that go beyond macroeconomic policies, such as capital controls. This framework distinguished between macroeconomic policy responses (discussed in chapter 3) and other policy suggestions regarding capital flow management (CFM).

2.7.1 Macroeconomic policies

According to the IMF (2011:43), the exchange rate should be allowed to appreciate on a multilateral basis when it is undervalued. This is very important given the current global economic situation, as most of the factors that influence capital inflow to developing countries are structural in nature, reflecting much-improved public and private sector balance sheets in developing countries relative to developed countries. If sustained, such movement would suggest that the equilibrium of the medium-term real exchange rates for developing countries is perhaps stronger than currently projected.

In general, countries committed to exchange rate flexibility can diminish the role for potentially destabilising speculative investors, as well as protecting the credibility of the policy framework in countries with an inflation-targeting exchange rate regime. A sharp and sustained increase in the exchange rate can be problematic, especially when there is confirmation that the exchange rate is already overvalued. Countries with foreign exchange reserves are more able (from a precautionary outlook) to respond to capital inflow by building up reserves. Intervention can be sterilised because of higher liquidity growth that could lead to overheating or be in conflict with

inflation objectives. However, sterilisation can also become counterproductive if inflows are being driven by yield differentials (IMF, 2011:43).

According to the IMF (2011) and to Ghosh and Ostry (2010:8), authorities in countries need to consider tightening fiscal policy or to reduce policy rates, to allow freedom of monetary easing, which could offer a better-sustained response to deal with capital inflow. It is important that monetary policy easing should be in line with the country's inflation objective. Finally, lowering interest rates should not be an option when a country's economy is already overheating with high or rising inflation or when experiencing a potential asset or credit boom.

Figure 2.5, below, illustrates this policy framework in a more practical manner, showing how to manage capital inflow under certain conditions. Each of the three circles represents a situation where the relevant condition is met. For example, in the case of the circle (a), where the exchange rate is considered to be mostly in line with the fundamentals or overvalued. Area (c), where all three circles intersect with one another, illustrates where CFM measures may be appropriate. It reflects to cases where the economy is overheating, the exchange rate is not undervalued and the reserves are considered to be adequate. Other intersection, similar to area (c) represents other confluences of factors. For instance area (b) is in this case outside of the ("economy overheating") circle. This area represents cases where the economy is not overheating, the exchange rate is not overvalued and reserves are considered to be adequate.

Areas where there is no intersection, represent cases where only one of the circles (example circle (e), (a) and (g)) are applicable. For example area (g) represents cases where the economy is overheating, the reserves are considered to be inadequate and the exchange rate is assessed to be undervalued. Lower rates/rebalance policy mix in area (a), refers to relaxing monetary policy; to a point where fiscal policy is tightened, so that there is more room to lower policy rates.

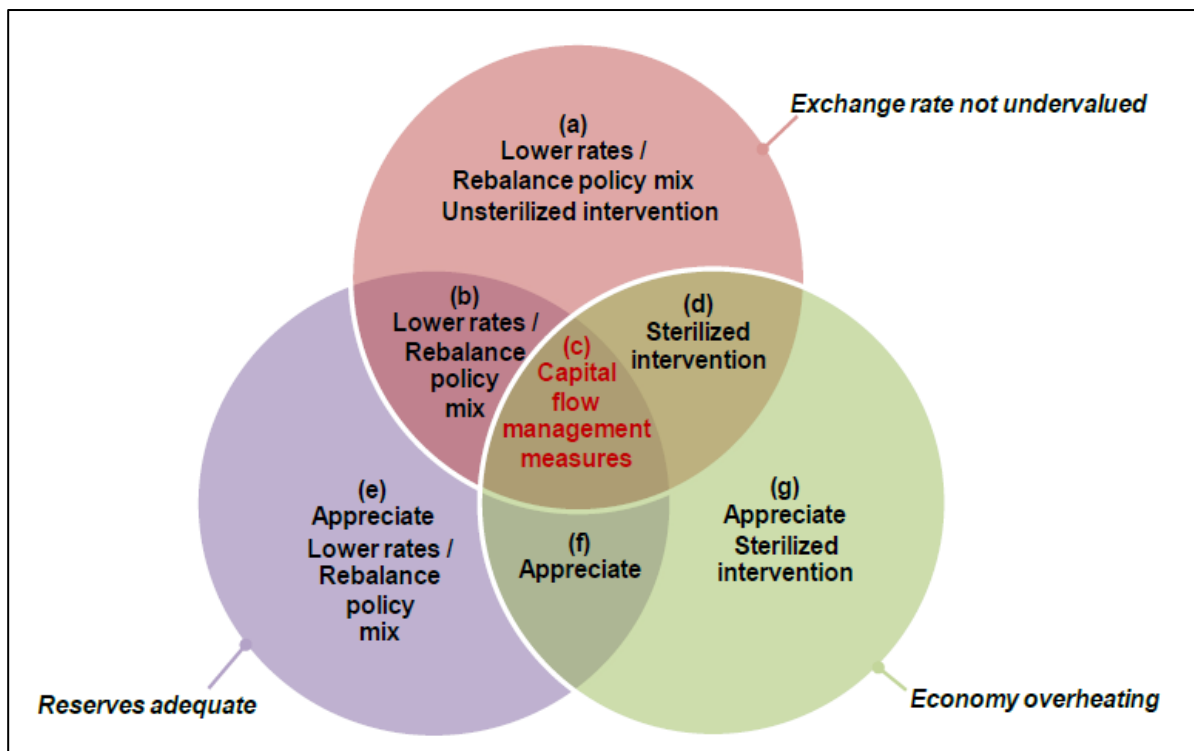


Figure 2.5: Coping with Capital Inflows: Policy considerations.

Source: International Monetary Fund (2011)

Capital Flow Management (CFM) on the other hand, includes a variety of tax, administrative and measures (all or some) that are specifically designed to control the flow of prudential capital. The aim of CFM would be to divert capital flows to other countries and/or to mitigate the appreciation in the exchange rate. However, as already noted, CFMs should only be implemented when appropriate macroeconomic policies are already in place.

2.7.2 Capital flow management (CFM)

As mentioned above, if macroeconomic policies fail to manage the flow of capital, target CFMs that do not discriminate based on residency can be considered as a second line of defence to address potential financial and macroeconomic stability risk. These measurements address the risk directly and at the same time avoid burdens that are related with measures targeting non-resident (foreigners) investors. For example, if vulnerabilities do arise, due to the inflow of foreign capital inflow, which could lead to an appreciation in the exchange rate amongst other things (see Section 2.4 for the benefits and consequences of portfolio inflow), they should be targeted, irrespective of the residency of the investor.

In support of banks, these measures can be in the form of liquidity requirements and currency-specific reserves, and differentiated risk weights for domestic as opposed to foreign currency loans. As to non-banking institutions, such as leasing companies and corporates, authorities may consider the imposition of a differentiated tax management of domestic borrowing against foreign currency borrowing. Given that these measures do not discriminate by residency, they can be much more effective than any other residency-based measure, since it removes any incentive for circumvention from residents acting as non-residents (IMF, 2011:45).

When alternative options have been deployed or deemed infeasible, authorities can, however reluctantly, consider CFMs that discriminate based on residency. According to the IMF (2011:45), residency-based CFMs may be required when the current capacity of the country's regulatory institutions or current regulatory perimeter, does not authorise direct targeting of the risk at hand through anything other than a residency-based measure. Residency-based CFMs can further be distinguished between market-based (also known as price-based) and administrative or quantity-based controls. Market-based controls seek to influence the flow of capital through reserve requirements and taxes, while quantity-based controls in the other hand are discretionary in nature, and involve total restrictions and quantity limits (Ghosh & Ostry, 2010:8). There is still controversy regarding their effectiveness, given the effects that controls have on investors' behaviours or actions. According to Stiglitz, Ocampo, Spiegel, Ffrench-Davis and Nayyar (2006), price-based controls are considered very flexible, less prone to political manipulation and are very market-friendly. Quantity-based controls are less popular amongst the international financial community, even though they are able to mitigate risk more effectively than price intervention.

Both these capital controls have different qualities and most countries have used a combination of these two controls. Price-based controls are very functional, since they are able to address potential problems in developing economies, which lack proper financial regulatory institutions. When the cost of investments or foreign borrowing is increased, authorities are able to stabilise exchange rate fluctuations and the volatility of capital inflow. Price-based controls are also very effective when it comes to shifting the composition of capital inflows, because these controls can be

designed to tax- specific types of instruments, rather than others. The downside of price-based controls is that they are sometimes seen as easily circumventable even when properly enforced. According to Ghosh and Ostry (2010:5), even if investors do devise strategies to bypass these controls, the cost of so doing may end up being more than the projected return of the planned transaction. In addition, Stiglitz *et al.* (2006, 197-198) note that “interventions don’t have to be perfect to be effective, what is important is the ability of these controls to continually stabilise the flow of capital”.

In conclusion, both the design and implementation of CFMs must be founded on the country’s specific circumstances, as well as on considerations of effectiveness. CFMs should not, however, be considered as a long-term and permanent solution and should be reduced once the pressure of capital inflow eases. This again raises the question of handling taxes on certain inflows as a permanent source of fiscal revenue. If inflows into the country are perceived to be permanent, the exchange rate assessment needs to be revised and authorities need to place greater reliance on the response of macroeconomic policy. Therefore, it is important for authorities to compose a detailed analysis and assessment by weighing the benefits of controls against the risk that such approaches may create an adverse market reaction. The ease with which the measure can be subsequently adjusted should therefore be taken into account in designing CFMs.

2.8 Conclusion

The aim of this was to understand the background and features regarding the inflow of foreign portfolio investment. Foreign portfolio inflow was defined as foreign investors purchasing commodities, stocks, money market instruments or bonds in another country. Foreign investors base their decision on personal profile or appetite, as well as taking financial and market conditions into consideration. These conditions are generally affected by both push (external)-and pull (internal)-factors

The literature identified three push-factors and six pull-factors that have the potential in influence the inflow of foreign portfolio inflow to developing countries. These push-and pull-factors, also referred to as external and internal factors, that were the main reason behind the surge of portfolio inflow to developing countries during the 1990s.

Three elements of internal factors contributed to the growing inflow of portfolio to developing countries, being better credit rating, macroeconomic management and the fixed exchange rate regime, as found in most Latin American and Asian countries.

From an external point of view, the global financial crisis that unfolded in 2008 and the more recent debt crisis in Europe (2011), contributed to the change in foreign investors risk appetite. Foreign investors started to diversify their portfolios to include developing countries, which had a more promising economic outlook. South Africa also began to experience large amounts of capital inflow following the transition to democracy in 1994.

The inflow of capital continued (particularly, portfolio inflow) to increase into South Africa, after almost all exchange rate controls on foreign investors were removed. South Africa's equities have always been very popular amongst foreign investors, due to its potential growth prospects in profits. South Africa's equity market is also substantially larger than those of the average developing economy are. Then in addition, South Africa is technologically advanced, well-regulated and very liquid, when compared to other developing countries. Although the quantity of equity inflow has varied over the years, in general, portfolio equity investments held by foreigners, remained significantly long-term. One of the reasons is the equities significant rand-hedge qualities, as opposed to those of bonds. This is in contrast with the frequent characterisation of portfolio investment being short-term and volatile. South Africa's debt securities have, however been more volatile in contrast to the equity investments.

The surge of portfolio inflow has been beneficial to South Africa's economy. Its impact on the country's credit extensions to the private sector, asset prices, mortgage extensions and credit card extensions has been positive, and this promotes economic growth. Since portfolio inflows are associated with "hot money", it is, however, not sustainable. It is, therefore, of primary importance that these funds are invested efficiently by the government and, secondly, are effectively managed by utilising a potential CFM framework.

Capital Flow Management (CFM) includes a variety of tax, administrative and prudential measures that are specific designed to control (all or some of) the flow of capital. The aim of CFM would be to divert capital flows to other countries and/or mitigate the appreciation in the exchange rate. However, CFMs should only be implemented when appropriate macroeconomic policies are already in place. Chapter 3 will continue this argument by focusing on the exchange rate of South Africa and its relationship with foreign portfolio inflow.

CHAPTER 3

EXCHANGE RATE VOLATILITY

3.1 Introduction

The aim of chapter 2 was to investigate the reasons for and trends in the inflow of foreign portfolio investment in general and for South Africa in particular. It comprised an examination of the unique characteristics of both equity and bond investments in the country.

Chapter 3 focuses on the second important aspect of this dissertation, the exchange rate and the relationship between the volatility of the exchange rate and portfolio inflow into South Africa. In other words, how does South Africa's exchange rate influence the flow of portfolio investments? This aspect was briefly touched upon previously (section 2.3), where several studies revealed that the exchange rate in fact appears to be a significant pull-factor in determining the flow of portfolio investments. Accordingly, before the potential relationship between the volatility of the exchange rate and portfolio inflow into South Africa can be examined, an understanding of the history and characteristics of South Africa's exchange rate is needed.

Chapter 3 will commence with a brief history of South Africa's exchange rate regime from 1970 to 2010 to lay the foundation for understanding how South Africa's exchange rate has evolved over the years and of the link between exchange rate volatility and portfolio inflow. In other words, how does the volatility of the exchange rate influence foreign investors' decision-making when it comes to portfolio investments? From there, various factors that have a significant effect on the level of the exchange rate will be examined (that is, the determinants of supply and demand of foreign currencies). In addition, chapter 3 will also aim to provide valuable insight by exploring different methods of measuring exchange rate volatility.

3.2 The History of South Africa's exchange rate regime

The aim of this section is to provide a brief overview of South Africa's exchange rate regime. This evolution of South Africa's exchange rate system over the past 40 years can be divided into 5 periods:

- The first period was from 1970 to 1979,
- The second period from 1979 to 1985,
- The third period from 1985 to 1994,
- The fourth period from 1994 to 2000, and
- The fifth period from 2000 to 2010.

The period 1970 to 1979 represents an era of the end of the Bretton Woods system and South Africa's attempt to maintain a relative stable exchange rate. Between 1979 and 1985 was the establishment of the De Kock commission; a significant period of reforming by developing the foreign exchange rate market and a floating exchange rate system. From 1985 to 1994 represents a time span in which South Africa's social and political environment forced authorities to return to more direct control measures to manage the exchange rate. After 1994 and after South Africa's first successful democratic elections, during which South Africa's international financial relations were normalised and South Africa adopted a single, managed, floating exchange rate system in 1995. The final period listed, 2000 to 2010, is the era where an inflation targeting framework was established in 2000, that under which South Africa currently operates. These episodes of regime changes are examined more fully below.

3.2.1 The period 1970 to 1979

This period can be described as the ending phase of the Bretton Woods system and a time when policymakers attempted to maintain a comparatively stable rand exchange rate. From the early 1970s, intense pressure started to build up against the Bretton Woods system, causing several currencies to switch to a floating regime system. Consequently, the South Africa Reserve Bank (SARB) was forced to alter the country's exchange rate regime on a regular basis. In 1971, the Bretton Woods System finally ended. The South Africa rand, which had been pegged for more than a decade to the pound sterling, was thereafter pegged to the US dollar. The foreign

exchange market of the rand, at that time, was relatively underdeveloped and did not permit an independent floating exchange rate. Furthermore, most of South Africa's international transactions were denominated in US dollars (Van der Merwe, 1996:2 and Aron, Elbadawi & Kahn, 1997:3).

An important aspect of the exchange rate regime between the years of 1971 to 1979 was the controls on many of the foreign exchange transactions. During this period, several adjustments were made to the exchange control regulations, which made them either less restrictive or more, depending on the international and domestic environment at the time. It is important to mention that this period started with strict foreign exchange controls, which had already been imposed by authorities in 1961. This was after South Africa experienced massive capital flight in the aftermath of political disorder as well as of the Sharpeville shootings (Aron *et al.*, 1997:2).

The purpose of these controls was to prevent the outflow of capital by restricting resident flows and placing the returns of asset sales by non-residents into blocked rand accounts. It also ensured that foreign sales and purchases of shares on the JSE did not affect the country's commercial rand exchange rate, foreign reserves or the liquidity of domestic banks (Gelb, 1991:88). In other words, South African shares, which were subjected to exchange controls, became less attractive to foreign investors, which could invest in other countries where there were no such controls.

3.2.2 The period 1979 to 1985

In 1977, the De Kock commission was appointed to investigate South Africa's monetary policy. The commission's primary objective was to evaluate the exchange rate system of South Africa. The commission published an interim report in January 1979, where they concluded that South Africa's exchange rate system, which was based on a fixed dollar peg in a relatively underdeveloped foreign exchange market, was not efficient enough to achieve the optimum combination in terms of balance of payments equilibrium, internal economic stability and economic growth (De Kock Commission, 1979:12-13). Consequently, the pegging of the rand to the US dollar ended and a new system, known as a managed floating exchange rate, was introduced.

The De Kock Commission proposed a restructuring in the foundation of the foreign exchange market, as well as to related policies. The Commission's long-term objective was to establish a unitary exchange rate system, whereby the rand was operating independently, more flexibly and was able to find its own level in well-developed and competitive foreign exchange markets in South Africa. The only intervention or controls on the exchange rate were performed by the SARB in the form of selling and purchasing of foreign currencies (mainly, US dollars) with the aim of keeping the rand more stable (van der Merwe, 1996).

Moreover, exchange controls would only be temporarily imposed, with the objective being to abolish them in the end. To pursue this policy, greater flexibility was required of the foreign exchange market and therefore a dual exchange rate was established. The dual exchange rate of South Africa consisted of a freer floating rate for a 'financial rand' and managed market determined rate for a flexible and independent 'commercial rand' (van der Merwe, 1996).

During the period of 1981 to 1982, South Africa's political and social unrest prevented further reform of the exchange rate policy, as well as in the foreign exchange markets (De Kock Commission, 1984:123-124). Steps towards the long-term goal, as outlined by the De Kock Commission, were nevertheless further implemented in 1983. The exchange rate controls on non-residents were raised, which led to the abolishment of the dual exchange rate system. The exchange controls on residents, however, remained, but were less strict than they had been in the previous years and restrictions on emigrant assets remained.

The reason for the reintroduction of exchange controls in August 1985, in the midst of South Africa's worst ever debt and financial crisis; was because of fear. Without any form of exchange control, foreign investors would be able to convert their foreign loans, subjected to the debt standstill, into equity shares. This enabled foreigners to sell the latter, and the returns could be transferred through a unitary commercial rand foreign exchange market, thereby weakening the rand. The retention of the unitary exchange rate could well have placed downward pressure on the rand and even though the unitary exchange rate remained stable over a long period of time, it was temporary following a decline in the gold price in 1983, increasing political instability

and the debt crisis in 1984, which caused a sharp depreciation against all major currencies (Farell & Todani, 2004:15).

Regardless of the action taken by the authorities to restrict speculation against the rand, the increase of violence, political instability and continued flight of capital caused the value of the rand to depreciate even further (Aron *et al.*, 1997:3 and Bah & Amusa, 2003:3-4).

3.2.3 The period 1985 to 1994

In the latter part of 1984, South Africa's socio-political environment had a negative impact on all sectors of the country's economy. Moreover, developments in the foreign exchange markets were in an inferior position, forcing authorities to implement more direct control measures to influence the flow of capital and consequently to manage exchange rates. In 1985, financial sanctions were imposed on South Africa by the United Nations and by other organisations. Consequently, South Africa began to experience large amounts of capital outflow in the form of assets and credit, forcing the SARB to revert to even tighter exchange controls and to reinstate the dual exchange rate system (Schultes & Khasawneh, 2009).

The government responded to the ratification, by declaring a debt standstill, meaning all debt payments were put on halt. Furthermore, the financial rand was reinstated after it was abolished in 1983 for foreigners who wanted to shift their money out of the country and to implement tighter controls on residents. These tighter controls were undoubtedly a setback in terms of the De Kock Commission's long-term objective (no exchange rate controls and a freely floating unitary exchange rate regime). As a result, foreign investors became net sellers of shares on the JSE for lengthy periods (Gidlow, 2010:72-74).

According to Van der Merwe (1996:7-8) these sales by foreign investors were modest in contrast to other outflows on the capital account, which represented commercial rand transactions rather than financial rand transactions. This was evident, in the net sales of shares by foreigners that reached R1353 million in 1986, compared to a net outflow of capital of R8300 million, in the same year, through the

commercial rand. Even though foreign investors continued selling off their shares on the JSE, this was counterbalanced by foreign investors purchasing local bonds. The increase in buying local bonds became an important aspect for the very first time in the second half of the 1980s. This was assisted by the promising high yields obtainable by foreign investors on local fixed interest securities (Gidlow, 2010:72-74).

The fact that South Africa was isolated from the international economy implied that authorities were unable to prevent a sharp depreciation of almost 19% in the exchange rate between January 1993 and the end of July 1994. Despite South Africa's borrowings from the International Monetary Fund (IMF) in August 1994, the commercial rand depreciated still further, reflecting the continued outflow of foreign capital (Van der Merwe, 1996:6-7). The dual currency exchange rate system was retained until the unification of the rand in March 1995.

3.2.4 The period 1995 to 1999

The year of 1994 was the first successful transformation of political stability in South Africa's history. The first universally democratic election in 1994 brought relief to the foreign exchange market, in which the new political regime paved the way for South Africa's integration back into the world economy.

South Africa's pursuit to achieve the long-term goal of full financial liberalisation and integration into the world economy started after South Africa's government abolished the financial rand in March 1995. South Africa's exchange rate regime again reverted to a single managed floating system. Under a managed floating regime, the spot exchange rate of the rand remained market determined, implying the currency is subjected to the supply and demand in a competitive foreign exchange market. The change in the exchange rate regime, as mentioned above was part of a highly desirable objective of gradually liberalising the financial markets. Nonetheless, all but a few exchange controls over foreigners were abolished, while exchange controls over emigrants and residents were retained. Significant easing over residents was achieved in July 1997, although it remained an on-going process (Aye, Bulcilar, Bosch & Stofberg, 2013:124-125).

These exchange control measures had limited success in regulating the flow of capital. Furthermore, the exchange controls also exhibited many other drawbacks. For instance, it discouraged inward foreign investments; it prevented effective application of monetary policy and had significant direct costs. Globalisation during this period was increasing at a great pace in technology, financial markets and the cointegration of countries' economies with one another and this made it even more difficult for countries to maintain exchange control regulation, not excluding South Africa (SARB, 2007).

According to Bah and Amusa (2003:4), the reduction in exchange controls relating to capital flows and the foreign exchange rate market have already caused a significant increase in the volatility of South Africa security prices (bonds and stocks), as well as the exchange rate of the rand against major international currencies. The relaxation of exchange controls while maintaining a single managed floating system left the currency exposed to both domestic and external shocks. The Asian crisis, as well as the decline in the price of gold and other metals in 1997, is an example where the vulnerability of the currency was exploited. Substantial amounts of capital were withdrawn from developing countries around the world. In the end, the rand depreciated by more than 20% in 1997 against the U.S. dollar (Bah & Amusa, 2003:5).

The SARB struggled to prevent a sudden depreciation in the rand, by trying to open its position on the forward book in the foreign exchange market (Mboweni, 2004). According to Ayogu and Dezhbakhsh (2008), this method unfortunately culminated into a large net open position against the SARB, with a negative effect on both the markets' assessment of domestic economic conditions and especially on foreign portfolio investments into South Africa.

3.2.5 The period 2000 to 2010

In February 2000, South Africa introduced inflation targeting as a new operating framework for monetary policy. The adoption of the inflation-targeting framework still allowed South Africa's exchange rate to be determined in a highly competitive foreign exchange market. Regarding South Africa's previous exchange regime

(single managed float system), unless exchange controls were removed completely, the liberalisation of the foreign exchange market would have largely remained incomplete.

Under the inflation targeting framework, monetary policy is implemented according to the inflation benchmark that is set. Moreover, the inflation targeting regime excludes pre-commitment to an exchange rate target that, according to SARB (2012), endures more policy efficiency. For that reason, the SARB ceased its foreign exchange market interventions policy in order to stabilise the value of the rand; apart from reserve accumulation under the supervision of the SARB, that is. This was assisted in May 2003 by the closure of the SARB negative net forward position and the end of its forward book in the foreign exchange market in February 2004 (Mboweni, 2004).

Since the year 2000, South Africa's exchange rate regime remained unchanged. The rand remained strong from 2005 until early 2006. The strong rand could have been a result of the increase in the foreign exposure limit on collective investment schemes, implemented by the SARB in 2005. Even though the exchange rate regime remained the same, the SARB loosened exchange rate controls on foreign exposure. Foreign exposure limit on collective investment schemes were increased in 2005 from 20% to 25% of total retail assets, as well as a 15% to 25% increase of total retail assets for investment managers. This enabled South African residents to diversify their investment portfolios through domestic channels. The increase in the total foreign exposure limits on total retail assets, led to a higher demand for South Africa's currency.

In 2006, however, the rand started to depreciate; it continued to fall, but only marginally during 2007. However, in the second half of 2008 the rand fell by more than 17%. This was a result of the international credit crisis that gained momentum in 2007 to 2008. Foreign investors decided to withdraw funds from developing countries, due to risk aversion. This continuous outflow of funds contributed to volatility in the exchange rate. Since the adoption of the inflation targeting framework, with a free floating exchange rate, the fluctuation in the exchange rate of the rand has dramatically increased (Bhorat, Hirsch, Kanbur & Ncube, 2013).

Although many argue that the inflation target framework is the best policy framework for South Africa, because it is able to absorb external shocks in the economy and provide great discipline to monetary policy, the exchange rate remains exceedingly volatile. It already caused a significant increase in the volatility of South Africa security prices as noted by Bah and Amusa (2003:4). This is an aspect that will be further discussed in the following section, which investigates the impact exchange rate volatility has on portfolio inflow and how it influences foreign investors, investing in equities and bonds, respectively.

3.3 Exchange rate volatility and portfolio inflow

The exchange rate is an important indicator for an investor of the economic and political policy of a country. This was further explained by Friedman (1953:158) when he stated that: “The ultimate objective is a world in which exchange rates, while free to vary, are in fact highly stable: Instability of exchange rates is a symptom of instability in the underlying economic structure.”

In this context, instability in the exchange rate can be referred to as volatility and indirectly may be regarded as exchange rate risk or currency risk. Currency risk is a form of risk that results from the change in the price of one currency relative to another. Studies related to exchange rate instability, as well the positive and negative relationship between the level of the exchange rate and portfolio investment will be examined in the empirical literature in more detail (see section 4.3). Concerning the theoretical effect of exchange rate risk on portfolio investment, exchange rate volatility may be perceived as a significant risk signal for portfolio inflow. This is because the volatility in the exchange rate influences wealth across multinational investors, which makes it harder for foreign investors to predict profitability and investment costs. Thus, according to Ncube, Shimeles and Verdier-Chouchane (2012:22), exchange rate risk or volatility counts as an important risk factor that affects the decision-making of portfolio investors. Foreign investors take the volatility of a country’s exchange rate seriously when making investment decisions.

This is especially true after the Asian crisis in 1997, when foreign investors became substantially concerned with exchange rate risk after many emerging countries experienced a sharp devaluation in their local currency. Therefore, foreign investors tend to examine closely any potential risk of currency misalignment of emerging countries. By definition, exchange rate misalignment is defined as the gap, in percentage, between observed exchange rates and equilibrium exchange rates. However, various methodologies can be used to estimate the equilibrium of exchange rates, (Jeong, Mazier & Saadaoui, 2010:27), an examination of which falls beyond the scope of this study. Given the importance of the exchange rate in the decision-making of portfolio investments, foreign investors also search and evaluate long-term factors that may influence the sustainability of emerging countries exchange rate. This includes macro-economic factors, such as the current account balance of a country, the effective management of monetary and fiscal policies, financial sector sustainability and other factors such as the growth of corporate and consumer debt.

In addition to what Ncube *et al.* (2012:22) have noted regarding exchange rate risk that counts as an important risk factor, Bonga and Hoveni (2013:263) further reveal that exchange rate volatility creates cash flow uncertainty for investors. They offer that this volatility will reflect in the stock market as increased trading activity, as foreign investors attempt to liquidate their positions or hedge against the anticipated price volatility. Similarly, volatile stock prices will increase uncertainty for both foreign and domestic investors. Foreign investors are generally more sensitive to market uncertainty and so instability in the local stock market may cause capital outflow, inducing fluctuations in the exchange rate. Exchange rate volatility also has a significant impact on the bond market, since foreign currency denominated bond has unknown domestic currency cash flows.

The cash flows of the domestic currency are reliant on the exchange rate at the time that payments are received, in other words when the particular bond matures. According to SIFMA (2013), foreign investors invest in international bonds for two reasons, primarily to take advantage of higher interest rates or yields and secondly, to diversify their holdings. Since the long-term interest rate is equal to the short-term interest rate plus a risk premium, any volatility in the exchange rate contributes to a

higher risk premium. This implies that the higher expected returns from investing in foreign bonds goes with a higher potential risk arising from adverse currency fluctuations. Moreover, because bonds have relatively lower levels of absolute returns⁴ compared to equities, exchange rate volatility can have a significant impact on bond returns.

According to Carrieri, Errunza and Basma (2006), foreign investors perceive currency risk as a source of non-diversable risk, which makes foreign investments more risky relative to domestic investments. Therefore, it is likely that the higher the exchange rate volatility, the lower foreign portfolio inflow will be. This is true even though investors have hedging derivatives to their disposal, to minimise or hedge currency risk as well as the level of uncertainty that goes with it. According to Döhring (2008), hedging derivatives has proved to be more difficult and complex than it might appear. Some of these derivatives, such as currency futures and options are coupled to the volatility of the exchange rate, highlighting the cost of hedging instrument to cover currency risk, especially when the market corrects, which may perhaps be too high a risk for an investor or for many international fund managers.

Again, this has an impact on the cash flow of foreign investors and as a result, many investors opt not to hedge, illustrating the difficulty of predicting foreign exchange rate movement (Cote, 1994). In a highly competitive foreign exchange market, there are certain factors that determine the level of the exchange rate through the supply and demand of international forces.

3.4 The determinants of supply and demand of foreign currencies

Since 2000, South Africa operates under an inflation targeting framework (see section 3.2), which consists of a flexible exchange rate. A flexible exchange rate is theoretically determined by international forces of supply and demand. Through supply and demand, a certain level of equilibrium is reached in the foreign exchange market. When the exchange rate is above the equilibrium, there will be surplus supply and the exchange rate will react by falling to a new level, where equilibrium is

⁴ The return that an asset achieves over a certain period of time.

reached. On the other hand, when the exchange rate reach a level below equilibrium, there will be a shortage of supply in the foreign exchange market and the exchange rate will rise again (Pretorius, 2004:25-45).

It is important to take note that these forces of supply and demand are only applicable in free-floating conditions where there is no intervention from government. There is a link between the balance of payments and the foreign exchange market - any item entering the accounts as a credit generates a supply of foreign currency, while debits generate a demand for foreign currency. According to Walters (1999:451-453), the following factors determine the supply and demand of a country's exchange rate: interest rates, inflation, national income, capital account and monetary and fiscal policy. Therefore, these factors are considered as key macroeconomic variables in determining the level of the exchange rate, and are subsequently reviewed.

3.4.1 Interest rates

Changes in the real interest rate have a significant impact on the exchange rate and play a very important role in financial transactions. For instance, when the interest rate rises in a specific country, a higher expected rate of return can be obtained and this makes foreign investors more likely to invest in that country. This is noted in section 2.3, where it is noted that foreign investors reallocate their portfolios to those developing countries having higher positive real interest rates. The increase in the demand for that country's currency will result in an appreciation in the currency (Pretorius, 2004:25-45).

Countries with above average inflation and whose currencies tend to depreciate tend to have higher than average interest rates. According to the Myburgh Commission (2002), from a foreigner investor's perspective, a higher interest rate compensates roughly over time for capital losses from currency depreciation. Therefore, raising interest rates tends to support the local currency by making it more attractive to hold and more expensive to borrow or even to short⁵.

⁵ The sale of a security that is not owned by the seller, or that the seller has borrowed. Short selling is motivated by the belief that a security's price will decline, enabling it to be bought back at a lower price to make a profit.

3.4.2 Inflation

According to Heakal (2004:37-38), inflation has a significant impact upon the exchange rate of a country. This relation between the inflation rate and exchange rate takes place through several channels of which the prices of homogenous commodities traded in global markets are the least controversial. Any change in commodity prices directly influences the rate of inflation for wages, food and industrial material cost in manufacturing. Once again, prices of wages and traded goods act as a channel for interaction. These channels yield a persistent pattern of both price and cost effects, which are indirectly and directly linked to exchange rate movement.

A study conducted by Gray and Irwin (2003) show that inflation tends to be correlated with depreciation over the medium- to long-term. In other words, the percentage change in the exchange rate between two countries should be approximately equal to the percentage differential in their inflation rates. Even though this relationship is not applicable in the short-term, when there is surge of portfolio flow, it holds up reasonably well in the long-run especially when inflation is very high (Gray & Irwin 2003:3).

Inflation also has a naturally reinforcing effect on the exchange rate, meaning the exchange rate has a significant impact on the inflation rate of a country also. The exchange rate affects inflation through two channels. The first channel is referred to as the direct channel, whereby the exchange rate of country affects the price of important goods. This includes goods intended for the consumer market, semi-manufactured and raw material which are used for the production of consumer goods of domestic origin. The exchange rate affects not only the price of imports, but also the price of domestic goods, since these imported goods put competitive pressure on the price of domestic goods (CNB National Bank, 2005).

The second channel through which the exchange rate affects inflation is known as the indirect channel. When there is a change in the exchange rate, all other things being equal, it changes the real exchange rate. This consecutively affects the

economy of a country, through aggregate demand and the output gap. However, compared to the direct channel, the pass-through of the exchange rate into the real exchange rate and its potential impact on a country's economic activity and subsequently on inflation is relative slow (CNB National Bank, 2005). However, it is important to know that a country's inflation depends on its monetary policy and that the fluctuations in the exchange rate are subject to the stance of monetary policy. South Africa, for instance, has a monetary policy framework that manages inflation between certain boundaries and the Reserve Bank tries to prevent exchange rate volatility that can create an inflationary spiral (Lafleche, 1996:2).

3.4.3 National income

Through the current account, it is possible that a country's national income can affect the supply and demand for foreign currencies. When there is a rise in a country's national income, the demand for foreign goods and services will rise simultaneously. This could induce a deficit in the current account, meaning the country's imports exceed the value of its exports. The specific country needs to borrow capital from foreign sources, such as foreign portfolio inflow, to make up the deficit. In other words, the country requires more foreign currency than it receives through sales of exports, and it supplies more of its own currency than foreigners demand for its products. The excess demand for foreign currency lowers the country's exchange rate (Heakal, 2004:45-46).

3.4.4 Capital Account

The capital account, also referred to as the financial account, is a significant component in the balance of payment of a country. It is generally seen as source of financial funding to cover the deficit of a country's balance of payment. The capital account consists of the sum of public and private flows of which private flows are the sum of four elements, namely:

- Foreign direct investment (FDI),
- Portfolio investments,
- Current private transfers, and
- Liability of foreign banks.

Pesaran, Shin and Smith (1999) analysed the effect different components of private capital inflows have on developing countries real effective exchange rate (REER). Pesaran *et al.* (1999) showed that private and public capital inflows are associated with REER appreciation. By dividing private capital inflows into the four elements, he revealed that the appreciation effect of private flows differs by the type of flow (1999). For instance, portfolio investments have the highest appreciation effect, since it is more volatile, followed by bank loans and FDI. According to Pesaran *et al.* (1999), since these flows are possibly related to an increase in productive capacity, the real appreciation related to bank loans and FDI are barely one-seventh of the real appreciation due to portfolio investment. Finally, he opined that private transfer or investments could help countries to offset the real depreciation of their exchange rate during periods of economic slowdown.

3.4.5 Monetary and fiscal policy

Monetary and fiscal policies are important components of any country's economy. They can improve or discourage the ability of a country to generate wealth and to sustain strong export earnings, which are needed to meet future foreign debt servicing. The inflation rate has the ability to influence interest rates, monetary stability and financial liberalisation, which are all instruments of monetary policy (Walters, 1999:459-461). Economists have proved that countries with a sound inflation rate, utilising a flexible exchange rate, find it very effective to use an inflation-targeting framework as a basis for monetary policy.

The fiscal policy of a country has an indeterminate effect on the real exchange rate. According to Mtonga (2006), the direction of its quantitative influence depends mainly on the composition change in the expenditure of the government. If the government, for instance, decides to increase its expenditure on tradable goods, it would lead to a growing demand for tradable goods through an increase in import consumption. This would create a trade deficit; which leads to a decrease in the real exchange rate.

In contrast, when government expenditure increases on non-tradable goods, it has the potential to create a surplus demand in the non-tradable market. To maintain equilibrium in the goods market, an increase in the relative price of non-traded goods

would be required, meaning an appreciation in the real exchange rate. In conclusion, changes in the stance of a country's fiscal policy can either depreciate or appreciate the real exchange rate (Mtonga, 2006:21).

Based on the literature above, it is evident that these key macroeconomic variables are significant in determining the level of the exchange rate. However, given this, it is also essential to know the level of volatility within the exchange rate. The following section will focus on this matter, by examining the different measuring methods that are used to measure the volatility of the exchange rate and more importantly, how these measuring methods developed over the years and how they can be distinguished from one another.

3.5 Measures of exchange rate volatility

The increased integration, as well as reduced policy restriction, between the financial markets of economies has enhanced mobility of international capital flow significantly. Capital transactions are becoming more frequent and so is the risk of capital dominating current transactions in open economies, especially via portfolio investments. According to De Wet (2002:3-4), this illustrates the vital role and far-reaching implication that capital flows can have on a country's exchange rate (since capital flows have a significant impact on the level of a country's exchange rate), and thus emphasises the importance of measuring exchange rate volatility. The best-known measures of volatility are standard deviation and Auto Regressive Conditional Heteroscedasticity (ARCH) family models. These models are subsequently discussed.

3.5.1 Standard deviation

Different methods to measure volatility have evolved over the years, which reflect new advances in econometric techniques. However, there is yet no clear dominant approximation to measure volatility. The most common measure of volatility, which is found in studies done by, amongst others, Kenen and Rodrick (1986), Chowdhury (1993), as well as that of Gervais, Larue and Bonroy (2004), is standard deviation. Standard deviation is a measure of the variation or dispersion of a set of data from its mean (Chatterjee & Hadi, 2012). Akhtar and Hilton (1984) were amongst the first to measure the effects of volatility by measuring the standard deviation of daily

observations of the nominal exchange rate during each three-month period. In this measure, exchange rate volatility is defined in the equation below.

$$V = \left[\left(\frac{1}{m} \right) \sum_{i=1}^m (EXRATE_{t-1} - EXRATE_{t-2})^2 \right]^{\frac{1}{2}} \quad (3.1)$$

Source: Chatterjee & Hadi, 2012.

From the above equation, the EXRATE denotes the exchange rate of a country's local currency against a foreign currency, where m is the order of the moving average. This methodology allocates large weight to extreme volatility. The closer the measure is to zero, the more the exchange rate pursues a constant trend and the lower the exchange rate risk or uncertainty. Studies consider standard deviation as the benchmark proxy for measuring exchange rate volatility.

Although standard deviation is the most common basis for measuring volatility, it still has its shortcomings mainly because of the lags that are involved in the calculations. Standard deviation assumes that the exchange rate is empirically normally distributed and it discards the distinction between the predictable and unpredictable elements in the exchange rate. Oskooee and Hegerty (2007:214-215) finds that skewness and kurtosis are just as important to take into consideration when measuring the volatility of the exchange rate. Therefore, their study also indicates that the non-normality of the volatility variable limits the effectiveness of standard deviation measurement. For this reason, ARCH family models were developed. These models have the ability to model and forecast the changing variance in a time series, such as the exchange rate.

3.5.2 ARCH family models

Auto Regressive Conditional Heteroscedasticity models, known as ARCH models, have the ability to measure the volatility dynamics of exchange rates. ARCH family models were first introduced by Engle in 1982. Since then various types of this model has been proposed. Amongst these family methods, are the generalised ARCH (GARCH) model proposed by Bollerslev in 1986, the exponential GARCH (EGARCH) model introduced by Nelson in 1991 and the threshold GARCH

(TGARCH) model specification of Zakoian in 1990, which has proved to be particularly useful when measuring volatility (Pretorius, 2004:3).

The reason behind the popularity of ARCH type models to model volatility is due to their primary theoretical properties (Diebold & Lopez, 1995:8). These ARCH models are able to capture volatility clustering, which is often found in financial data and this makes them very attractive to the economist.

Standard deviation models generally employ “moving sample” measures of volatility, which discard information, whereas ARCH family models attempt to model the nature of this time-varying volatility directly. According to Farrell (2001), ARCH models focus on the conditional rather than on the unconditional second moment⁶ of the data process. In other words, any uncertainties that can be eliminated by conditioning on past values or additional variables are irrelevant. Looking back in history, various studies used different ARCH family models to model the exchange rate. One of the first studies on exchange rate volatility was done in 1989 by Hsieh who examined the statistical properties of daily exchange rates changes of five currencies over a period of 9 years, from 1974 to 1983. He revealed that the variations in the exchange rate are not normally distributed and independent, that each day of the week has a different distribution, and that both variance and mean change over time.

Hsieh (1989) concluded that the standard GARCH (1,1) and ARCH models were thus successful in removing heteroscedasticity in the data. In other words, ARCH family models do compensate for distribution of non-normality in the variation of the exchange rate. According to Hsieh (1989), the exponential GARCH fit the data better and do not indicate integrated variance, when compared to the standard GARCH models that do indicate integrated variance.

In 1996, the movement of the rand-dollar exchange rate was examined by Cilliers, Smit and Kotze (1996) and a follow-up study was conducted in 1998 by McKenzie

⁶ The unconditional moments can be categorised into four moments, the first moment the mean, the second moment the standard deviation the third moment the skewness and the fourth moment the kurtosis.

and Mitchell (1998). McKenzie and Mitchell (1998) studied whether ARCH models were able to capture the features of volatility in 17 daily spot exchange rates for the period 1986 to 1997. They concluded that the sum of both GARCH and ARCH coefficients' was less than unity and that shocks in the economy were more transitory rather than permanent. They furthermore, determined that the GARCH models were preferable, because ARCH models, in terms of its leverage term, did not enhance the GARCH model.

Once more, the above literature emphasises that there is no clear dominant approximation when measuring volatility. Every measurement instrument, even within the ARCH family models, has unique characteristics in measuring exchange rate volatility. It is important to understand how these ARCH family models differ from one another, in order to measure volatility effectively. The following section examine each of the following models, namely ARCH, GARCH, EGARCH and TGARCH models in terms of their characteristics

3.5.2.1 Autoregressive conditional heteroscedasticity (ARCH)

The autoregressive conditional heteroscedasticity (ARCH) model was first introduced by Engle in 1982. The ARCH model enables the modelling of the attitudes of market participant with respect to the wide distribution in exchange rate volatility, uncertainty and risk by accurately measuring the variance in time series data. When conventional modelling methods are used, the variance of the error terms can be seen as a being constant or homoscedastic. In reality, volatility increases and decreases during certain periods, making it preferable to examine the conditional volatility of a data series, in this case, the exchange rate. The ARCH process models the conditional volatility of data and enables an estimate to be made of the fluctuation (riskiness) within the exchange rate for a set period (Asteriou & Hall, 2007:250).

From the ARCH model description σ_t^2 denotes the conditional volatility $\sigma_t^2 = h_t$ and the exchange rate can be represented as $r_t = u + \varepsilon_t$ where u , represents the average return and ε_t the residual return, which is defined as $\varepsilon_t = \sqrt{h_t} z_t$, where $z_t \sim D(0,1)$

follows a standard normal distribution. The innovation z_t is extended by the conditional variance factor h_t (Poon, 2005:37). Engle (1982) proposed the ARCH (q) procedure to take the following form:

$$h_t = \omega + \sum_{j=1}^q \alpha_j \varepsilon_{t-j}^2, \quad (3.2)$$

where $\omega > 0$ to warrant that h_t is a positive variance process. When there is volatility persistence in financial markets, q is likely to be of a higher order. In equation 3.4, h_t is known at time $t - 1$, which indicates that a forecast is readily available. This forecasting model can be constructed by assuming $E[\varepsilon_{t+\tau}^2] = h_{t+\tau}$. The unconditional variance of r_t can be represented as follows (Poon, 2005:38):

$$\sigma^2 = \frac{\omega}{1 - \sum_{j=1}^q \alpha_j}. \quad (3.3)$$

The model is covariance stationary when the sum of the autoregressive variables (that is, α_j), is less than one (Poon, 2005:38).

3.5.2.2 Generalized autoregressive conditional heteroscedasticity (GARCH)

The disadvantage of an ARCH model is that it leans itself more to being a moving average specification, as opposed to an auto-regression. To compensate for this shortcoming, Tim Bollerslev expanded the ARCH process in 1986, by including a lagged conditional variance term as an autoregressive term (Asteriou & Hall, 2007:260). This expansion is known as a generalized autoregressive conditional heteroscedasticity model (GARCH). When this model is compared to the regular ARCH (q) model, the GARCH (p, q) model permits additional dependencies on the p lags for past h_t as indicated below (Poon, 2005:38):

$$h_t = \omega + \sum_{i=1}^p \beta_i h_{t-i} + \sum_{j=1}^q \alpha_j \varepsilon_{t-j}^2, \text{ and } \omega > 0. \quad (3.4)$$

Given a GARCH (1, 1) model, $\alpha_1 \geq 0$ and $\beta_1 \geq 0$ requires that h_t carries a positive value. The unconditional variance can be represented by the following equation (Poon, 2005:38):

$$\sigma^2 = \frac{\omega}{1 - \sum_{i=1}^p \beta_i - \sum_{j=1}^q \alpha_j} \quad (3.5)$$

The GARCH model is covariance stationary when $\sum_{i=1}^p \beta_i + \sum_{j=1}^q \alpha_j < 1$ (Poon, 2005:38).

3.5.2.3 Exponential generalized autoregressive conditional heteroscedasticity (EGARCH)

ARCH and GARCH models are successful in capturing various features of financial data. However, these models cannot capture the asymmetric effects contained within data. The unconditional returns have a propensity to exhibit fatter tails⁷ than represented under a normal distribution, are more skewed and exhibit a higher kurtosis. In order to solve these shortcomings, Nelson (1991:350) developed the E-GARCH model. This model handles excess conditional kurtosis in returns based on a generalised exponential distribution (Daly, 2008:23-35). The E-GARCH model reduces the restrictive features of the common GARCH model by explaining variation in the volatility of the exchange rate. This variant allows for the assessment of the determinants of volatility that are decomposed to (i) conditional shocks (ii) asymmetric/symmetric shocks and (iii) shock persistence.

⁷ A fat-tailed distribution looks normal but the parts far away from the average are thicker, meaning a higher probability of vast deviation. A probability distribution with fat tails would be one in which moderately extreme outcomes were more likely than one might have expected.

$$\log(h_t) = \gamma + \sum_{j=1}^q \zeta_j \left| \frac{\varepsilon_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{j=1}^q \xi_j \frac{\varepsilon_{t-j}}{\sqrt{h_{t-j}}} + \sum_{i=1}^p \delta_i \log(h_{t-i}) \quad (3.6)$$

Where γ , ζ , ξ and δ are estimated parameters, $\log(h_t)$ is the variance of the series, this makes the leverage effect exponential instead of quadratic, and therefore the estimate of the conditional variance are guaranteed to be non-negative. The EGARCH model allows for testing asymmetries, similar to TARARCH (see below). To test for asymmetries, the parameters of importance are the ξ . If $\xi_1 = \xi_2 = \dots = 0$, then the model is symmetric. When $\xi_j < 0$, then positive shocks (good news) generate less volatility than negative shocks (Daly, 2008).

3.5.2.4 Threshold GARCH (TGARCH)

The Threshold ARCH (TARCH) model was developed by Zakoian (1990). Similar to the EGARCH specification, it distinguishes between positive and negative innovations in the return process. The variance equation of TGARCH (1,1) takes the form:

$$h_t = \gamma_0 + \gamma_0 \varepsilon_{t-1}^2 + \theta \varepsilon_{t-1}^2 d_{t-1} + \delta h_{t-1} \quad \text{where } \sigma_t \sim N(0, \sigma_t^2) \quad (3.7)$$

where d_t takes the value of 1 for $\varepsilon_t < 0$, and 0 otherwise. This means ‘goods news’ and ‘bad news’ have different impacts. Good news has an impact of γ , while bad news has an impact of $\gamma + \theta$. When $\theta > 0$, one can conclude that there is asymmetry, but if $\theta = 0$ the impact news is symmetric. TGARCH models can be extended to higher order specifications by including more lagged terms, as follows (Asteriou & Hall, 2011:306):

$$h_t = \gamma_0 + \sum_{i=1}^q (\gamma_i + \theta_i d_{t-i}) \varepsilon_{t-i}^2 + \sum_{j=1}^q \delta_j h_{t-j} \quad (3.8)$$

The TGARCH model differs from EGARCH model in several aspects. Firstly, the standard deviation is modelled additively, rather than multiplicatively as in EGARCH models. Secondly, non-standardised innovations are used here in contrast to the EGARCH specification. Finally, the TGARCH model is somewhat less restrictive than the EGARCH model that imposes a constant structure on all lags. Put

differently, TGARCH allows the difference between positive and negative shocks to vary between the different lags of past residuals (Zakoian, 1990).

3.6 Conclusion

The successful transformation of political stability in 1994 has brought relief to the foreign exchange market, in which the new political regime paved the way for South Africa's integration back into the world economy. South Africa's pursuit to achieve its long-term goal of full financial liberalisation and integration into the world economy started after South Africa's government abolished the financial rand in March 1995. Since then, a single managed floating system was adopted, where the spot exchange rate of the rand is market-determined, in other words the currency is subjected to the supply and demand in a competitive foreign exchange market. All but a few exchange controls over foreigners were abolished, while exchange controls of emigrants and residents were retained. These exchange control measures in South Africa, according to the SARB (2007), had limited success in regulating the flow of capital.

Finally in February 2000, South Africa introduced inflation targeting as a new operating framework for monetary policy. The adoption of the inflation-targeting framework, allowed South Africa's exchange rate to free float. Moreover, the inflation targeting regime excludes pre-commitment to an exchange rate target, which endures more policy efficacy. For this reason, the SARB ceased its foreign exchange market interventions policy, in order to stabilise the value of the rand. The adoption of inflation targeting and the reduction in exchange controls caused a significant increase in the volatility of South Africa securities prices (bonds and stocks), as well as in the exchange rate of the rand against major international currencies.

Exchange rate volatility may, however, be perceived as a risk signal for portfolio inflow, because volatility influences wealth across multinational investors. Moreover, it makes it harder for foreign investors to predict profitability and investment costs. Thus, according to research reports, exchange rate risk or volatility counts as an important risk factor that affects the decision making of portfolio investors. It is likely that the higher exchange rate volatility, the lower the foreign portfolio inflow will be.

Even though investors have hedging derivatives at their disposal, some of these derivatives prove to be more difficult and complex than they appear. As a result, many investors opt not to hedge. This is because of the difficulty of predicting foreign exchange rate movement, as well as the various factors that have a significant impact on the exchange rate level. These factors are theoretically determined by international forces of supply and demand under a flexible exchange rate. They include interest rates, inflation, national income, capital account and monetary and fiscal policy, which are considered key macroeconomic variables in determining the level of the exchange rate. Given these different factors, there is more than one method to measure the volatility of the exchange rate. These methods include standard deviation and the ARCH family models, which have evolved over the years and reflect new advances in econometric techniques. Given these measuring methods, the aim of chapter 4 is to utilise these econometric techniques, in order to model the relationship between exchange rate volatility and portfolio inflow in South Africa.

CHAPTER 4

EMPERICAL INVESTIGATION

4.1 Introduction

The previous two chapters captured the characteristics pertaining to portfolio investment and the exchange rate respectively. These chapters laid the foundation for investigating the theoretical relationship between portfolio investments and the exchange rate. Given the importance of portfolio inflow for both macroeconomic policy and the enhancement of economic growth in South Africa, there have been surprisingly few empirical studies completed on the influence of volatility the exchange rate on a specific country's portfolio inflow. This chapter's primary objective is to shed light on this issue through an empirical examination of the nature of the relationship between exchange rate volatility and portfolio flows in South Africa.

It is therefore firstly important to review the available empirical studies on this subject in order to identify and select the appropriate variables, as well as the methods used to determine the effect of exchange rate volatility on portfolio investments. For this reason, this chapter will start with an overview of the empirical literature on the determinants that drives portfolio investments to developing countries and studies on the relationship between exchange rate volatility and foreign portfolio inflow. This will be followed by a description of the estimated procedure, after which a description of the data sampling and variables will be presented. Finally, the results and the interpretation of the results will be presented.

4.2 Determinants that drives portfolio investments

Agarwal (1997) examined the key factors that influence foreign portfolio inflow (FPI), as well as the potential impact FPI has on six of the Asian countries' national economies. The study was carried out between 1986 and 1993, since inward portfolio investments gained momentum into most Asian countries in 1986. Agarwal (1997) constructed a model that includes both push-and pull-factors (see section 2.3), which are considered as significant factors in explaining the driving force behind the inflow of foreign portfolio funds.

The first set of factors in Argarwal's (1997) equation represent pull-factors and include the real exchange rate, foreign exchange rate reserves, growth of economic activity and the gap between investments and savings. The second set of factors represents the push-factors, which is the attractiveness or profitability prospects of investing abroad. This included growth of income in developed countries, financial development, the interest rate differential between two countries and finally the behaviour of capital markets in developing countries. The equation is specified as follows Agarwal (1997):

$$\text{Foreign portfolio equity investment}_t = \text{OPEN}_t + \text{TRGAP}_t + \text{SGMCAP}_t + \text{REER}_t + \text{INF}_t + \text{IIND}_t + \text{TOR}_t + \text{INTDIFF}_t + \text{P/E}_t + \text{GDPW}_t + \text{FEXRESS}_{t-1} \quad (4.1)$$

where OPEN represented the degree of openness in an economy, I-S denoted the gap between investments and saving rates as a percentage of GDP, TRGAP represented the trade gap as a percentage of GDP, SGMCAP denoted the share of a country's capital market in the global market capitalisation, REER denoted the real effective exchange rate, INF represented inflation rate, IINDP represented the index of industrial production, TOR denoted the turnover ratio in the capital market, INTDIFF represented the difference between the interest rate differential between the United States and the given country, P/E denoted price to the earnings ratio, GDPW represented the growth rate of the world GDP and FEXRESS denoted the lag stock of foreign exchange reserves (Agarwal, 1997).

The regression results were obtained using ordinary least squares (OLS) and showed that the real exchange rate, index of economic activity, the inflation rate and the share of domestic capital market in the world stock market capitalisation, are four statistically significant determinants that explained the variance in the flow of portfolio investments to the developing countries. The model fitted the data very well and explained approximately 60% of the variation in foreign portfolio inflow (Agarwal, 1997).

The IIF (Institute of International Finance) (2013) did a similar study in which they estimated a simple econometric model to analyse the importance of push-and pull-factors that drive portfolio investments from developed countries to developing countries over the past two decades. The IIF used country-level analysis of flows to 30 major emerging market countries for the period 1990 to 2010. The explanatory variables in this study included a variety of push-and pull-factors, as well as a lagged dependent variable (that is, an autoregressive specification). Regarding push-factors, they tested different proxies for risk aversion, as well as several proxies for liquidity and global interest rates. On the pull side, the IIF tested the significance of emerging countries' inflation, real GDP growth and stock market performance. From the study above, the IIF (2013) estimated the following baseline model:

$$\text{Flows}_t = 82.1 \text{ Growth}_t - 141.8 \text{ Risk}_t - 0.79 \text{ Flows}_{t-1} \quad (4.2.)$$

The dependent variable Flows_t is emerging markets economies private capital inflows in year t , deflated by the U.S. headline CPI (consumer price index); Growth_t denoted emerging markets' real GDP growth, while Risk_t presented the U.S. corporate BBB rated spread over Treasuries. The model of the IIF revealed relatively small standard errors, but more importantly, the independent variables were statistically significant at the 1% level. The IIF (2013) furthermore, ran a series of panel regressions using the same sample of 30 emerging countries. They found that these results support the findings of emerging countries' real GDP growth and risk aversion as key driving factors in determining the flow of portfolio investments into their economy. The model fitted the data quite well and explained 68% of the variation in capital flows to developing countries, over the sample period.

4.3 Empirical studies on the relationship between exchange rate volatility and foreign portfolio inflow

While most authors concentrate on the determinants of foreign portfolio inflow, studies regarding the effect of exchange rate volatility on portfolio investments are limited. Section 3.3 already touched on the theory regarding the relationship between the volatility of the exchange rate and portfolio inflow. In summary, section 3.3 mentioned that the volatility of the exchange rate might be perceived as a risk signal

for portfolio inflow, because currency risk influences wealth across multinational investors. It also makes it harder for foreign investors to predict profitability and investment costs. Therefore, according to Ncube, Shimeles and Verdier-Chouchane (2012:22), exchange rate risk or volatility counts as an important risk factor that affects the decision-making of portfolio investors. This section goes a step further by examining previous empirical studies done on the nature of the relationship between exchange rate volatility and portfolio inflow. This includes studies conducted by Kasekende, Kitabire and Martin (1996) and Ndung'u and Ngugi (1999) who primarily focused on the flow of foreign portfolio investments and its relationship with the exchange rate.

4.3.1 Portfolio inflow

Unlike various studies conducted on the relationship between exchange rate volatility and the inflow of foreign direct investment (FDI), related research in the field of foreign portfolio investments (FPI) to emerging countries is more restricted. Most of the empirical analyses focus only on industrialised countries, perhaps due, in part, to the availability of data. Furthermore, foreign portfolio flows, in particular equity inflows to emerging countries only began in the late 1980s. One of the earlier studies done on the nature of the relationship between the volatility of the exchange rate and capital flows in the Sub-Saharan was done by Kasekende, Kitabire and Martin (1996). The study primarily focused on the short-term flow of private capital investments. They found that a surge of private capital inflow leads to a short-term exchange rate appreciations in almost all of the countries that were examined, namely, Zimbabwe, South Africa, Zambia, Uganda, Tanzania and Kenya.

A similar study on developing countries was done by Ndung'u and Ngugi (1999), who estimated a Vector Autoregression (VAR) model for Kenya and included explanatory variables such as domestic inflation, money supply, the real effective exchange rate, the real interest rate differential and the volatility of capital flows. The study revealed that the real interest rate differential and exchange rate movements explain nearly half of the forecast error variance in volatility of private capital inflows. Furthermore, the impulse response functions showed that when a unit shock occurred in the volatility of foreign capital flows, it would lead to an initial decline in

the real exchange rate. This would be followed by a consistent rise, while there were no signs of the effect dying out. The spillover effect of capital flows to the real exchange rate accounted only 7%, which implies that there was no strong feedback from the real exchange rate movements to the volatility in capital flows (Ndung'u & Ngugi, 1999).

Despite the findings above, there is still disparity in the literature on the nature of causality between exchange rate volatility and portfolio inflow. On the one hand are academics such as Aggarwal (1981) who argue that exchange rate fluctuations affect the value of firms and that such effects are exhibited in the prices of assets in the form of common stock, which are issued by firms. The same is true for bonds; according to Miyajima, Mohanty and Chan (2012), who offer fluctuations in the exchange rate contribute to a higher risk premium which affects the yield of long-term bonds. From this viewpoint, exchange rate volatility is expected to give rise to asset price changes in portfolio investments; this causal relation is known as the traditional approach (Granger *et al.*, 2000). Then again, advocates of the portfolio balance approach believe that volatility in asset prices (both bonds and equities) influence exchange rate movements. Several push-and pull-factors attract portfolio flows from foreign investors and hence cause an increase in the demand for a country's currency, which lead to an appreciation in the exchange rate (Pan *et al.*, 2007). The conflict of thoughts between researchers in their explanation of the direction of causality between portfolio inflow and the volatility of the exchange rate, reinforces the importance of investigating the nature of the relationship between these variables in the South African context.

4.4 Modelling procedure

The foregoing issues regarding the relationship between exchange rate volatility and portfolio inflow can be clarified, by following a similar process conducted by Ndung'u and Ngugi (1999), using a vector autoregression (VAR) model. VAR models have the ability to examine the inter-relationship between several economic variables, without imposing assumptions about the underlying structure of the economy. Furthermore, VAR models can be used to explain whether variable X_t predicts changes in variable Y_t in addition to the predictions already presented by lagged

values of Y_t , and *vice versa*. This implies that in the current context, it is able to determine whether the exchange rate volatility provide additional information that can explain changes in portfolio inflow beyond information already provided by lagged portfolio inflow (Asteriou & Hall, 2011).

From the VAR model, a Granger causality test can follow. The definition of causality provided by Granger (1969) has over the years formed the foundation for determining the relationship between two stationary time series. The Granger causality measure is based on the two series being stationary. Nevertheless, economic variables such as portfolio inflow and foreign exchange rates typically exhibit a random walk⁸ and are therefore non-stationary (Gujarati, 2004:800). A random walk is also known as a unit root process in time series literature. If the exchange rate is non-stationary for example, then there is no tendency for the rate to return to a constant average over time. In addition, the variance is not constant over time and an observation is correlated with its more recent lag (Coughlin & Kees, 1990). This calls for a formal testing procedure before modelling, as is explained below.

4.4.1 Unit root test

The Dickey and Fuller, and the Augmented Dickey and Fuller (ADF), methodologies are some of the most popular methods used to test for the existence of a unit root. To understand the concept behind these methodologies, consider the following first order autoregressive process, AR(1) model, of the form:

$$Y_t = \phi Y_{t-1} + u_t, \quad \text{with} \quad -1 \leq \phi \leq 1 \quad (4.3)$$

By subtracting Y_{t-1} from both sides of the equation (4.3), provides the first difference form of the random walk model, as in the following equation:

$$\Delta Y_t = (\phi - 1)Y_{t-1} + u_t$$

⁸ A series of sequential movements in which the direction and size of each move is randomly determined.

$$\Delta Y_t = \gamma Y_{t-1} + u_t, \text{ where } \gamma = (\phi - 1) \quad (4.4)$$

where $\Delta Y_t = Y_t - Y_{t-1}$ presents the first difference of the random variable Y at a certain time period t , u_t presents the white noise term at time period t . However equation 4.4 has its restrictions by ignoring the possible presence of a constant term that may cause the series Y_t to drift away from the origin (Asteriou & Hall, 2011). To account for this, two alternative specifications of the test equation are:

$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + u_t \quad (4.5)$$

The model can finally be presented in a way that allows for a drift around a trend as follows:

$$\Delta Y_{t-1} = \alpha_0 + a_2 t + \gamma Y_{t-1} + u_t \quad (4.6)$$

The standard Dickey-Fuller procedure, test the null hypothesis that $\gamma = 0$, (that is if $\phi = 1$) against the alternative hypothesis that $\gamma < 0$ (that is $\phi < 1$) for each of the above equations (4.4, 4.5 and 4.6). Rejecting the null hypothesis implies that the series is stationary. If the null hypothesis cannot be rejected, it can be concluded that the series has a unit root, meaning it is not stationary (Asteriou & Hall, 2011). The t-statistics, whose critical values originally calculated by Dickey and Fuller (1979), are used to test the null hypothesis. The standard Dickey-Fuller test assumes that the white noise terms u_t are serially correlated. If this assumption does not hold, the augmented Dickey-Fuller test (known as the ADF test) is more appropriate. Dickey and Fuller extended their test procedure by suggesting an augmented version of the test that includes extra lagged terms (p) of the dependent variable in order to eliminate autocorrelation (Asteriou & Hall, 2011). In this context, equation 4.6 is expanded to take the following form:

$$\begin{aligned} \Delta Y_t &= \alpha_0 + a_2 t + \gamma Y_{t-1} + B_1 \Delta Y_{t-1} + B_2 \Delta Y_{t-2} + \dots + B_p \Delta Y_{t-p} + u_t \\ &= \alpha_0 + a_2 t + \gamma Y_{t-1} + \sum_{i=1}^p B_i \Delta Y_{t-i} + u_t \end{aligned} \quad (4.7)$$

where $\Delta Y_{t-i} = Y_{t-i} - Y_{t-(i+1)}$ are the lagged differences.

4.4.2 Granger causality test

One of the key benefits of VAR models is that it allows one to test the direction of causality, which helps to determine the relationship between two variables X_t and Y_t , with their discrete level of lags can be captured with a VAR model. In addition, it is possible that the dependent variable Y_t can be influenced by variable X_t and *vice versa*, that there is a bi-directional feedback or that the two variables are independent (Asteriou & Hall, 2011).

The most applied procedure to test causality, as well as statistically identify the cause and effect of the relationship amongst the variables, is the Granger causality test. Granger (1969) developed a test that defines causality as follows: a variable Y_t is said to be Granger to be caused by X_t , if X_t helps to predict Y_t better by using past values of Y_t , instead of using not such past values (Asteriou & Hall, 2011).

As mentioned above (section 4.3), the Granger causality test can only be statically effective when all variables are stationary. In a two-variable model, the Granger causality test firstly involves estimating the following VAR model:

$$Y_t = a_1 + \sum_{i=1}^n B_i X_{t-i} + \sum_{j=1}^m \gamma_j Y_{t-j} + e_{1t} \quad (4.8)$$

$$X_t = a_2 + \sum_{i=1}^n \theta_i X_{t-i} + \sum_{j=1}^m \delta_j Y_{t-j} + e_{2t} \quad (4.9)$$

where it is assumed that both ε_{1t} and ε_{2t} are uncorrelated white-noise error terms. With the null hypothesis of the Granger causality test stating that X_t does not cause Y_t or $\sum_{i=1}^n \beta_i = 0$ (equation 4.8) and Y_t does not cause X_t or $\sum_{i=1}^n \delta_j = 0$ (equation 4.9).

4.5 Sampling, data collection and variables selection.

Up to this point, the research identified various push-and pull-factors explaining the flow of portfolio inflow (see section 4.2). The empirical analyses of this research consist primarily of a combination of push-and pull-factors. All the individual factors identified in section 2.3 were taken into account, as well as the empirical literature in

section 4.2, on determinants that influence portfolio inflow. Based on the examination undertaken in section 2.3, and section 4.2, the study can identify four push-factors and two pull-factors that have the potential of determining the inflow of foreign portfolio inflow to South Africa. The following pull-factors are considered as explanatory variables in the final empirical analysis; GDP, inflation, real exchange rate and turnover ratio, while the push-factors consist of interest rate differential and risk aversion (see section 2.3 for description).

4.5.1 Data description

The above procedure, as well as selection of the variables, is only as effective as the quality of the data. The quality of the data used in estimating an economic model is very important. Inaccurate statistics will influence the outcome of the model and so produce inaccurate results. It is therefore vital to consider data from a reputable institution. The data in this research was sourced from various institutions such as the South African Reserve Bank (SARB), International Monetary Fund (IMF), the Federal Reserve Bank of the US, the Chicago Board Options Exchange (CBOE) and the OANDA database. The data was collected on a quarterly basis from the period 1995 to 2012. The reason for choosing this period is that portfolio inflow only started to increase in South Africa after 1995, which was South Africa's first successful transformation of political stability and paved the way for South Africa's integration back into the world economy.

South Africa's foreign portfolio inflow (FPI), GDP and turnover ratio were all collected from the South Africa Reserve Bank database. FPI entails capital movements of liabilities of South Africa's private non-banking sector, GDP measures the size of the country's economy at constant prices in South Africa rand and finally the turnover ratio is based on stock transactions on the secondary market, which is the total value (turnover) of shares traded on the JSE. Inflation in South Africa was collected from the International Monetary Fund (IMF) database using the consumer price index (CPI). The CPI is a very effective instrument to measure inflation, as it examines the weighted average of prices of a basket of consumer goods and services.

The VIX contract is traded on the Chicago Board Options Exchange (CBOE). It is a popular indicator for risk aversion in the financial market (see section 2.3) and shows strong co-movement with measures of the monetary policy stance. The data is collected from CBOE's database, from 1995 to 2012 where the daily data were totalled to quarterly averages. The interest rate differential is determined by subtracting the US 10-Year Treasury bond yield (sourced from the Federal Reserve Bank of America) from South Africa's 10-Year Treasury bond yield (sourced from the SARB). In addition, it should be noted that the values of the variable foreign portfolio inflow are a flow of funds and that this means it may contain both positive and negative values. For taking log natural, the study added a constant to the series.

Exchange rate volatility as explanatory variable was calculated from the nominal exchange rate using the weekly Rand/Dollar exchange rate, which was collected from Oanda's data base. The real effective exchange rate was also used as an indicator of the exchange rate level. The use of real exchange rate data (sourced from SARB data base) follows the approach used by other related studies, including those of Muzindutsi (2011) and Kodongo (2011). They mention that short-term investments are normally defined as speculative investments that buy and sell assets with the goal to take advantage of favourable movements in the level of the exchange rate. In addition, they revealed that a higher level in South Africa's real exchange rate also allows foreign investors to purchase a greater number of shares with the same nominal amount of money; therefore a higher level in the real exchange rate can lead to an increase in foreign portfolio inflow.

4.5.2 Ensample volatility measurement

In order to construct exchange rate volatility as an explanatory variable, the study employed three different volatility measurements, namely the standard deviation, and the GARCH and EGARCH models. The standard deviation was calculated, as explained in equation 3.1 in section 3.5, from which the GARCH and EGARCH models followed, as explained in equation 4.3.2 and 4.3.3, respectively. According to ARCH models, the variance of the residuals in a given period is dependent on the squared error terms from the past periods. Therefore, the volatility in past periods can be captured by the lags of the squared error terms. GARCH and EGARCH

expands the traditional ARCH model to allow for the variance of the residuals to be captured by the lagged squared residual terms, and on past values of itself (see section 3.5). Therefore, the GARCH and EGARCH models capture the volatility with fewer parameters than the standard deviation model. To construct an appropriate volatility measurement, an autoregressive AR process firstly need to be conducted which was derived from a Box-Jenkins Methodology to specify the optimal AR lags. The AR model can thus be written as follow:

$$e = \alpha_0 + \sum_{i=1}^p \alpha_i e_{t-i} + \varepsilon_t \quad (4.10)$$

where e= nominal exchange rate

Furthermore, to determine the appropriate lags, it is needful to compare the models by using the Akaike Information Criteria (AIC) and the Schwartz Bayesian (SBC) Criteria. According to Bollerslev (1987), the AIC and the SBC are the most important model selection criteria to determine a parsimonious model. The AIC is determined as follow:

$$AIC = T \ln(\sum \varepsilon_t^2 + 2n) \quad (4.11)$$

where n is the number of parameters estimated. The AIC measure squared deviation of the model of the mean and the lowest AIC indicates a good fitted model. After estimating a variation of models, the AR(1) is the only model that is significant at the 5% level of significance and is therefore the best fitted model. All the Q-statistics are also insignificant in this model, meaning that the residuals are not auto-correlated and that the model is not over fitted.

From the AR(1) model, the three commonly used measures of exchange rate volatility, the conditional standard deviation, GARCH(1,1) and EGARCH(1,1) can be constructed, as indicated above. Different combinations such as the GARCH(1,2), GARCH(2,2) etc. were tested and displayed similar results as a conventional GARCH (1,1) model. The GARCH (1,1) and EGARCH(1,1) model are nevertheless preferred over the other models, since they have better, meaning smaller AIC and

SBC criteria and are also a very popular volatility measurements that are used in the academic researches such as those written by Mohammadi Su (2010), Muzindutsi (2011) and Alberg, Shalit and Yosef (2008), for example, and are commonly used in the financial industry to measure volatility. The measurements are used to determine the extent of the difference (if any) in the results produced by different volatility measures. Since GARCH methods (including EGARCH) account for data clustering, the series with GARCH methods seems to be less volatile when compared with that of standard deviation. This is reflected in Figure 4.1 below, which illustrates that the GARCH and EGARCH being relatively smoother than a conventional standard deviation.

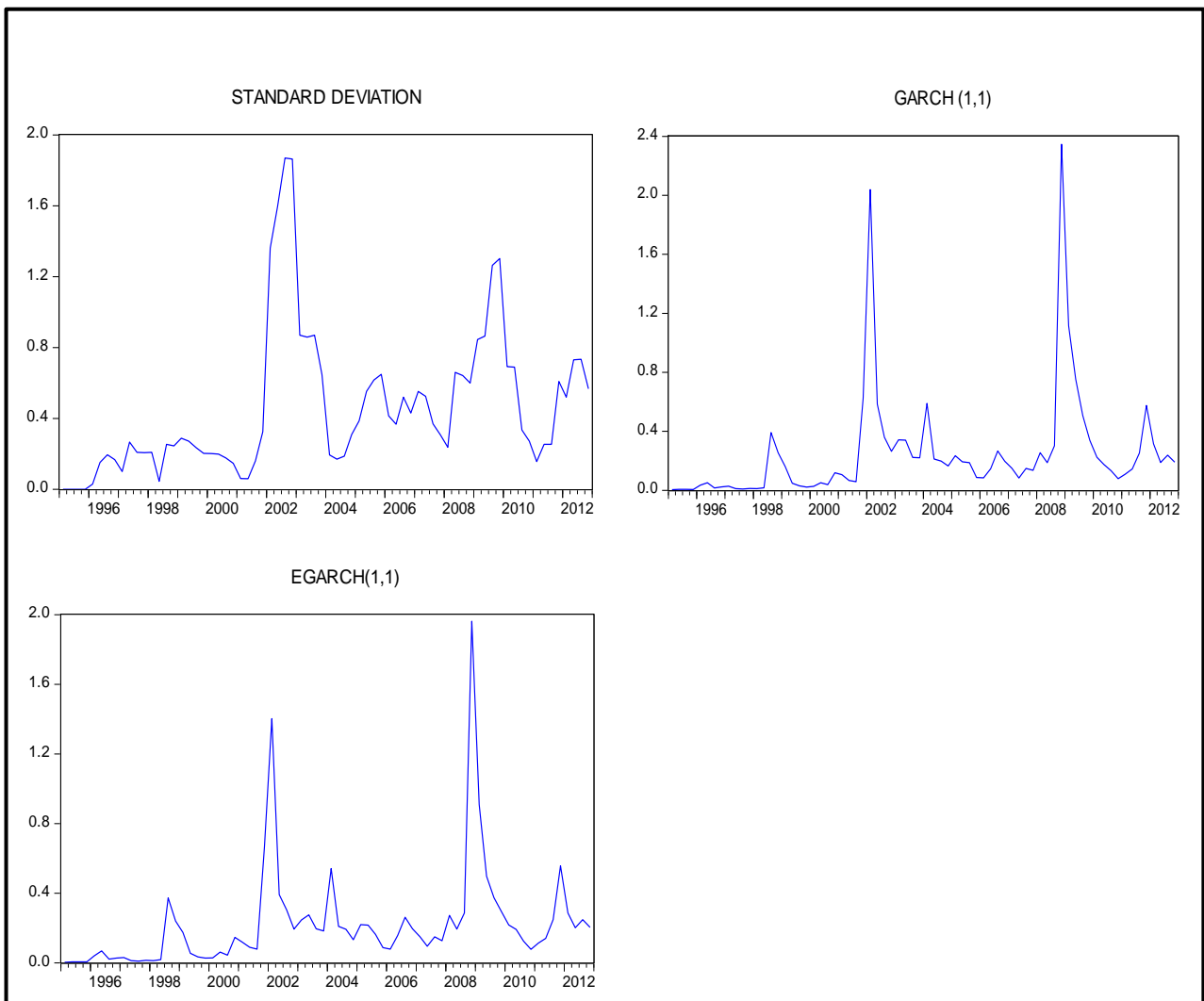


Figure 4.1: Exchange rate volatility measured by GARCH (1,1), EGARCH(1,1) and standard deviation.

Sourced: Estimated by the author with the use of EViews

4.6 Model specification

The main objective of this study is to determine the nature of the relationship between exchange rate volatility and South Africa's portfolio inflow. Unlike various studies conducted on the relationship between exchange rate volatility and the inflow of foreign direct investment (FDI), related research in the field of foreign portfolio investments (FPI) to emerging countries are more limited. In chapter 2, it was shown that the flow of portfolio investments could lead to an increase or a decrease in the level of the exchange rate.

This relationship was observed in studies such as Kasekende, Kitabire and Martin (1996) and Gossel and Biekpe (2012). On the other hand, studies done by Ndung'u and Ngugi (1999) and Ncube, Shimeles and Verdier-Chouchane (2012:22) revealed that exchange rate volatility counts as an important risk factor that affects the decision-making of portfolio investors. As mentioned in section 4.3.1, despite these findings, there is still disparity in the nature of causality in the literature between exchange rate volatility and portfolio inflow.

This section will present the empirical findings of this research on the subject by investigating the nature of the relationship between exchange rate volatility and South Africa's portfolio inflow for the period 1995 to 2012 by using a VAR specification. For the purpose of this research, portfolio inflow is seen as being influenced by the following set of variables, which represents a combination of both push-and pull-factors:

- Exchange rate volatility,
- Gross domestic product (GDP),
- Inflation,
- Real exchange rate,
- Turnover ratio,
- Interest rate differential, and
- Risk aversion.

These variables as well foreign portfolio inflow are represented as the vector x_i in equation 4.12 below. Equation 4.12 presents the VAR n-matrix algebra model which, when rewritten from the standard bivariate model, takes the following form:

$$X_t = A_0 + A_1 X_{t-1} + e_t \quad (4.12)$$

where A_0 is the vector of intercepts, A_1 is equal to an $n \times n$ -matrix containing the estimated parameters (B's) and e_t , a vector of independent and identically distributed error terms. As mentioned in section 4.2, VAR models can be used to explain whether variable X_t predicts changes in variable Y_t in addition to the predictions already presented by lagged values of Y_t , and *vice versa*. The data for all the variables, except for the exchange rate volatility was transformed using natural logs logged.

Figure 4.2 presents a visual display of the basic relationship between quarterly foreign portfolio inflow and the volatility of the exchange rate (for graphical purposes, the GARCH(1,1) is used). Graphical analysis is commonly used to conduct a preliminary investigation of the data and so assist in identifying any form of relationship or trends in the data set (Settimi *et al.*, 2005). Overall, the scatter plot does show some sort of relationship between the volatility of the exchange rate and portfolio inflow. This graphical analysis needs to be formally tested in an econometric model that has proper and suitable controls for other factors, as illustrated in Figure 4.2 below. Further evidence illustrated by Figure 4.3, shows that portfolio inflow does not have a tendency of an upward trend or a high level of fluctuation. This suggests that both portfolio inflow and the exchange rate volatility may follow a stationary process; however this needs to be verified using unit root test, as discussed in the next section.

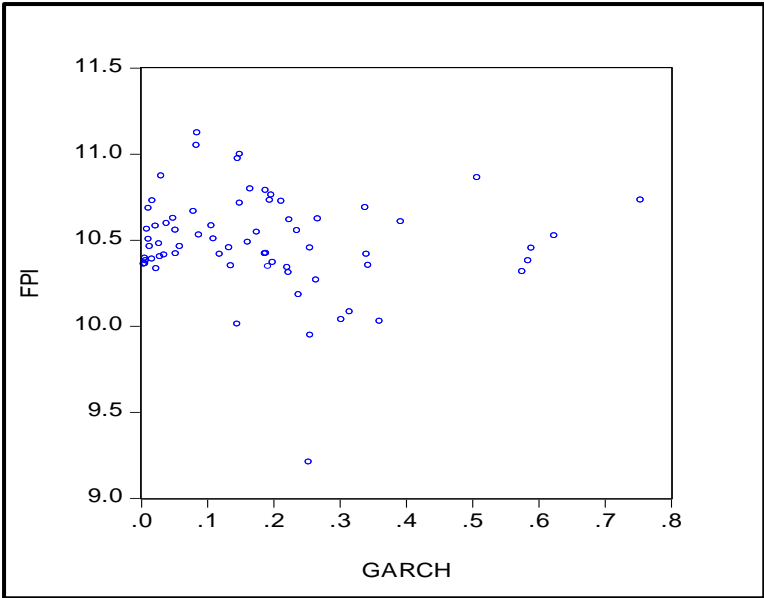


Figure 4.2: Scatter plot of the basic relationship between exchange rate volatility and foreign portfolio inflow

Source: Estimated by the author with the use of EViews

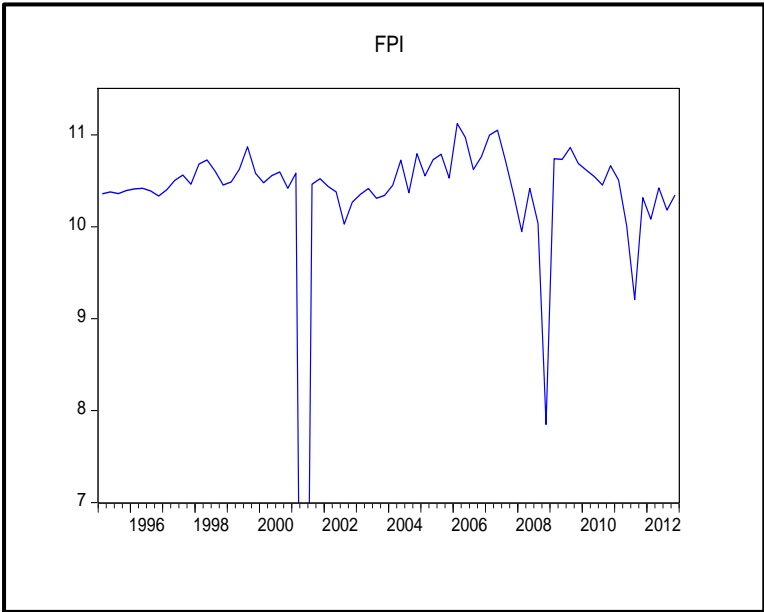


Figure 4.3: Line plot of foreign portfolio inflow over time

Source: Estimated by the author with the use of EViews

4.7 Unit root test results

It has been stated (in section 4.3) that the Augmented Dickey Fuller test is one of the most popular methods used to test for the existence of a unit root and to check whether a series is stationary. As a result, the ADF tests for stationary of the variables in the levels and in the first differences. The results for all the test equations (intercept, trend and intercept and none) are summarised in Table 4.1 below.

Table 4.1. Results from the ADF unit root test

Variables	Level			First Difference		
	Intercept	Intercept and Trend	None	Intercept	Intercept and Trend	None
FPI	<0.001	<0.001	0.5694		-	-
SDV	<0.004	<0.007	<0.002	-	-	-
GARCH	<0.001	<0.001	<0.001	-	-	-
EGARCH	<0.001	<0.001	<0.003	-	-	-
GDP	0.9675	0.1905	0.9968	<0.03	0.12	0.07
INFL	0.8903	0.2575	1.000	<0.001	<0.001	<0.01
IRD	0.4784	0.8338	0.3627	<0.001	<0.001	<0.001
RA	0.0413	0.1718	0.6373	<0.001	<0.001	<0.001
REXRATE	0.1283	0.3620	0.5120	<0.001	<0.001	<0.001
TOR	0.0617	0.4951	0.9995	<0.001	<0.001	<0.001

Source: Estimated by the author with the use of EViews

A rejection of the null hypothesis under the ADF means there is no presence of a unit root in the series and that the series is, in fact, stationary. Given Table 4.1, the estimated values for FPI, SDV, GARCH and EGARCH are more than the critical values at the 1% level of significance for all test equations. This means that these variables are already stationary in levels. The ADF estimated values for; INFL, IRD, RA, REXRATE TOR and GDP are less than the critical values at the 5% level of significance. Thus the ADF fails to reject the null hypothesis (for both variables) at the 5% level of significance.

Based on the ADF test, it is concluded that these variables are not stationary in levels and need to be first difference. Based on the first difference, the ADF test concludes that all the variables; INFL, IRD, RA, REXRATE, TOR and GDP (GDP is significant at an intercept) are stationary in their first difference, that is, all the variables are $I(1)$. Since foreign portfolio inflow is not integrated of the same order, it is not expected that a long-run relationship exists between foreign portfolio inflow and the other independent variables. The study focuses specifically on the causal relationship between foreign portfolio and the exchange rate volatility. By using an impulse response between these two variables, it is able to control for the short-run effect. For explanation purposes between the different pull-and push-factors, the study also takes the first difference foreign portfolio inflow, that is, quarterly growth in portfolio inflow as a dependent variable.

4.8 Selection of the Lag Length

One of the criteria of a VAR model is to select the optimal lag length. The difficulty of choosing the optimal lags is that too few lags mean that the regression residuals do not behave like a white-noise process, whereas too many lags reduces the power of the test to detect a unit root (Enders, 2004:191). To ensure that the optimal number of lags is selected, the study makes use of various information criteria to identify the lag length. According to Brooks (2002:257), the types of information criteria include Akaike's (1974) Information Criterion (AIC); Schwarz's (1978) Bayesian Information Criterion (SBC); and The Hannan-Quinn Information Criterion (HQC) (see section 4.4.2). Based on the different information criteria, it was found that the optimal number of lags is four. Not only did the AIC and SBIC display the lowest value, the

adjusted R-squared also proved to be the highest, when including four lags, which is consistent with the findings of Abdalla and Murinde (1997:30), who pointed out that the adjusted R-square can also be viewed as an information criterion when these techniques suggest different lag lengths.

4.9 Structural breaks results

To formally determine the existence of structural breaks in the foreign portfolio inflow series, the study conduct a CUSUM test on parameters from the regression series on its own intercept and trend. The test was firstly introduced by Brown, Durbin and Evans (1975), and is based on the cumulative sum of the recursive residuals. By plotting the cumulative sum together at critical lines of 5%, instability of the parameters could be detected, if the cumulative sum moves outside the area between the two critical lines. The CUSUM test on foreign portfolio inflow of South Africa indicates no sign of variance instability or the presence of structural breaks (see Figure 4.4 below). The study conduct a one-step forecast test as well, to identify the specific breakpoint in the time series data. In contrast to the CUSUM test, the one-step forecast test detected a potential structural break in the time series data (see Figure 4.5). The higher part (right vertical axis) reveals the standard errors and recursive residuals. The lower part (left vertical axis) reveals the probability values for those sample points, where the null hypothesis of the parameter consistency would be rejected at the 5, 10 or 15% levels. The points however, with probability values less than 0.05 do not correspond to the point where the recursive residuals go outside the standard error bounds, implying that there is no structural break in the time series data.

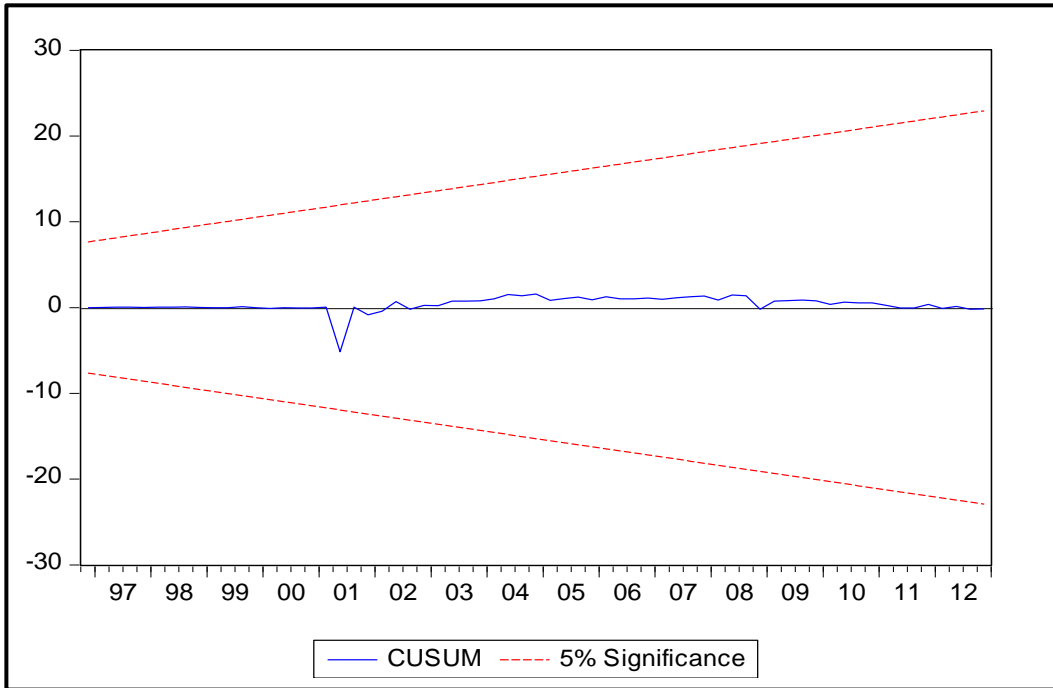


Figure 4.4: CUSUM structural break test
 Source: Estimated by the author with the use of EViews

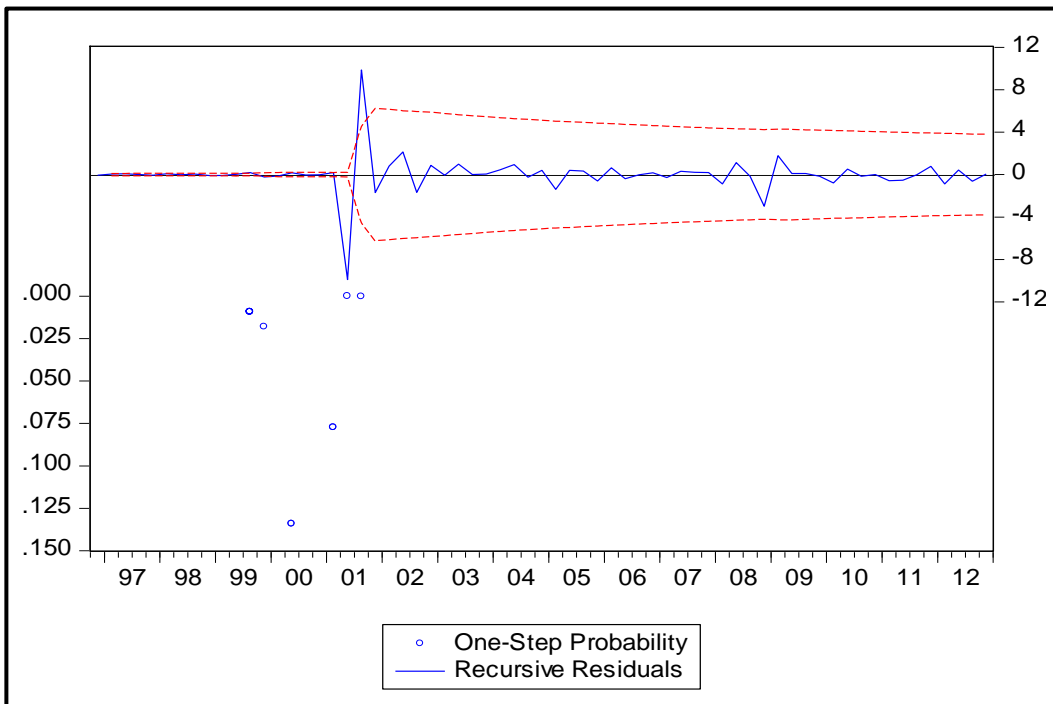


Figure 4.5: One-Step structural break test
 Source: Estimated by the author with the use of EViews

To confirm the findings of the one-step forecast test, the Chow structural break test can be used. The Chow structural break test divides the sample into two sub-samples. The first sub-sample runs from quarter one of 1995 to quarter two of 2001, while the second sample runs from quarter three of 2001 to quarter four of 2012. This is not surprising, since the potential structural break seems to be noticeable at quarter three of 2001 (see Figure 4.4). This particular date could be related back to the catastrophic events sometimes known as “Nine-eleven”. The sharp reversal in portfolio flows, however, started in 2000, which led to currency speculators and foreign investors to realize that a decrease in the value of the rand was imminent.

According to McKenzie and Pons-Vigon (2012), this led to a flight from rand-based assets that consequently led to panic and still further flight. By the end of 2001, portfolio inflows crashed and the ZAR/USD exchange rate dropped by 35%. The results of the Chow structural break test (see Table 4.2 below) confirms that the probability value of the F-distribution ($F_{9,52}$) are greater than 5%. The null hypothesis of no breaks can therefore not be rejected. This means there is significant evidence that there are no structural breaks in the parameters at the 5% and 1% levels of significance (see Table 4.2).

Table 4.2: Chow structural break test

Chow Breakpoint Test: 2001Q3			
Null Hypothesis: No breaks at specified breakpoints			
Varying regressors: All equation variables			
Equation Sample: 1995Q2 2012Q4			
<hr/>			
F-statistic	0.830844	Prob. F(6,59)	0.5509
Log likelihood ratio	5.758968	Prob. Chi-Square(6)	0.4507
Wald Statistic	4.985063	Prob. Chi-Square(6)	0.5457
<hr/>			

Source: Estimated by the author with the use of EViews

4.10 Estimation and Model Results

Chapter 3 mentioned that different methods in measuring volatility have been developed over the years and that there is no clear dominant approximation to measure volatility. The different estimated models based on a volatility measurement (GARCH (1,1) EGARCH (1,1) and standard deviation) are used in this section to determine the relationship between exchange rate volatility and foreign portfolio inflow. Even though the models are relatively similar, the outcome can be biased, if it is not examined individually, as the results of the relationship between the exchange rate volatility and portfolio inflow could be influenced by the method of measuring the exchange rate volatility.

The push-and pull-factors identified in section 4.5 and used in this analysis can be related back to section 2.4, which examined each of these variables having a distinctive relationship with foreign portfolio inflow. Following from the above models, the research anticipates a positive relationship between foreign portfolio inflow and South Africa's GDP. Foreign investors, particularly long-term investors, find higher domestic growth appealing, since it is an indication of growth within the different sectors of the economy. South Africa is likely, therefore, to provide a higher rate of return on their investments, while at the same time reducing risk to their diverse portfolio, due to higher economic growth.

In terms of the real exchange rate, a positive relationship is expected between foreign portfolio inflow and South Africa's real exchange rate. This is due to an inverse relationship that exists between the volatility of the exchange rate and excess U.S. dollar returns on portfolios, captured by the negative foreign exchange risk factor loadings. U.S. dollar returns on South African portfolios have a tendency to increase with dollar depreciation, meaning an appreciation in South Africa's local currency. Factor loadings are generally higher for the exchange rate factor than they are for the world equity market factor, implying that portfolio returns are more sensitive to changes in foreign exchange rates. The turnover ratio is just as important in determining the inflow of foreign portfolio investments to South Africa. According to Bhaskaran, Sundararajan and Kohli (2005), it is a significant indicator in measuring the development of a country's stock market. Therefore, a positive

relationship should be anticipated between foreign portfolio inflow and South Africa's stock market turnover ratio. Foreign investors are attracted to high trading markets which provide liquidity, because this liquidity enables investors to buy assets or divest their positions with ease.

Risk aversion, on the other hand, is measured by VIX, a familiar proxy used in the financial world, that determines any tension or uncertainty rising within global financial markets. The research expects a negative relationship between South Africa's foreign portfolio inflows and risk aversion, since risk aversion is associated with uncertainty and tension within the financial market that could lead to a significant flight-to-quality by foreign investors. Interest rate differentials are perhaps one of the key factors that have a significant effect on the composition and the volume of portfolio inflow. When there is a rise in US interest rates, it has the tendency to decrease the share of South Africa short-term portfolio inflows. This is because interest rate differentials influence the expected rate of return on investments of foreign investors. Thus, from the above models, a positive coefficient will illustrate an increase or wider spread between South Africa and the US 10 Year Treasury bond yield and *vice versa* (the variable interest rate differential is the difference between South Africa's 10 Year Treasury bond yield and the US 10-Year Treasury bond yield).

The variable inflation has a similar effect to tax, since it reduces investors' capital return and is particular harmful for portfolios that consist mainly of fixed income investments (see chapter 2.3.2). Many studies, such as those of Sturges (2000) and Ibbotson *et al.* (1982), used inflation in explaining the inflow of foreign portfolio investments, and revealed that inflation has a negative effect on both the stock and long-term bond markets in most countries. However, including inflation in the model might lead to multicollinearity, due to a high correlation between inflation and interest rate differential (see Table A1 in Appendix). Multicollinearity increases standard errors of the coefficients; increased standard errors in turn mean that coefficients for some independent variables may be statistically insignificant while they should be otherwise significant (Asterious & Hall, 2011). Typically, there is an inverse relationship between interest rates and inflation of a country. For example, if interest

rates are low, money is easier and cheaper to borrow, causing increased demand and price pressure in an economy.

Exchange rate volatility is a key variable in this study and captures the uncertainty or risk faced by foreign investors, which may have a significant impact on the decision-making process of portfolio investors. Based on the research thus far, the study identified two potential outcomes;

- Firstly, a positive relationship between exchange rate volatility and foreign portfolio inflow can be expected. It is possible that foreign investors risk appetite may increase in line with the volatility of exchange rate by seeking higher a return on their capital. This outcome is normally associated with speculative investors that buy and sell assets with the goal being to take advantage of favourable exchange rate movements (World Bank, 2013).
- Secondly a negative relationship can be expected between exchange rate volatility and foreign portfolio inflow to South Africa. One of the reasons is that foreign investors perceive currency risk as a source of non-diversable risk, which makes foreign investments more risky relative to domestic investments. Therefore, it is likely that the higher the exchange rate volatility, the lower foreign portfolio inflow will be (see section 3.3). The results of the various VAR models for volatility variables are summarised and presented in Table 4.3 below (for a full view of the VAR models, see Appendix A Table A3-A5).

Table 4.3: Results of the VAR (reporting the FPI equation only)

	Lag	EGARCH	SDV	GARCH
Exchange rate volatility	1	3.019***	3.902***	2.80***
		(3.188)	(3.211)	(3.77)
		0.680	1.21	0.74
Real exchange rate	1	10.747**	11.62**	10.39**
		(6.326)	(1.78)	(1.75)
		1.69	6.509	5.92
Turnover ratio	2	3.127**	3.13**	3.24**
		(1.70)	(1.69)	(1.79)
		1.83	1.85	1.90
	3	4.01**	3.82**	4.95***
		(2.23)	(2.10)	(2.61)
		1.79	1.81	1.89
	4	5.46***	5.32***	5.52***
		(3.00)	(2.91)	(2.94)
		1.81	1.82	1.87
Interest rate differential	1	3.99*	3.70*	2.69
		(1.46)	(1.37)	(1.03)
		2.69	2.69	2.59
	2	-4.60**	-5.19**	-5.30**
		(-1.72)	(-1.91)	(-2.11)
		2.69	2.70	2.50
Risk aversion	1	-3.09**	-3.04**	-3.22**
		(-2.18)	(-2.11)	(-2.25)
		1.34	1.44	1.43
	2	-3.83***	-3.56***	-3.96***
		(-2.84)	(-2.61)	(2.88)
		1.35	1.36	1.37
Adjusted R-Square		0.480	0.470	0.482

The table reports VAR coefficients, t-stats and standard error, in percentage *, **, *** indicate statistical significance at 10%, 5% and 1% level of confidence respectively. Figure in () are t-stats and the figures below, the standard errors. Observations run from 1995Q1 to 2012Q4.

Sourced: Estimated by the author with the use of EViews

Together, the models (with the exchange rate volatility measured by GARCH, EGARCH and standard deviation) revealed that exchange rate volatility at one lag has a positive impact on portfolio inflow. The effect is significant at a 1% level of confidence, meaning an increase in the exchange rate volatility is associated with an increase in portfolio inflow of 2.80% (according to the GARCH model), 3.01% (EGARCH model) and 3.90% (standard deviation) respectively. The coefficients of the different models show that exchange rate volatility has a positive significant

impact on portfolio inflow, irrespective of the volatility measurement. There seems to be no significant difference in the coefficients of the GARCH (with a coefficient of 2.80), EGARCH (with a coefficient of 3.01) and the standard deviation (with a coefficient of 3.91) respectively. However, the coefficient of the standard deviation measures a slightly higher volatility than those of the GARCH and EGARCH. This reflects the fact that both EGARCH and GARCH model series account for data clustering, and this displays a relatively smaller volume of volatility. The effect of exchange rate volatility with GARCH and EGARCH is 2.80 and 3.01, respectively, which is slightly lower than the 3.90 produced by the standard deviation measurement. In addition, the positive relationship between exchange rate volatility and foreign portfolio inflow implies that the risk appetite increase by foreign investors is driven largely by international investors' appetite for short-term speculative gains. International portfolio flows to African countries exhibit high volatility and low persistence, characteristics that qualify them to be described generally as "hot money" (Sula & Willett, 2009). (The Granger causality test as well as the impulsive responses will shed further light on this outcome, see section 4.9 and 4.10).

The coefficient of South Africa's GDP is not significant at any of the lag nor at any confidence level. However, the GDP of South Africa is still a determining factor in the model since it has a significant impact on the model's adjusted R-square. The result implies that even though GDP is not significant, it may be significant for foreign investors with a long-term perspective, as opposed to short-term investors or speculators, who do not take GDP into consideration as such investors are seeking profit opportunities. As expected, the final model also showed that the level of the exchange rate has a positive and statistically significant effect on foreign portfolio inflow. Each of the models are statistically significant at a 5% level of confidence, an increase in the real exchange rate is associated with an increase in foreign portfolio inflow by 10.39%, 10.74%, and 11.62% for each of the respective GARCH, EGARCH and standard deviation models. This indicates that there is evidence of short-run dynamic relation between the real exchange rate and foreign portfolio inflow.

The turnover ratio exhibits a positive and statistically significant effect on foreign portfolio inflow at lag 2, 3 and 4 for all models. The GARCH model reveals that an

increase in the turnover ratio in South Africa's stock market is associated with a 3.24% increase at two lags, 4.95% at three lags and a 5.52% at four lags in foreign portfolio inflow. This is also relevant to both the EGARCH and standard deviation models, which exhibit a statistically significant effect at lag 2, 3 and 4 respectively, with an increase of 3.12% and 3.13 % at two lags, 4.01% and 3.82% at three lags and 5.46% and 5.32% at four lags for the EGARCH and standard deviation respectively. These statistical results support the findings of Bhaskaran, Sundararajan and Kohli (2005), that market liquidity (measured by the turnover ratio) is a key factor that influences the inflow of portfolio capital to developing countries, because it enable foreign investors to buy and sell their assets with ease in the trading market.

In line with the expectation, the final model also showed that interest rate differential has a positive and statistically significant effect on foreign portfolio inflow at lag 1. The EGARCH and standard deviation shows a 10% level of significance at lag 1, whilst the GARCH does not exhibit any level of significance. This implies that an increase in the spread of interest rate differential (South Africa's 10-Year Treasury bond yield exceeded the US 10-Year Treasury bond yield) is associated with an increase in foreign portfolio inflow of about 3.99% and 3.70% at lag 1 for the EGARCH and the standard deviation model respectively. The second quarter (lag 2) exhibits a negative and statistically significant effect on foreign portfolio inflow at a 1% level of confidence for all VAR models, implying that the interest rate differential spread has a tendency to narrow in the second quarter. This is in line with the various studies conducted by, amongst others, Moore, Nam, Suh and Tepper (2013), Bhaskaran, Sundararajan and Kohli (2005), Montiel and Reinhart (1999) and Brink and Viviers (2003), all of which emphasise the potential impact that foreign interest rates have on the inflow of foreign capital. When there is a decrease in US interest rates, it has the tendency to increase the share of short-term and portfolio inflows to other developing countries, and this includes South Africa.

In terms of risk aversion, an increase in risk expectation or periods when market tension is building up (measured by the VIX) will have a negative impact on foreign portfolio inflow. All the models produce a negative coefficient at a 5% level of significance at lag one and a 1% level of significance at lag 2. This indicates that a

an increase in risk aversion is associated with a decline in foreign portfolio inflow of an average of 3.12% at one lag and an average of 3.78 at two lags for all relevant models (this includes each of the GARCH, EGARCH and standard deviation models). These empirical results are also consistent with those of Ederington and Golubeva (2010) who indicated that when the VIX increased there was a tendency amongst foreign investors to rebalance their portfolios.

The VIX is an overall risk measurement used in the international financial markets, while the volatility of the exchange rate can be perceived as a country specific risk measurement. The volatility of the exchange rate captures the uncertainty of risk sentiments within a country's macroeconomic and political policy. For example, when foreign investors in general try to rebalance their portfolios by rebalancing their equities out of the stock market, or liquidate them, when they perceive future risk to rise, prices of equities will drop and expected future returns will rise. It depends on the investor's risk aversion attitude to decide whether to invest in equities or not once there is a perception that risk is increasing. From South Africa's perspective, the results reveal that an increase in VIX will lead to a decrease in South Africa's portfolio inflow.

Overall, the final model produced an adjusted R-squared of about 0.48 for both GARCH and EGARCH models and a 0.47 for the standard deviation. All the VAR models produce similar results, meaning that there are no distinct differences between the volatility methods used to determine the relationship between the exchange rate volatility and foreign portfolio inflow into South Africa. The results are therefore robust.

4.11 Granger causality test results

From a portfolio perspective, the fluctuations in portfolio inflow into South Africa do seem to be able to explain future changes in the volatility of the exchange rate. This is consistent with the Granger causality test findings, where there is evidence of a bidirectional causal relation from foreign portfolio inflow to exchange rate volatility (see Table 4.4 below).

Table 4.4: VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: DFPI

Excluded	Chi-sq	df	Prob.
DGDP	1.264578	4	0.8674
DIRD	5.848670	4	0.2107
DRA	11.85664	4	0.0184
DREXRATE	5.762224	4	0.2176
DTOR	12.50537	4	0.0140
GARCH	19.22154	4	0.0007
All	38.54258	24	0.0305

Dependent variable: GARCH

Excluded	Chi-sq	df	Prob.
DFPI	8.326215	4	0.0503
DGDP	1.760800	4	0.7796
DIRD	1.546070	4	0.8185
DRA	4.412247	4	0.3531
DREXRATE	1.858603	4	0.7617
DTOR	0.852699	4	0.9312
All	18.88334	24	0.7582

Dependent variable: DFPI

Excluded	Chi-sq	df	Prob.
DGDP	2.153525	4	0.7075
DIRD	4.764750	4	0.3123
DRA	11.39300	4	0.0225
DREXRATE	4.145334	4	0.3867
DTOR	12.16264	4	0.0162
EGARCH	19.04943	4	0.0008
All	38.31236	24	0.0322

Dependent variable: EGARCH

Excluded	Chi-sq	df	Prob.
DFPI	39.54429	4	0.0000
DGDP	6.122123	4	0.1902
DIRD	3.883873	4	0.4219
DRA	4.052860	4	0.3989
DREXRATE	6.799242	4	0.1469
DTOR	0.815520	4	0.9364
All	58.07300	24	0.0001

Dependent variable: DFPI

Excluded	Chi-sq	df	Prob.
DGDP	2.274231	4	0.6855
DIRD	5.253237	4	0.2623
DRA	10.61823	4	0.0312
DREXRATE	4.181764	4	0.3820
DTOR	11.37899	4	0.0226
SDV	17.88445	4	0.0013
All	36.75402	24	0.0463

Dependent variable: SDV

Excluded	Chi-sq	df	Prob.
DFPI	27.14063	4	0.0000
DGDP	5.828638	4	0.2123
DIRD	3.273339	4	0.5132
DRA	2.914979	4	0.5722
DREXRATE	8.061387	4	0.0894
DTOR	0.751516	4	0.9448
All	44.51357	24	0.0066

Source: Estimated by the author with the use of EViews

Overall, the results for all VAR models indicate a short-run dynamic relationship between the exchange rate volatility and foreign portfolio inflow to South Africa. Results in Table 4.4 show that the null hypotheses for no causality in both variables are rejected.

This form of short-run causality can be interpreted between two macroeconomic variables, which are effected by both country-specific and time-varying effect. The country-specific nature of the relationship can be clarified by idiosyncrasies or characteristics around foreign investors' attractiveness to a certain country's capital markets. This includes foreign investors' perceived openness to international capital flows, accounting practices, legal structures and the levels of state control. In South Africa's case, capital markets exhibit a high level of sophistication amongst other developing countries and so are likely to be perceived by foreign investors as more accessible. Regarding the time-varying effect, South Africa's characteristics as a country may also explain the time-varying nature of causality of its portfolio inflow and exchange rate volatility, since this phenomenon can be attributed to the changes in South Africa's exchange rate and exchange control policies since March 1995 (see section 3.2.4).

4.12 Impulse response analysis

To further examine the short-run dynamic relations between exchange rate volatility and foreign portfolio inflow, an impulse response function can be used to show how each of these variables respond to each another when a one-unit shock presents itself. It is evident that all three volatility measurements provide similar results. A number of observations can be made from Figure 4.6. First, a one-unit shock in net portfolio flows has a little effect on the volatility of the exchange rate. Theory suggests the effect exerted on the volatility of the exchange rate by a one-unit shock in foreign portfolio flows is largely in the form of an appreciation (decrease in the nominal value of the exchange rate). This is in line with economic theory that an inflow of portfolio investments can lead to an appreciation in the exchange rate, due to an increasing demand for South-Africa's currency. Secondly, a one-unit shock in volatility elicits a large response to net portfolio inflow. This large effect can be ascribed to speculators reacting to profit taking or arbitrage opportunities presenting

itself in the market. It is evident this leads to a sudden spike in foreign portfolio inflow before it dies out again.

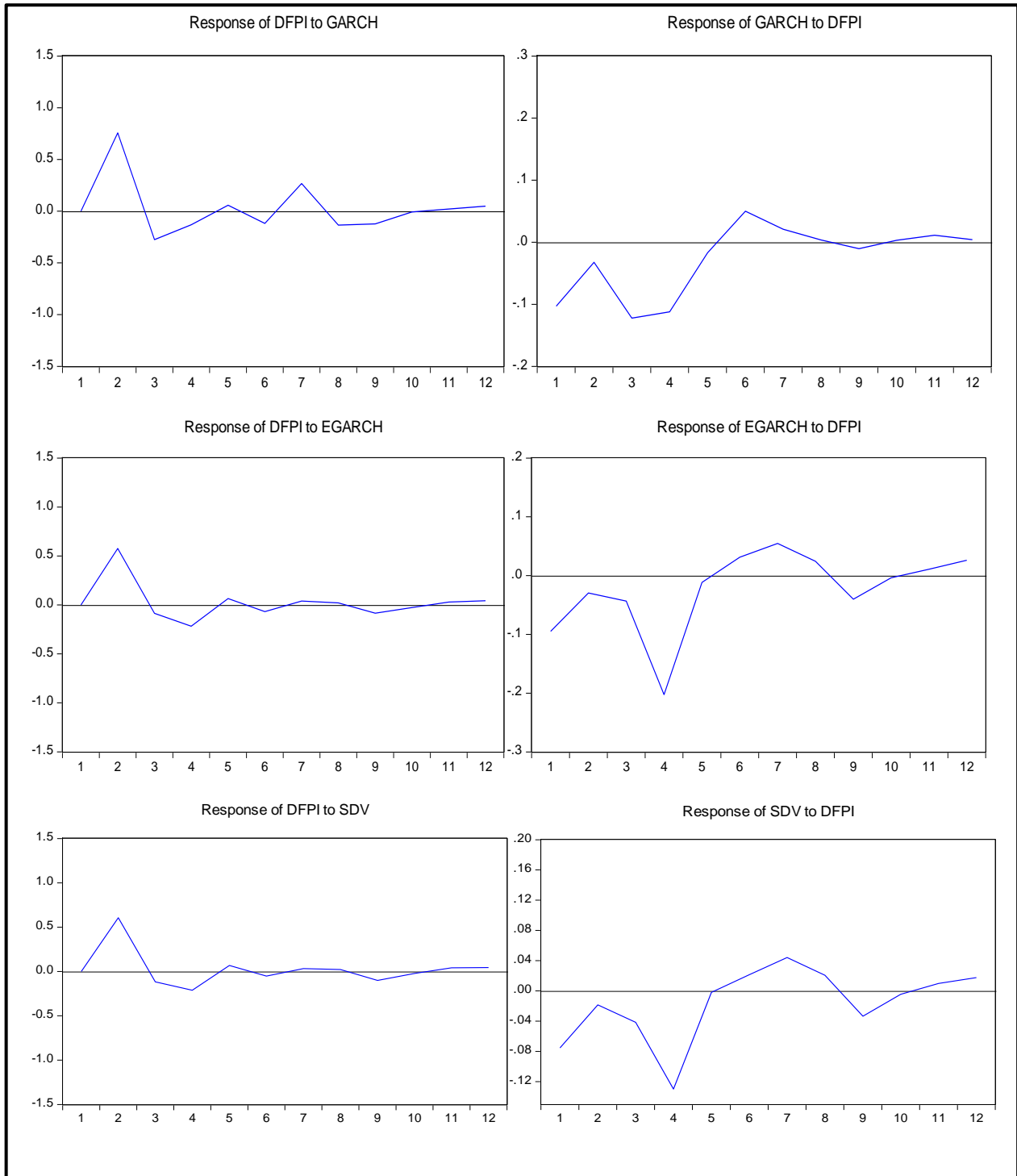


Figure 4.6: Impulse responses of one variable to a one unit shock in error terms of the other variable

Sourced: Estimated by the author with the use of EViews.

In general, the results obtained from the impulse response function are parallel to the Granger causality test results, meaning that it is possible to make decisive inferences that can be generalised about the nature of causality that exist between the volatility of the exchange rate and the inflow of portfolio investments to South Africa.

To provide additional evidence on the persistence of foreign portfolio inflow to South Africa, an impulse response analysis was done. This shed light into how a one-unit shock in the error terms of foreign portfolio flows propagate themselves on foreign portfolio flows over time. The results are displayed in Table A2 in Appendix A. It indicates that the half-life of foreign portfolio inflow (the amount of time it takes for the shock to lose half or more of its initial value) takes approximately one month. Meaning, it takes a month or less for the effect of a shock on foreign portfolio flows to dissipate. In conclusion then, the short memory of foreign portfolio inflow makes it reasonable to conclude once more that there is a lack of persistence in foreign portfolio inflows to South Africa. This seems to support the presence of the “hot money” phenomenon in portfolio investments.

4.13 Summary

In conclusion, the research based on quarterly data between 1995 to 2012 finds that there is a statistically significant relationship between exchange rate volatility and foreign portfolio inflow to South Africa. However, the nature of the relationship between exchange rate volatility and foreign portfolio inflow to South Africa’s capital markets can be described as country-dependent and time-varying. South Africa’s portfolio inflow exhibits high volatility and low persistence that are characteristics that qualifies them to be described generally as “hot money”, largely driven by foreign investors’ appetite for short-term speculative gains. In general, these findings correspond with those of Sula and Willet (2009), who find that both private loans and portfolio inflows are more reversible (volatile) than are foreign direct investments in developing countries.

Each of the VAR models with its own distinctive volatility measurement (GARCH, EGARCH and standard deviation) revealed that exchange rate volatility has a positive impact on foreign portfolio inflow (significant at a 1% level of significance). Moreover, the objective of the study sought to determine the causal relationship between the observed variables. The study identified the presence of bidirectional causality between the exchange rate volatility and foreign portfolio inflow to South Africa for each of the VAR models. The study revealed that net portfolio flows are associated with exchange rate appreciation and the impulse response analysis showed that the effect of a 1 % shock in exchange rate volatility is much larger for foreign portfolio inflow than the other way around. This means the results support the portfolio balance theory, that foreign portfolio flows should exert influence on exchange rate movement.

This is however in contrast to the findings of Morrissey *et al.* (2004), who offered that neither non-permanent (for example, portfolio investments, loans etc.) nor permanent (FDI, grant etc.) capital inflows have a short-run effect on the exchange rate movements. They also believed that both non-permanent and permanent capital inflows have a significant effect on the appreciation of the exchange rate in the long-run, but that the level of the appreciation is, to some extent, greater for permanent inflows than for non-permanent inflows. Finally, the results of this research differs from those of Ndung'u and Ngugi (1999), who find only a weak response or feedback from exchange rate volatility to Kenya's capital flows movement.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

Portfolio inflow into South Africa is comprised of short-term investments in South African assets that are mainly traded on the JSE and the South African bond market and are therefore, per definition, highly unstable. This is because portfolio investments are easily reversible, which explains why financing the current account deficit in this way may not be sustainable in the long-run, and accordingly may prevent the country from achieving higher sustainable economic growth. The risk associated with this is that when foreigners' expectations of South Africa shift due to any form of instability or risk within the country, or even because of events in the international economy, it leads to massive withdrawal or outflow of funds. This uncertainty or the risk perceived by foreign investors is potentially captured in the volatility of the exchange rate. However, the relationship between the exchange rate and portfolio inflows may be twofold; on the one hand, volatility may signal riskiness, while on the other hand, portfolio withdrawals may be the cause of this volatility. The main objective of the study was to determine the nature of the relationship between exchange rate volatility and portfolio flows in South Africa, with the aim to shed light on this relationship and the extent to which volatility in the exchange rate affects South Africa's portfolio inflow.

This information will be informative to South Africa's policymakers. The main reason for South Africa's high current account deficit is due to the absence of a sufficiently large domestic savings base. Largely due to this shortfall, traditionally, South Africa's net portfolio inflow has been utilised to finance a significant proportion of its current account deficit.

Over the period of 2004 to 2008, the level of domestic savings decreased substantially in South Africa and in 2012, it fell to less than 13% of gross domestic product (GDP), which initially was 18% of GDP at the end of 2010. This is a result of deterioration in both the government and the private sector's savings rate. For the past decade, South Africa's savings rate has been weak, despite the sharp increase in the country's terms of trade and booming export commodity prices. Usually, these

factors will improve the savings rate; yet that has not been the case and, instead, the extra gains have been consumed (Bisseker, 2013). As a result, South Africa consumes more than it saves, resulting in a current account deficit. Such a low level of aggregate savings made South Africa reliant on foreign capital inflows to fund the higher levels of investment that underpinned higher rates of growth (Linde, 2009:2). South Africa has become more dependent on portfolio inflow to finance the low savings rate.

In order to reach the objective of the study, namely, to shed light on the relationship between portfolio inflow and exchange rate volatility in South Africa, the following goals were set:

- 1) To define portfolio inflow in the South African's context;
- 2) To explore the characteristics of portfolio inflow concerning the following;
 - a. The benefits and consequences of portfolio inflows; and
 - b. The trend of portfolio inflow into South Africa's equity- and bond markets;
- 3) To investigate the unique push-and pull-factors on portfolio inflow;
- 4) To evaluate the transformation of South Africa's exchange rate regime since the abolishment of the Bretton Woods era in 1974;
- 5) To theoretically establish the relationship between the exchange rate and portfolio inflow;
- 6) To identify and evaluate different measures of exchange rate volatility;
- 7) To model the relationship between portfolio inflow and exchange rate volatility in South Africa; and
- 8) To explore policy suggestions to possibly attract and sustain more portfolio inflow into South Africa.

The first three goals were addressed in chapter 2; the second three in chapter 3 and the chapter 4 addressed the second last goal. This chapter (section 5.3) will address the last goal within the context of the policy framework described in chapter 2. The next section draws conclusions based on the goals described above.

5.2 Conclusions

Since the various goals were addressed in distinct chapters, the conclusions are structured accordingly.

5.2.1 Conclusions with regard to portfolio inflow in South Africa.

Chapter 2 examined the background and features regarding the inflow of foreign portfolio investment. In chapter 2, portfolio inflow was defined as foreign investors purchasing commodities, stocks, money market instruments or bonds in another country (World Bank, 2013). These investments can be either longer-term or short-term of nature. Short-term investments are normally defined as speculative investments that entail buying and selling of assets with the goal to take advantage of favourable exchange rate movements (World Bank, 2013). Long-term foreign portfolio investments are made by foreign investors with the aim of holding onto the assets for an extended period. This addresses the first goal of the study.

In terms of the second goal of the study, namely, the characteristics of portfolio inflow in South Africa, chapter 2 showed that capital inflow (particular portfolio inflow) in South Africa continued to increase after almost all exchange rate controls on foreign investors were removed. In particular, the surge of portfolio inflow into South African equities has always been very popular amongst foreign investors, due to its potential growth prospects in profits. This is because South Africa's equity market is also substantially larger than the average developing economies. It is also technologically advanced, well-regulated and very liquid, when compared to other developing countries. Although the quantity of equity inflow varied over the years, the outcome remained significantly long-term accumulation of portfolio equity investments by foreigners. Since the mid-1990s when South Africa would experience a significant weakness in the rand, bonds were negatively affected. The surge of portfolio inflow has been beneficial to South Africa's economy through its impact on the country's credit extensions to the private sector, asset prices, mortgage extensions and credit card extensions, which promotes economic growth.

One of the reasons for this is significant rand hedge qualities of equities, as opposed to bonds. This is in contrast with the frequent characterisation of portfolio investment as both short-term and volatile. South Africa's debt securities have, however, been

more volatile in contrast to equity investments, as evidenced by the gap between the volume of net- and gross transactions in the domestic bond market since 1999.

In terms of the third goal of this study, the literature of chapter 2 identified three push-factors and six pull-factors that had the potential of explaining the inflow of foreign portfolio inflow to developing countries. These push-and pull-factors, also referred to as internal and external factors, were the main reason behind surge of portfolio inflow to developing countries during the 1990s. The main pull-factors are real GDP, inflation turnover ratio, stock market capitalisation, bank credit to private sector and law and order. The main push-factors are global liquidity, risk aversion and long-term interest rate differentials

5.2.2 Conclusions with regard to exchange rate movements

Chapter 3 addressed goals four to six of this study and analysed the South African exchange rate. The chapter firstly showed the different phases of the South African exchange rate since the fall of Bretton Woods (thereby addressing goal four) and it became evident that political instability hampered the liberation of the exchange rate. The successful transformation of political stability in 1994 has brought relief to the foreign exchange market, in which the new political structure paved the way for South Africa's integration back into the world economy. South Africa's aim of achieving its long-term goal of full financial liberalisation and integration into the world economy started after South Africa's government abolished the financial rand in March 1995. From March 1995 until the beginning of the new millennium, a single management float system was adopted, where the spot exchange rate of the rand was market-determined. All but a few exchange controls over foreigners were abolished, while exchange controls of emigrants and residents were retained.

In February 2000, South Africa introduced inflation targeting as a new operating framework for monetary policy. The adoption of the inflation-targeting framework, allowed South Africa's exchange rate to free float. Moreover, the inflation-targeting regime excludes pre-commitment to an exchange rate target, which ensures more policy efficacy. For this reason, the SARB ceased its foreign exchange market interventions policy previously used to stabilise the value of the rand. The adoption of inflation targeting and the reduction in exchange controls caused a significant

increase in the volatility of South Africa's security prices (bonds and stocks), as well as the exchange rate of the rand against major international currencies. This is one of the policy frameworks that are used not only to manage inflation, but also to manage capital flows through the sterilisation of reserves and the management of monetary policy.

Chapter 3 also addressed the fifth goal of this study, namely, to explore the relationship between portfolio inflow and the exchange rate. It was shown that exchange rate volatility might be perceived as a risk signal for portfolio inflow, because, firstly, volatility influences wealth across multinational investors and, secondly, it is an indicator of macroeconomic insecurity. Moreover, volatility makes it harder for foreign investors to predict profitability and investment costs. Thus, according to research reported, exchange rate risk (measured by volatility) counts as an important risk factor clearly affecting the decision making of portfolio investors. However, portfolio movements also have an influence on the level of exchange rate, whereby uncertainty amongst foreign investors can lead to massive withdrawal or outflow of funds, which then causes the currency to depreciate and *vice versa*.

Concerning the sixth goal of the study, namely, the measurement of exchange rate volatility, chapter 3 showed that there existed more than one method to measure the volatility of the exchange rate. These methods include standard deviation and autoregressive conditional heteroscedasticity (ARCH) models, which have evolved over the years and now reflect new advances in econometric techniques. These econometric techniques were used to model the nature of the short-term relationship between exchange rate volatility and portfolio inflow in South Africa. The standard deviation measures the amount of variability or dispersion around a mean. The GARCH and EGARCH models differ from the standard deviation in the sense that they take skewness and kurtosis into account, as opposed to the standard deviation, which assumes that the exchange rate is normally distributed. Therefore, both the GARCH and EGARCH models have the ability to model and forecast changes in the variance of the exchange rate.

5.2.3 Conclusions with respect to the empirical relationship between exchange rate volatility and portfolio inflow

Chapter 5 addressed the seventh goal of this research, namely, to model the relationship between portfolio inflow and exchange rate volatility in South Africa. The research used quarterly data that range from 1995 to 2012 and a VAR framework to analyse the nature of the relationship between exchange rate volatility and South Africa's portfolio inflow. The models also included the following push-and pull-factors (as identified in the literature) long-term interest rate differential, risk aversion, GDP, turnover ratio and the real exchange rate in order for the model not to be underspecified and therefore perhaps overestimate the importance of volatility.

Each of the VAR models with its own distinctive volatility measurement (GARCH, EGARCH and standard deviation, which were firstly calculated from a weekly average Rand/ Dollar exchange rate) revealed that the real exchange rate, turnover ratio, interest rate differential and risk aversion has a significant impact on foreign portfolio inflow, at various lag lengths. The models also showed that exchange rate volatility has a statistically significant and positive impact on foreign portfolio inflow.

The nature of this positive relationship between exchanges rate volatility and foreign portfolio inflow to South Africa's capital markets can therefore be described as country-dependent and time-varying. South Africa's portfolio inflow exhibits high volatility and low persistence that are characteristics that qualifies it to be described generally as "hot money", which is largely driven by foreign investors' appetite for short-term speculative gains. In general, these findings correspond with those of Sula and Willet (2009), who find that both private loans and portfolio inflows are more reversible (volatile) than are foreign direct investments in developing countries. The research also revealed that volatility of capital flows in normal periods is not a very dependable predictor of the scope of which these reversals occur during difficult financial periods.

The study identified the presence of bidirectional causality between the exchange rate volatility and foreign portfolio inflow to South Africa for each of the VAR models. The study reveals that net portfolio flows are associated with exchange rate appreciation and that the impulse responses are much larger for foreign portfolio

inflow from exchange rate volatility. Thus, the results support the portfolio balance theory, that foreign portfolio flows should exert influence on exchange rates movements.

The main conclusions from this research are that there exist a bidirectional causal relationship between the exchange rate volatility and portfolio inflow in South Africa. However, a one-unit shock in exchange rate volatility elicits a large response to net portfolio inflow. This large effect can be ascribed to speculators reacting to profit taking or arbitrage opportunities presenting itself in the market. It is evident this leads to a sudden spike in foreign portfolio inflow before it dies out again, in other words an increase in the exchange rate volatility is associated with an increase in portfolio inflow of 2.80% (according to the GARCH model), 3.01% (EGARCH model) and 3.90% (standard deviation) respectively.

In addition, the positive relationship between exchange rate volatility and foreign portfolio inflow implies that the risk appetite increase by foreign investors is driven largely, as mentioned above, by international investors' appetite for short-term speculative gains. International portfolio flows to African countries exhibit high volatility and low persistence, characteristics that qualify them to be described generally as "hot money" and the results of this research confirm this for South Africa as well. Foreign capital inflow to South Africa mostly comprise of short-term investments in shares traded on the Johannesburg Stock Exchange (JSE) and in South African government bonds, traded on the Bond Exchange. By definition, these investments are highly unstable, which explains why financing the current account deficit in this way may not be sustainable in the long-run, and accordingly, prevents the country from achieving higher and sustainable economic growth. The risk associated with this is that when foreigners' expectations of South Africa shift, due to any form of instability or risk within the country or even internationally, it leads to massive withdrawals or outflow of funds, which in turn causes the currency to depreciate. This relationship is again confirmed in the research results of this study.

5.3 Recommendations

In this section, the last goal of this study is addressed, namely, policy suggestions to possibly attract and sustain more portfolio inflow into South Africa. In addition, some recommendations for further research are also proposed.

5.3.1 Policy recommendations

Capital inflow needs to be managed from a macroeconomic level before utilising other measures that go beyond macroeconomic policies, such as capital controls. This is because most of the factors that influence capital inflow to developing countries are structural in nature, reflecting much-improved public and private sector balance sheets in developing countries relative to developed countries. How to manage the inflow of capital will depend on each country's unique economic circumstances, whether the economy is overheating, has adequate reserves or an exchange rate that is under or overvalued (see chapter 2, section 2.7).

South Africa's situation can be summarised as needing to attract more foreign portfolio investment. In other words, attracting and sustaining more foreign portfolio inflow into the country in order to compensate for South Africa's low savings rate. Based on the policy framework described in chapter 2, section 2.7, there are signs of South Africa's economy overheating as price and credit developments continuously remain under pressure. Supported by the rand depreciation and acceleration in administrative price inflation; consumer price inflation has continued to increase since 2011, which remains near the top of the inflation targeting band, and this places even greater pressure on South Africa's economy.

South Africa's high inflation and weak exchange rate could be an indication of macroeconomic instability due to social and political turmoil. The combination of lower credibility of government's economic policies with regulatory uncertainty about the role of government in the economy of South Africa has weakened not only the credibility of government plans, but has also reduced investors' confidence in the leadership of the South African economy. This includes such factors as high youth unemployment, poor service delivery, dysfunctional labour law and the downgrading in the country's credit rating by Standard & Poor's from BBB to BBB- in 2014. With South Africa's economy dependant on much needed foreign portfolio inflow, a

sudden reversal or halt of foreign portfolio investments may result in an economy downturn. The amount of South Africa's debt and equity portfolio liabilities held by non-resident are approximately US\$140 billion or about 40% of South Africa's GDP in the end of 2012 (IMF, 2013).

To achieve higher and sustained foreign portfolio inflow, South Africa primarily needs to restore the confidence of foreign investors. This could entail a tighter monetary policy to reduce inflationary pressures coupled with less reserve accumulation to counter further depreciation of the rand. This is because the economy is already overheating and so lowering interest rates should not be an option. The rise in South Africa's interest rates may lead to an inflow of foreign portfolio inflow, as it may lead to a decrease in the share of short-term and portfolio inflows in other countries. This is because interest rate differentials influence the expected rate of return on the investments of foreign investors.

Secondly, since portfolio inflows are associated with "hot money", it is not sustainable to finance the current account deficit, it is therefore important that these funds (that flow into government bonds) be invested effectively by the government. If not, foreign portfolio inflow will not have the desired effect, and may have a negative effect on the prospects of long-term economic growth within the country (Brink & Viviers, 2003:214).

5.3.2 Recommendations for further research

This study is limited to South Africa only and the observed variable foreign portfolio inflow comprises of both equities and bonds, collectively. Future research can focus on other developing countries to determine whether the relationship found is unique to the country under investigation, or is applicable to other developing countries. The research can also be expanded to comparing different BRICS (Brazil, Russia, India, China and South Africa) countries' foreign portfolio inflow. Furthermore, future research could examine bonds and equities individually by splitting foreign portfolio inflow. A reason for this would be that there might exist theoretical differences between equity and bond investors. For instance, bond investors are more concerned with higher inflation than equity investors are, because these investors base their investment decision more decisively on future interest rates. The expected

future interest rates are equal to the short-term interest rate plus a risk premium, that includes inflation. The risk premium of a bond increases when the expectations of future inflation and interest rates (bond return fundamentals) increase (Sturges, 2000).

Separating the data will determine which kind of portfolio investment is the most dominant concerning foreign investment in BRICS countries. Further, what are the future trends of portfolio investments in these developing countries and the magnitudes of the potential causal relationship between BRICS countries real exchange rate and foreign portfolio investments (bonds and equities separately)?

Appendix A

Table A1: Correlation Matrix

	DINFL	DGDP	DGL	DIRD	DRA	DREXRATE	DTOR
DINFL	1.000000	-0.071997	-0.023676	0.540528	0.216866	-0.121084	0.015650
DGDP	-0.071997	1.000000	0.152377	0.216701	0.080203	-0.006635	-0.225275
DGL	-0.023676	0.152377	1.000000	-0.005350	-0.212799	0.213003	0.152895
DIRD	0.560528	0.216701	-0.005350	1.000000	0.217055	-0.486789	-0.292188
DRA	0.216866	0.080203	-0.212799	0.217055	1.000000	-0.429284	0.012540
DREXRATE	-0.121084	-0.006635	0.213003	-0.526789	-0.429284	1.000000	0.142236
DTOR	0.015650	-0.225275	0.152895	-0.292188	0.012540	0.142236	1.000000

Source: Estimated by the author with the use of EViews

Table A2: Impulse responses of net portfolio flows to one unit shocks in their own error terms

Respo nse of DFPI:			Respo nse of DFPI:		
Period	DFPI	SDV	Period	DFPI	EGARCH
1	1.387559	0.000000	1	1.373319	0.000000
2	-1.395029	0.605861	2	-1.407480	0.576757
3	0.045018	-0.116212	3	0.044099	-0.085429
4	0.066000	-0.210803	4	0.066062	-0.216965
5	0.021614	0.068436	5	0.020915	0.065750
6	0.133825	-0.052050	6	0.133613	-0.068143
7	-0.102316	0.031886	7	-0.093962	0.039928
8	0.028657	0.022323	8	0.030536	0.020747
9	-0.128463	-0.100258	9	-0.136791	-0.084031
10	0.196085	-0.022071	10	0.202649	-0.026086
11	0.004779	0.041898	11	-0.001455	0.030047
12	-0.029480	0.044039	12	-0.025283	0.042281

Source: Estimated by the author with the use of EViews

Table A3: GARCH VAR model

Vector Autoregression Estimates

Date: 05/12/14 Time: 20:55

Sample (adjusted): 1996 Q2 2012 Q4

Included observations: 67 after adjustments

Standard errors in () & t-statistics in []

	DFPI	DGDP	DIRD	DRA	DREXRATE	DTOR	GARCH
DFPI(-1)	-0.928880 (0.14199) [-6.54208]	0.001484 (0.00095) [1.56737]	0.021229 (0.01162) [1.82650]	0.005346 (0.01949) [0.27424]	-0.003590 (0.00538) [-0.66737]	0.017741 (0.01251) [1.41785]	0.023318 (0.03952) [0.59005]
DFPI(-2)	-0.927446 (0.18299) [-5.06830]	0.000850 (0.00122) [0.69631]	0.009846 (0.01498) [0.65727]	-0.010760 (0.02512) [-0.42828]	0.007204 (0.00693) [1.03912]	0.014380 (0.01613) [0.89171]	-0.066678 (0.05093) [-1.30917]
DFPI(-3)	-0.640726 (0.19479) [-3.28930]	-0.000391 (0.00130) [-0.30135]	0.005491 (0.01595) [0.34434]	-0.004064 (0.02674) [-0.15196]	0.008280 (0.00738) [1.12193]	0.014140 (0.01717) [0.82370]	-0.106776 (0.05422) [-1.96945]
DFPI(-4)	-0.336862 (0.15222) [-2.21298]	-7.30E-05 (0.00102) [-0.07196]	0.005869 (0.01246) [0.47098]	-0.007189 (0.02090) [-0.34398]	0.001758 (0.00577) [0.30490]	-0.018533 (0.01341) [-1.38150]	-0.082915 (0.04237) [-1.95705]
DGDP(-1)	-1.233713 (12.5297) [-0.09846]	-0.209638 (0.08355) [-2.50915]	-1.052991 (1.02568) [-1.02663]	3.005995 (1.72030) [1.74737]	-0.009330 (0.47470) [-0.01966]	0.085374 (1.10421) [0.07732]	2.579763 (3.48739) [0.73974]
DGDP(-2)	-3.121789 (13.1834) [-0.23680]	-0.087297 (0.08791) [-0.99305]	-1.949511 (1.07919) [-1.80646]	1.639664 (1.81005) [0.90587]	0.623001 (0.49947) [1.24734]	-0.639718 (1.16182) [-0.55062]	-0.073044 (3.66933) [-0.01991]
DGDP(-3)	-10.65826 (12.5534) [-0.84903]	-0.069974 (0.08371) [-0.83593]	-1.441217 (1.02762) [-1.40249]	0.673408 (1.72355) [0.39071]	0.644943 (0.47560) [1.35607]	1.180464 (1.10630) [1.06704]	-1.279682 (3.49398) [-0.36625]
DGDP(-4)	-9.503288 (12.2672) [-0.77469]	0.834965 (0.08180) [10.2076]	0.104972 (1.00418) [0.10453]	1.769290 (1.68425) [1.05049]	0.315538 (0.46475) [0.67894]	-1.629479 (1.08107) [-1.50728]	1.443003 (3.41431) [0.42263]
DIRD(-1)	2.691614 (2.59781) [1.03611]	0.042351 (0.01732) [2.44487]	0.010154 (0.21266) [0.04775]	0.217527 (0.35667) [0.60988]	0.136389 (0.09842) [1.38578]	-0.279920 (0.22894) [-1.22269]	0.293843 (0.72305) [0.40639]
DIRD(-2)	-5.298605 (2.50017) [-2.11930]	-0.003756 (0.01667) [-0.22531]	0.022524 (0.20466) [0.11005]	0.134474 (0.34327) [0.39175]	-0.084789 (0.09472) [-0.89515]	-0.038757 (0.22033) [-0.17590]	0.173099 (0.69587) [0.24875]
DIRD(-3)	1.617352 (2.47248) [0.65414]	-0.012708 (0.01649) [-0.77080]	0.200850 (0.20240) [0.99236]	0.614501 (0.33947) [1.81020]	-0.064731 (0.09367) [-0.69103]	-0.085511 (0.21789) [-0.39244]	0.662579 (0.68816) [0.96282]

DIRD(-4)	-2.573544 (2.42882) [-1.05959]	-0.009592 (0.01620) [-0.59226]	-0.207085 (0.19882) [-1.04156]	0.353696 (0.33347) [1.06065]	0.098852 (0.09202) [1.07427]	-0.197155 (0.21405) [-0.92109]	0.130681 (0.67601) [0.19331]
DRA(-1)	-3.218867 (1.42984) [-2.25120]	-0.014624 (0.00953) [-1.53378]	0.108794 (0.11705) [0.92949]	-0.155780 (0.19631) [-0.79353]	-0.007428 (0.05417) [-0.13713]	-0.101584 (0.12601) [-0.80617]	0.247131 (0.39797) [0.62098]
DRA(-2)	-3.960767 (1.37238) [-2.88605]	-0.023705 (0.00915) [-2.59033]	0.078124 (0.11234) [0.69541]	-0.259887 (0.18842) [-1.37926]	0.046424 (0.05199) [0.89287]	0.120124 (0.12094) [0.99322]	-0.637704 (0.38197) [-1.66949]
DRA(-3)	0.431490 (1.29090) [0.33426]	-0.004746 (0.00861) [-0.55134]	0.129270 (0.10567) [1.22330]	-0.301540 (0.17724) [-1.70134]	-0.032341 (0.04891) [-0.66127]	-0.044164 (0.11376) [-0.38821]	-0.212924 (0.35930) [-0.59262]
DRA(-4)	-1.094089 (1.24305) [-0.88016]	-0.014223 (0.00829) [-1.71594]	-0.045540 (0.10176) [-0.44755]	-0.094170 (0.17067) [-0.55177]	0.001747 (0.04709) [0.03710]	0.027976 (0.10955) [0.25538]	-0.046494 (0.34598) [-0.13438]
DREXRATE(-1)	10.39234 (5.92233) [1.75477]	0.018575 (0.03949) [0.47035]	-0.068218 (0.48480) [-0.14071]	1.810185 (0.81312) [2.22622]	-0.053399 (0.22437) [-0.23799]	0.014809 (0.52192) [0.02837]	2.142859 (1.64836) [1.30000]
DREXRATE(-2)	-1.059135 (5.56971) [-0.19016]	0.012531 (0.03714) [0.33740]	-0.400267 (0.45593) [-0.87791]	-0.936953 (0.76471) [-1.22525]	0.081946 (0.21101) [0.38834]	0.018351 (0.49084) [0.03739]	-0.624017 (1.55021) [-0.40254]
DREXRATE(-3)	3.411303 (5.46901) [0.62375]	-0.011507 (0.03647) [-0.31555]	0.776973 (0.44769) [1.73551]	-0.357478 (0.75088) [-0.47608]	-0.084835 (0.20720) [-0.40944]	-0.750108 (0.48197) [-1.55634]	0.357360 (1.52219) [0.23477]
DREXRATE(-4)	-10.20431 (5.35437) [-1.90579]	-0.045081 (0.03570) [-1.26264]	0.035356 (0.43831) [0.08066]	0.118927 (0.73514) [0.16177]	0.005911 (0.20286) [0.02914]	-0.118964 (0.47187) [-0.25211]	-0.338742 (1.49028) [-0.22730]
DTOR(-1)	0.477344 (1.75132) [0.27256]	-0.001493 (0.01168) [-0.12784]	0.200780 (0.14336) [1.40051]	0.482253 (0.24045) [2.00561]	-0.107376 (0.06635) [-1.61832]	-0.089724 (0.15434) [-0.58134]	-0.002365 (0.48744) [-0.00485]
DTOR(-2)	3.245509 (1.80894) [1.79415]	0.008739 (0.01206) [0.72446]	0.180974 (0.14808) [1.22214]	0.278287 (0.24836) [1.12049]	-0.070262 (0.06853) [-1.02522]	-0.133014 (0.15942) [-0.83437]	-0.232990 (0.50348) [-0.46276]
DTOR(-3)	4.954764 (1.89373) [2.61640]	0.003729 (0.01263) [0.29529]	-0.079553 (0.15502) [-0.51318]	0.355567 (0.26000) [1.36754]	-0.053562 (0.07175) [-0.74655]	0.066169 (0.16689) [0.39649]	0.288790 (0.52708) [0.54790]
DTOR(-4)	5.524283 (1.87355) [2.94856]	0.001513 (0.01249) [0.12107]	-0.073316 (0.15337) [-0.47804]	-0.066006 (0.25723) [-0.25660]	0.058642 (0.07098) [0.82616]	-0.160729 (0.16511) [-0.97346]	0.232318 (0.52147) [0.44551]

GARCH(-1)	2.801530 (0.74166) [3.77737]	-0.002587 (0.00495) [-0.52313]	0.080224 (0.06071) [1.32138]	0.101691 (0.10183) [0.99865]	-0.042064 (0.02810) [-1.49702]	-0.106622 (0.06536) [-1.63129]	0.650562 (0.20643) [3.15155]
GARCH(-2)	0.356680 (0.86994) [0.41001]	-0.000745 (0.00580) [-0.12840]	-0.140376 (0.07121) [-1.97123]	-0.106728 (0.11944) [-0.89357]	0.050974 (0.03296) [1.54661]	0.030142 (0.07667) [0.39316]	0.028611 (0.24213) [0.11817]
GARCH(-3)	-0.065254 (0.80781) [-0.08078]	-0.002044 (0.00539) [-0.37948]	0.049411 (0.06613) [0.74722]	0.016781 (0.11091) [0.15130]	0.023623 (0.03060) [0.77187]	-0.025857 (0.07119) [-0.36321]	0.016760 (0.22484) [0.07454]
GARCH(-4)	-0.683827 (0.76481) [-0.89411]	0.003811 (0.00510) [0.74726]	0.003357 (0.06261) [0.05362]	-0.151063 (0.10501) [-1.43860]	0.016025 (0.02898) [0.55304]	-0.027463 (0.06740) [-0.40746]	-0.122182 (0.21287) [-0.57397]
C	-4.322490 (1.52628) [-2.83205]	0.006205 (0.01018) [0.60969]	0.025938 (0.12494) [0.20760]	0.109009 (0.20955) [0.52020]	-0.078860 (0.05782) [-1.36378]	0.271804 (0.13451) [2.02075]	0.630366 (0.42481) [1.48389]
R-squared	0.701820	0.932537	0.401245	0.564780	0.503590	0.560178	0.532083
Adj. R-squared	0.482109	0.882827	-0.039944	0.244092	0.137814	0.236098	0.187302
Sum sq. resids	71.45259	0.003177	0.478802	1.346918	0.102559	0.554931	5.535233
S.E. equation	1.371252	0.009144	0.112250	0.188269	0.051951	0.120845	0.381660
F-statistic	3.194283	18.75961	0.909464	1.761149	1.376772	1.728519	1.543248
Log likelihood	-97.22432	238.4740	70.45998	35.81138	122.0785	65.51683	-11.53466
Akaike AIC	3.767890	-6.252955	-1.237611	-0.203325	-2.778463	-1.090055	1.209990
Schwarz SC	4.722160	-5.298685	-0.283341	0.750945	-1.824193	-0.135785	2.164260
Mean dependent	-0.001012	0.008592	-0.005379	0.001242	-0.003083	0.051032	1.532079
S.D. dependent	1.905452	0.026712	0.110073	0.216543	0.055949	0.138264	0.423362
Determinant resid covariance (dof adj.)		5.31E-14					
Determinant resid covariance		1.00E-15					
Log likelihood		491.5011					
Akaike information criterion		-8.611973					
Schwarz criterion		-1.932083					

Source: Estimated by the author with the use of EViews

Table A4: EGARCH VAR model

Vector Autoregression Estimates

Date: 05/12/14 Time: 20:55

Sample (adjusted): 1996 Q2 2012 Q4

Included observations: 67 after adjustments

Standard errors in () & t-statistics in []

	DFPI	DGDP	DIRD	DRA	DREXRATE	DTOR	EGARCH
DFPI(-1)	-0.950601 (0.14234) [-6.67855]	0.001804 (0.00092) [1.95964]	0.018210 (0.01206) [1.51006]	0.000654 (0.02000) [0.03272]	-0.003949 (0.00549) [-0.71892]	0.023010 (0.01212) [1.89880]	0.020659 (0.03016) [0.68501]
DFPI(-2)	-0.994849 (0.18995) [-5.23745]	0.001309 (0.00123) [1.06507]	0.008309 (0.01609) [0.51630]	-0.014606 (0.02669) [-0.54729]	0.005241 (0.00733) [0.71497]	0.022405 (0.01617) [1.38544]	-0.010084 (0.04025) [-0.25056]
DFPI(-3)	-0.945888 (0.22386) [-4.22545]	0.000816 (0.00145) [0.56378]	-0.000783 (0.01897) [-0.04129]	-0.022372 (0.03145) [-0.71133]	0.008208 (0.00864) [0.95016]	0.031650 (0.01906) [1.66068]	-0.192576 (0.04743) [-4.06010]
DFPI(-4)	-0.390014 (0.20610) [-1.89237]	0.000557 (0.00133) [0.41775]	0.012876 (0.01746) [0.73742]	-0.007720 (0.02896) [-0.26659]	-0.002110 (0.00795) [-0.26528]	-0.010025 (0.01755) [-0.57132]	-0.100618 (0.04367) [-2.30410]
DGDP(-1)	5.104477 (13.1488) [0.38821]	-0.232556 (0.08505) [-2.73435]	-0.924415 (1.11398) [-0.82983]	3.343450 (1.84736) [1.80986]	0.167162 (0.50739) [0.32946]	-0.628766 (1.11946) [-0.56167]	3.327218 (2.78601) [1.19426]
DGDP(-2)	2.487652 (13.7814) [0.18051]	-0.110662 (0.08914) [-1.24141]	-1.989778 (1.16757) [-1.70420]	1.655719 (1.93624) [0.85512]	0.817185 (0.53180) [1.53665]	-1.240644 (1.17332) [-1.05738]	2.532188 (2.92005) [0.86717]
DGDP(-3)	-10.06448 (13.1156) [-0.76737]	-0.085507 (0.08484) [-1.00792]	-1.627805 (1.11117) [-1.46495]	0.694521 (1.84270) [0.37690]	0.891393 (0.50611) [1.76127]	0.774784 (1.11664) [0.69386]	-2.121878 (2.77898) [-0.76355]
DGDP(-4)	-4.924969 (12.7608) [-0.38595]	0.817884 (0.08254) [9.90890]	0.156706 (1.08111) [0.14495]	2.065612 (1.79285) [1.15214]	0.438375 (0.49242) [0.89025]	-2.076214 (1.08643) [-1.91105]	0.261704 (2.70380) [0.09679]
DIRD(-1)	3.990971 (2.69772) [1.47939]	0.038802 (0.01745) [2.22364]	-0.025235 (0.22855) [-0.11041]	0.140411 (0.37902) [0.37046]	0.139800 (0.10410) [1.34294]	-0.242099 (0.22968) [-1.05408]	0.340885 (0.57160) [0.59637]
DIRD(-2)	-4.600024 (2.67038) [-1.72261]	-0.009475 (0.01727) [-0.54858]	-0.023706 (0.22624) [-0.10478]	0.194650 (0.37518) [0.51882]	-0.060205 (0.10305) [-0.58426]	-0.087340 (0.22735) [-0.38416]	0.010403 (0.56581) [0.01839]
DIRD(-3)	2.226395 (2.58570) [0.86104]	-0.011155 (0.01673) [-0.66695]	0.205167 (0.21906) [0.93656]	0.503753 (0.36328) [1.38667]	-0.050701 (0.09978) [-0.50814]	-0.086597 (0.22014) [-0.39337]	0.686296 (0.54787) [1.25267]
DIRD(-4)	-2.420210 (2.56663) [-0.94295]	-0.012964 (0.01660) [-0.78089]	-0.222928 (0.21745) [-1.02520]	0.367342 (0.36060) [1.01869]	0.121031 (0.09904) [1.22202]	-0.258633 (0.21852) [-1.18358]	0.506058 (0.54383) [0.93055]
DRA(-1)	-3.099270 (1.41858) [-2.18477]	-0.011262 (0.00918) [-1.22732]	0.154903 (0.12018) [1.28888]	-0.110533 (0.19931) [-0.55459]	-0.038299 (0.05474) [-0.69964]	-0.143457 (0.12078) [-1.18780]	0.179248 (0.30057) [0.59635]

DRA(-2)	-3.835346 (1.34919) [-2.84270]	-0.019976 (0.00873) [-2.28898]	0.079617 (0.11430) [0.69654]	-0.255897 (0.18956) [-1.34997]	0.030965 (0.05206) [0.59477]	0.128298 (0.11487) [1.11692]	-0.345475 (0.28587) [-1.20850]
DRA(-3)	0.123736 (1.24606) [0.09930]	-0.003826 (0.00806) [-0.47471]	0.114465 (0.10557) [1.08428]	-0.261271 (0.17507) [-1.49240]	-0.033784 (0.04808) [-0.70262]	-0.015981 (0.10609) [-0.15064]	-0.316114 (0.26402) [-1.19731]
DRA(-4)	-1.054837 (1.21887) [-0.86542]	-0.013950 (0.00788) [-1.76936]	0.005890 (0.10326) [0.05704]	-0.062208 (0.17125) [-0.36326]	-0.006552 (0.04703) [-0.13930]	-0.001021 (0.10377) [-0.00984]	0.018083 (0.25826) [0.07002]
DREXRATE(-1)	10.74748 (6.32683) [1.69872]	0.008944 (0.04092) [0.21856]	-0.096362 (0.53601) [-0.17978]	1.600721 (0.88890) [1.80079]	-0.024390 (0.24414) [-0.09990]	0.262210 (0.53865) [0.48679]	2.074580 (1.34055) [1.54756]
DREXRATE(-2)	-0.227230 (6.29440) [-0.03610]	-0.006648 (0.04071) [-0.16330]	-0.484914 (0.53327) [-0.90932]	-0.947337 (0.88434) [-1.07123]	0.113171 (0.24289) [0.46594]	0.039350 (0.53589) [0.07343]	-0.485738 (1.33368) [-0.36421]
DREXRATE(-3)	2.942822 (5.67821) [0.51827]	0.001602 (0.03673) [0.04362]	0.711218 (0.48106) [1.47843]	-0.808274 (0.79777) [-1.01317]	-0.064524 (0.21911) [-0.29448]	-0.662559 (0.48343) [-1.37053]	-1.596743 (1.20312) [-1.32717]
DREXRATE(-4)	-7.646273 (5.40696) [-1.41415]	-0.048659 (0.03497) [-1.39130]	0.181301 (0.45808) [0.39578]	0.422930 (0.75966) [0.55674]	0.011314 (0.20864) [0.05422]	-0.430200 (0.46034) [-0.93453]	1.464492 (1.14565) [1.27831]
DTOR(-1)	0.607115 (1.80934) [0.33555]	-0.002962 (0.01170) [-0.25313]	0.246264 (0.15329) [1.60654]	0.528714 (0.25421) [2.07987]	-0.089442 (0.06982) [-1.28106]	-0.176351 (0.15404) [-1.14482]	0.205979 (0.38337) [0.53729]
DTOR(-2)	3.127926 (1.83217) [1.70722]	0.004342 (0.01185) [0.36642]	0.173433 (0.15522) [1.11731]	0.324906 (0.25741) [1.26219]	-0.049194 (0.07070) [-0.69581]	-0.167359 (0.15599) [-1.07290]	0.275376 (0.38821) [0.70935]
DTOR(-3)	4.010008 (1.79612) [2.23260]	-0.000279 (0.01162) [-0.02405]	-0.081033 (0.15217) [-0.53252]	0.382967 (0.25235) [1.51761]	-0.032488 (0.06931) [-0.46874]	0.079180 (0.15292) [0.51780]	0.116480 (0.38057) [0.30607]
DTOR(-4)	5.460338 (1.81981) [3.00049]	-0.002366 (0.01177) [-0.20097]	-0.045939 (0.15418) [-0.29796]	-0.025768 (0.25568) [-0.10078]	0.053282 (0.07022) [0.75875]	-0.167070 (0.15494) [-1.07832]	0.167775 (0.38559) [0.43511]
EGARCH(-1)	3.019271 (0.94687) [3.18868]	-0.005582 (0.00612) [-0.91133]	0.059684 (0.08022) [0.74400]	0.091827 (0.13303) [0.69026]	-0.018901 (0.03654) [-0.51730]	-0.082393 (0.08061) [-1.02206]	0.659159 (0.20063) [3.28550]
EGARCH(-2)	0.760782 (1.11778) [0.68062]	-0.005326 (0.00723) [-0.73661]	-0.094534 (0.09470) [-0.99825]	-0.025358 (0.15704) [-0.16147]	0.049204 (0.04313) [1.14076]	-0.060024 (0.09517) [-0.63073]	0.256647 (0.23684) [1.08363]
EGARCH(-3)	-0.850998 (0.76815) [-1.10785]	0.004808 (0.00497) [0.96765]	0.013283 (0.06508) [0.20410]	-0.132379 (0.10792) [-1.22661]	0.035300 (0.02964) [1.19091]	-0.012164 (0.06540) [-0.18599]	-0.358470 (0.16276) [-2.20245]
EGARCH(-4)	-0.039279 (0.71203) [-0.05517]	0.000871 (0.00461) [0.18905]	0.040797 (0.06032) [0.67630]	0.023974 (0.10004) [0.23965]	0.001510 (0.02748) [0.05495]	-0.080533 (0.06062) [-1.32846]	0.163736 (0.15087) [1.08529]

C	-1.457391 (0.66506) [-2.19136]	0.006493 (0.00430) [1.50931]	0.005304 (0.05634) [0.09414]	-0.107569 (0.09344) [-1.15123]	-0.031234 (0.02566) [-1.21704]	0.159360 (0.05662) [2.81445]	0.019264 (0.14092) [0.13670]
R-squared	0.700921	0.936327	0.356718	0.542884	0.483461	0.588271	0.687139
Adj. R-squared	0.480547	0.889411	-0.117279	0.206062	0.102853	0.284891	0.456610
Sum sq. resids	71.66815	0.002999	0.514409	1.414681	0.106717	0.519486	3.217530
S.E. equation	1.373319	0.008883	0.116349	0.192947	0.052994	0.116922	0.290984
F-statistic	3.180593	19.95726	0.752574	1.611784	1.270234	1.939060	2.980704
Log likelihood	-97.32524	240.4113	68.05701	34.16704	120.7469	67.72800	6.639755
Akaike AIC	3.770903	-6.310785	-1.165881	-0.154240	-2.738714	-1.156060	0.667470
Schwarz SC	4.725172	-5.356515	-0.211611	0.800030	-1.784444	-0.201790	1.621740
Mean dependent	-0.001012	0.008592	-0.005379	0.001242	-0.003083	0.051032	0.269495
S.D. dependent	1.905452	0.026712	0.110073	0.216543	0.055949	0.138264	0.394742
Determinant resid covariance (dof adj.)	2.43E-14						
Determinant resid covariance	4.59E-16						
Log likelihood	517.6798						
Akaike information criterion	-9.393427						
Schwarz criterion	-2.713538						

Source: Estimated by the author with the use of EViews

Table A5: SDV VAR model

Vector Autoregression Estimates
 Date: 05/12/14 Time: 20:55
 Sample (adjusted): 1996 Q2 2012 Q4
 Included observations: 67 after adjustments
 Standard errors in () & t-statistics in []

	DFPI	DGDP	DIRD	DRA	DREXRATE	DTOR	SDV
DFPI(-1)	-0.914845 (0.14361) [-6.37030]	0.001727 (0.00092) [1.87681]	0.019263 (0.01198) [1.60800]	0.003211 (0.01993) [0.16107]	-0.004083 (0.00552) [-0.73999]	0.022136 (0.01210) [1.82944]	0.020460 (0.02518) [0.81262]
DFPI(-2)	-0.940564 (0.18741) [-5.01863]	0.001154 (0.00120) [0.96054]	0.008511 (0.01563) [0.54443]	-0.010638 (0.02601) [-0.40893]	0.005459 (0.00720) [0.75816]	0.020093 (0.01579) [1.27248]	-0.015976 (0.03286) [-0.48622]
DFPI(-3)	-0.822709 (0.21319) [-3.85909]	0.000530 (0.00137) [0.38785]	0.000420 (0.01778) [0.02365]	-0.015963 (0.02959) [-0.53945]	0.008209 (0.00819) [1.00229]	0.028182 (0.01796) [1.56900]	-0.131955 (0.03738) [-3.53040]
DFPI(-4)	-0.316809 (0.18782) [-1.68677]	0.000279 (0.00120) [0.23142]	0.012189 (0.01567) [0.77801]	-0.003596 (0.02607) [-0.13793]	-0.001283 (0.00722) [-0.17778]	-0.012032 (0.01582) [-0.76032]	-0.059914 (0.03293) [-1.81949]
DGDP(-1)	4.201896 (13.1182) [0.32031]	-0.229107 (0.08407) [-2.72508]	-0.906715 (1.09426) [-0.82861]	3.271536 (1.82088) [1.79668]	0.105117 (0.50400) [0.20856]	-0.548432 (1.10526) [-0.49620]	2.629462 (2.29993) [1.14328]
DGDP(-2)	1.047852 (13.8261) [0.07579]	-0.107090 (0.08861) [-1.20856]	-2.023332 (1.15331) [-1.75437]	1.511491 (1.91913) [0.78759]	0.789613 (0.53120) [1.48647]	-1.149844 (1.16490) [-0.98707]	1.711935 (2.42403) [0.70623]
DGDP(-3)	-11.60960 (13.1899) [-0.88019]	-0.080540 (0.08453) [-0.95276]	-1.655069 (1.10024) [-1.50428]	0.539100 (1.83083) [0.29446]	0.867765 (0.50676) [1.71239]	0.832744 (1.11130) [0.74934]	-1.960507 (2.31250) [-0.84779]
DGDP(-4)	-6.116558 (12.8030) [-0.47774]	0.821698 (0.08205) [10.0142]	0.167492 (1.06797) [0.15683]	1.944512 (1.77712) [1.09419]	0.414786 (0.49189) [0.84324]	-2.000308 (1.07870) [-1.85436]	0.082572 (2.24466) [0.03679]
DIRD(-1)	3.702638 (2.69642) [1.37317]	0.039207 (0.01728) [2.26880]	-0.027639 (0.22492) [-0.12288]	0.125963 (0.37428) [0.33655]	0.147931 (0.10360) [1.42795]	-0.233150 (0.22718) [-1.02626]	0.250304 (0.47274) [0.52947]
DIRD(-2)	-5.189946 (2.70557) [-1.91824]	-0.008075 (0.01734) [-0.46568]	-0.037897 (0.22569) [-0.16792]	0.164528 (0.37555) [0.43810]	-0.056863 (0.10395) [-0.54703]	-0.084210 (0.22795) [-0.36942]	0.017394 (0.47435) [0.03667]
DIRD(-3)	1.947723 (2.62554) [0.74184]	-0.010108 (0.01683) [-0.60072]	0.211804 (0.21901) [0.96709]	0.488735 (0.36444) [1.34106]	-0.048889 (0.10087) [-0.48466]	-0.066091 (0.22121) [-0.29877]	0.518994 (0.46032) [1.12747]
DIRD(-4)	-2.750466 (2.56825) [-1.07095]	-0.011919 (0.01646) [-0.72415]	-0.217643 (0.21423) [-1.01592]	0.363302 (0.35649) [1.01912]	0.114062 (0.09867) [1.15597]	-0.262696 (0.21639) [-1.21402]	0.383119 (0.45027) [0.85086]
DRA(-1)	-3.040286 (1.43837) [-2.11370]	-0.011151 (0.00922) [-1.20961]	0.154739 (0.11998) [1.28968]	-0.108170 (0.19965) [-0.54179]	-0.038371 (0.05526) [-0.69434]	-0.152271 (0.12119) [-1.25648]	0.151606 (0.25218) [0.60118]

DRA(-2)	-3.562719 (1.36532) [-2.60945]	-0.020306 (0.00875) [-2.32068]	0.090591 (0.11389) [0.79543]	-0.236985 (0.18951) [-1.25050]	0.026871 (0.05246) [0.51226]	0.123599 (0.11503) [1.07446]	-0.268861 (0.23937) [-1.12320]
DRA(-3)	0.519407 (1.26013) [0.41219]	-0.004800 (0.00808) [-0.59433]	0.123982 (0.10511) [1.17950]	-0.233928 (0.17491) [-1.33740]	-0.038268 (0.04841) [-0.79044]	-0.029714 (0.10617) [-0.27987]	-0.179075 (0.22093) [-0.81055]
DRA(-4)	-0.851871 (1.22726) [-0.69412]	-0.014805 (0.00787) [-1.88230]	-0.002846 (0.10237) [-0.02780]	-0.057713 (0.17035) [-0.33879]	-0.006773 (0.04715) [-0.14365]	-0.000839 (0.10340) [-0.00811]	0.054458 (0.21517) [0.25310]
DREXRATE(-1)	11.62680 (6.50930) [1.78618]	0.006135 (0.04172) [0.14707]	-0.063758 (0.54298) [-0.11742]	1.640196 (0.90352) [1.81533]	-0.014398 (0.25009) [-0.05757]	0.248830 (0.54843) [0.45371]	1.884546 (1.14123) [1.65133]
DREXRATE(-2)	-1.654073 (6.58480) [-0.25120]	-0.005930 (0.04220) [-0.14051]	-0.575733 (0.54927) [-1.04817]	-1.024354 (0.91400) [-1.12073]	0.150886 (0.25299) [0.59642]	0.019067 (0.55480) [0.03437]	-0.594569 (1.15447) [-0.51502]
DREXRATE(-3)	2.481032 (5.98208) [0.41474]	0.004673 (0.03834) [0.12190]	0.707459 (0.49900) [1.41776]	-0.895254 (0.83034) [-1.07817]	-0.042478 (0.22983) [-0.18482]	-0.615550 (0.50401) [-1.22130]	-1.507979 (1.04880) [-1.43782]
DREXRATE(-4)	-7.121442 (5.57484) [-1.27742]	-0.048474 (0.03573) [-1.35672]	0.236799 (0.46503) [0.50922]	0.451912 (0.77382) [0.58400]	-0.019154 (0.21419) [-0.08943]	-0.481185 (0.46970) [-1.02445]	1.474033 (0.97740) [1.50812]
DTOR(-1)	0.752007 (1.82640) [0.41174]	-0.002982 (0.01171) [-0.25472]	0.250672 (0.15235) [1.64537]	0.516907 (0.25351) [2.03897]	-0.095825 (0.07017) [-1.36560]	-0.172188 (0.15388) [-1.11897]	0.199007 (0.32021) [0.62149]
DTOR(-2)	3.132120 (1.85225) [1.69098]	0.004313 (0.01187) [0.36335]	0.173036 (0.15451) [1.11993]	0.300937 (0.25710) [1.17050]	-0.047472 (0.07116) [-0.66709]	-0.169620 (0.15606) [-1.08689]	0.219201 (0.32474) [0.67500]
DTOR(-3)	3.824557 (1.81551) [2.10660]	0.000193 (0.01164) [0.01657]	-0.088225 (0.15144) [-0.58257]	0.350646 (0.25200) [1.39144]	-0.027651 (0.06975) [-0.39641]	0.079290 (0.15296) [0.51835]	0.017953 (0.31830) [0.05640]
DTOR(-4)	5.322475 (1.82854) [2.91078]	-0.001933 (0.01172) [-0.16492]	-0.044448 (0.15253) [-0.29141]	-0.049314 (0.25381) [-0.19429]	0.057367 (0.07025) [0.81658]	-0.171766 (0.15406) [-1.11492]	0.056490 (0.32059) [0.17621]
SDV(-1)	3.902678 (1.21522) [3.21149]	-0.007484 (0.00779) [-0.96092]	0.083237 (0.10137) [0.82113]	0.116847 (0.16868) [0.69272]	-0.025502 (0.04669) [-0.54621]	-0.094229 (0.10239) [-0.92032]	0.682877 (0.21306) [3.20514]
SDV(-2)	0.602576 (1.43809) [0.41901]	-0.006029 (0.00922) [-0.65413]	-0.136641 (0.11996) [-1.13907]	-0.058474 (0.19961) [-0.29293]	0.062486 (0.05525) [1.13094]	-0.080009 (0.12116) [-0.66034]	0.139081 (0.25213) [0.55162]
SDV(-3)	-0.866316 (1.08362) [-0.79946]	0.006154 (0.00694) [0.88617]	0.018520 (0.09039) [0.20489]	-0.176610 (0.15041) [-1.17418]	0.044100 (0.04163) [1.05927]	-0.001469 (0.09130) [-0.01609]	-0.366500 (0.18998) [-1.92911]
SDV(-4)	0.068852 (0.99735) [0.06903]	0.001033 (0.00639) [0.16161]	0.062739 (0.08319) [0.75412]	0.031347 (0.13844) [0.22643]	-0.001266 (0.03832) [-0.03304]	-0.121296 (0.08403) [-1.44348]	0.206528 (0.17486) [1.18111]

C	-1.520656 (0.69385) [-2.19162]	0.006454 (0.00445) [1.45129]	0.004357 (0.05788) [0.07529]	-0.090082 (0.09631) [-0.93533]	-0.031018 (0.02666) [-1.16355]	0.163821 (0.05846) [2.80229]	0.048362 (0.12165) [0.39755]
R-squared	0.694686	0.936188	0.363391	0.544524	0.477278	0.588373	0.638763
Adj. R-squared	0.469718	0.889169	-0.105689	0.208911	0.092115	0.285068	0.372588
Sum sq. resids	73.16216	0.003005	0.509072	1.409605	0.107995	0.519358	2.248875
S.E. equation	1.387559	0.008893	0.115744	0.192600	0.053310	0.116907	0.243271
F-statistic	3.087930	19.91068	0.774689	1.622474	1.239157	1.939875	2.399787
Log likelihood	-98.01640	240.3380	68.40635	34.28744	120.3483	67.73627	18.63892
Akaike AIC	3.791534	-6.308597	-1.176309	-0.157834	-2.726816	-1.156307	0.309286
Schwarz SC	4.745804	-5.354327	-0.222039	0.796436	-1.772546	-0.202037	1.263556
Mean dependent	-0.001012	0.008592	-0.005379	0.001242	-0.003083	0.051032	0.237533
S.D. dependent	1.905452	0.026712	0.110073	0.216543	0.055949	0.138264	0.307124
Determinant resid covariance (dof adj.)		1.73E-14					
Determinant resid covariance		3.27E-16					
Log likelihood		528.9940					
Akaike information criterion		-9.731165					
Schwarz criterion		-3.051276					

Source: Estimated by the author with the use of EViews

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