EFFECTS OF EXCHANGE RATE VOLATILITY ON THE STOCK MARKET: A CASE STUDY OF SOUTH AFRICA.

BY

MLAMBO COURAGE

A DISSERTATION SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF COMMERCE IN ECONOMICS

DEPARTMENT OF ECONOMICS
FACULTY OF MANAGEMENT AND COMMERCE
UNIVERSITY OF FORT HARE

JANUARY 2013

SUPERVISOR: MR A. MAREDZA
ABSTRACT

This study assessed the effects of currency volatility on the Johannesburg Stock Exchange. An evaluation of literature on exchange rate volatility and stock markets was conducted resulting into specification of an empirical model. The Generalised Autoregressive Conditional Heteroskedascity (1.1) (GARCH) model was used in establishing the relationship between exchange rate volatility and stock market performance. The study employed monthly South African data for the period 2000 – 2010. The data frequency selected ensured an adequate number of observations. A very weak relationship between currency volatility and the stock market was confirmed. The research finding is supported by previous studies. Prime overdraft rate and total mining production were found to have a negative impact on Market capitalisation. Surprisingly, US interest rates were found to have a positive impact on Market capitalisation.

This study recommended that, since the South African stock market is not really exposed to the negative effects of currency volatility, government can use exchange rate as a policy tool to attract foreign portfolio investment. The weak relationship between currency volatility and the stock market suggests that the JSE can be marketed as a safe market for foreign investors. However, investors, bankers and portfolio managers still need to be vigilant in regard to the spillovers from the foreign exchange rate into the stock market. Although there is a weak relationship between rand volatility and the stock market in South Africa, this does not necessarily mean that investors and portfolio managers need not monitor the developments between these two variables.
DECLARATION ON COPY RIGHT
I, the undersigned, Courage Mlambo, student number, 200706118, hereby declare that the dissertation is my own original work, and that it has not been submitted, and will not be presented at any other University for a similar or any other degree award.

Date: ..........................

Signature: ..............................

DECLARATION ON PLAGIARISM
I, Courage Mlambo, student number 200706118, hereby declare that I am fully aware of the University of Fort Hare’s policy on plagiarism and I have taken every precaution to comply with the regulations.

Signature: ..........................

DECLARATION ON RESEARCH ETHICS
I, Courage Mlambo, student number, 200706118, hereby declare that I am fully aware of the University of Fort Hare’s policy on research ethics and I have taken every precaution to comply with the regulations. I have obtained an ethical clearance certificate from the University of Fort Hare’s Research Ethics Committee and my reference number is the following: ..........................

Signature: ..............................
ACKNOWLEDGEMENTS

First and foremost, my everlasting thanks to the Lord God Almighty for His steadfast and continual provision of wisdom and love which sustained me hitherto. If it was not for your love, grace, guidance, peace and protection that saw me through, I would not have reached this end. My deepest thanks to my supervisor, Mr A Maredza, for his encouragement and assistance; your availability for consultation and direction made the difference in my study. May the Lord bless you abundantly.

To Dr. W. Smith, my mentor, my academic life at University of Fort Hare would not have been easier without you. Thank you so much for your assistance and support. To my friends Eugine, Kin, Taps, Jena, Sitima, Chims, Carol, Wilson and Ali; thank you for being wonderful friends, your positive support contributed significantly to this piece of work, thank you very much. Lastly, I would like to thank the Department of Economics for its support and motivation.
DEDICATION

To my loving and caring mum, Mrs. Mlambo and sister Kudzai Mlambo, I gratefully and emotionally dedicate this Masters project to you for always being there when I was in need. Thank you for being a gift and blessing from God.
**LIST OF ACRONYMS AND ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APT</td>
<td>Arbitrage Pricing Theory</td>
</tr>
<tr>
<td>ARCH</td>
<td>Auto Regressive Conditional Heteroscedasticity</td>
</tr>
<tr>
<td>ARMA</td>
<td>Autoregressive moving-average</td>
</tr>
<tr>
<td>ASIGISA</td>
<td>Accelerated and Shared Growth Initiative for South Africa</td>
</tr>
<tr>
<td>CAPM</td>
<td>Capital Asset Pricing Method</td>
</tr>
<tr>
<td>COSATU</td>
<td>Congress of South African Trade Unions</td>
</tr>
<tr>
<td>DTI</td>
<td>Department of Trade and Industry</td>
</tr>
<tr>
<td>EGARCH</td>
<td>Exponential General Autoregressive Conditional Heteroscedasticity</td>
</tr>
<tr>
<td>EMH</td>
<td>Efficient Market Hypothesis</td>
</tr>
<tr>
<td>FDI</td>
<td>Foreign Direct Investment</td>
</tr>
<tr>
<td>GARCH</td>
<td>General Autoregressive Conditional Heteroscedasticity</td>
</tr>
<tr>
<td>JSE</td>
<td>Johannesburg Stock Exchange</td>
</tr>
<tr>
<td>LM TEST</td>
<td>Langrange Multiplier Test</td>
</tr>
<tr>
<td>LSE</td>
<td>London Stock Exchange</td>
</tr>
<tr>
<td>MC</td>
<td>Market Capitalisation</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>OLS</td>
<td>Ordinary Least Squares</td>
</tr>
<tr>
<td>RANDVOL</td>
<td>Volatility of the Rand</td>
</tr>
<tr>
<td>SA</td>
<td>South Africa</td>
</tr>
<tr>
<td>SARB</td>
<td>South African Reserve Bank</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>UNECA</td>
<td>United Nation Economic Commission for Africa</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>VAR</td>
<td>Vector Auto regression</td>
</tr>
<tr>
<td>VECM</td>
<td>Vector Error Correction</td>
</tr>
</tbody>
</table>
Table of Contents

ABSTRACT ................................................................................................................. i
DECLARATION ON COPY RIGHT ........................................................................... ii
DECLARATION ON PLAGIARISM .......................................................................... ii
DECLARATION ON RESEARCH ETHICS ............................................................... ii
ACKNOWLEDGEMENTS ......................................................................................... iii
DEDICATION ........................................................................................................... iv
LIST OF ACRONYMS AND ABBREVIATIONS ....................................................... v
CHAPTER ONE ....................................................................................................... 1
INTRODUCTION ..................................................................................................... 1
1.1 Background of Study ......................................................................................... 1
1.2 Problem statement ......................................................................................... 4
1.3 Objectives ....................................................................................................... 5
1.4 Hypotheses ..................................................................................................... 5
1.5 Significance of the study ................................................................................ 5
Organisation of the study .................................................................................... 5
CHAPTER TWO ..................................................................................................... 7
An overview of the exchange and stock market developments in South Africa .... 7
2.1 Introduction .................................................................................................... 7
2.2 Exchange rate policy ...................................................................................... 7
  2.3.1 South Africa’s exchange rate policy ........................................................... 8
  2.3.2 Reasons why South Africa adopted a flexible exchange rate regime ........ 10
2.4 Volatility of the rand ...................................................................................... 12
Figure 2.1: Rand/US Exchange Rate .................................................................... 14
Figure 2.2: Rand/US Exchange Rate .................................................................... 16
Figure 2.3: Rand/US Exchange Rate .................................................................... 17
2.5 The Johannesburg Stock Exchange (JSE) .................................................... 18
2.5.1 Introduction ................................................................................................................. 18
2.5.2 Background of the JSE ............................................................................................. 18
2.5.3 The role of the JSE as a stock market in South Africa ............................................. 19
2.5.4 An analysis of the economic indicators on the JSE .................................................. 21
  2.5.4.1 Total value of shares traded on the JSE ................................................................. 22
  Figure 2.4: JSE stock market transactions: Total value of shares traded on the JSE ........ 22
  2.5.4.2 Total volume of shares .......................................................................................... 23
  Figure 2.5: JSE stock market transactions: Total volume of shares traded on the JSE .... 23
  2.5.4.3 Market capitalization on the JSE ......................................................................... 24
  Figure 2.6: Market capitalization as a % of GDP ............................................................. 25
  2.5.4.4 All share index ...................................................................................................... 26
  Figure 2.7 All share index trend from 2000 to 2010.......................................................... 27
  2.5.4.5 Liquidity on the JSE ............................................................................................. 27
2.6 General assessment of the rand exchange rate and stock market performance ............ 28
2.7 Conclusion ...................................................................................................................... 29
LITERATURE REVIEW ....................................................................................................... 30
3.1 Introduction ...................................................................................................................... 30
3.2 Theoretical literature ...................................................................................................... 30
  3.2.1 Flow oriented model ............................................................................................... 30
  3.2.3 Empirical validity of the flow oriented model ......................................................... 31
  3.2.4 Stock oriented model ............................................................................................... 33
  3.2.5 Monetary models ..................................................................................................... 33
  3.2.6 Portfolio balance model .......................................................................................... 35
  3.2.7 Empirical validity of the Portfolio balance models .................................................. 37
  3.2.8 Efficient Market Hypothesis .................................................................................... 38
    3.2.8.1 Weak form efficiency .......................................................................................... 39
    3.2.8.2 Semi-strong Efficiency ...................................................................................... 40
4.2.1 Definition of Variables ................................................................. 66
4.2.2 Expected priori ................................................................. 67
4.3 Data sources and analysis ................................................................. 68
4.4 Testing for stationarity / Unit root .................................................. 69
  4.4.1 The ADF Test ................................................................. 69
  4.4.2 Phillips Peron test ................................................................. 70
4.5 Testing for ARCH effects (Heteroscedasticity Test) ......................... 70
4.6 Diagnostic tests ............................................................................. 71
  4.6.1 Normality Test ................................................................. 71
  4.6.2 Residual Diagnostics/Correlogram-Q-statistics ......................... 72
  4.6.3 Serial Correlation Test ................................................................. 72
    4.6.3.1 LM Test ................................................................. 72
4.7 Estimation Techniques ..................................................................... 73
  4.7.1 GARCH Model ...................................................................... 73
4.8 Conclusion ..................................................................................... 75
CHAPTER FIVE ..................................................................................... 76
5.1 Introduction ..................................................................................... 76
5.2 Descriptive statistics of monthly changes of stock market index and exchange rate ...... 76
  Table 5.1: Descriptive statistics ................................................................. 77
  Table 5.2 Matrix of correlation of independent variables ..................... 78
5.4 Testing for ARCH effects ................................................................. 79
  Table 5.3. ARCH test ................................................................. 79
  Table 5.4 Correlogram of squared residuals ......................................... 80
    5.5.1 Testing for stationarity................................................................. 81
  Figure 5.1 Graphical Representation of the Variables in Levels .................. 81
  Figure 5.2 Graphical Representation of the Variables in Levels .................. 82
    5.5.2 Augmented Dickey Fuller Results ............................................. 83
Table 5.5 Unit Root/ Stationarity Tests: ADF Test ......................................................... 83
  5.5.3 Phillips Peron test results .................................................................................. 83
Figure 5.3 Graphical Representation of the Variables after differencing ...................... 85
Figure 5.4 Graphical Representation of the Variables after differencing ...................... 86
5.6 The GARCH Model: Presentation of results .......................................................... 86
  5.6.1 Non normal Conditional Returns: choosing an appropriate GARCH model .... 86
  5.6.2 Presentation and Interpretation of results ......................................................... 87
Table 5.7 Presentation of results ................................................................................. 88
  5.6.2.1 Mean equation ......................................................................................... 89
  5.6.2.2 The variance equation .............................................................................. 91
5.7 Diagnostic Tests ................................................................................................. 93
  5.7.1 Normality test ............................................................................................ 93
Table 5.7 Normality test ......................................................................................... 93
  5.7.2 Heteroscedasticity test ............................................................................... 94
Table 5.8 ARCH test ............................................................................................. 95
  5.7.3 Testing for autocorrelation ......................................................................... 95
    5.7.3.1 Q-statistic Test .................................................................................. 95
Table (s) 5.9 Correlogram squared residuals ............................................................ 96
5.8 Conclusion and discussion of results ................................................................. 96
SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS ............ 98
  6.1 Summary of the study and conclusions ............................................................. 98
  6.2 Policy Implications and Recommendations ...................................................... 100
  6.3 Possible areas for further research ................................................................. 102
References ............................................................................................................. 103
Appendices ........................................................................................................... 128
Appendix 1 Data used in the regressions ................................................................. 128
List of figures

Figure 2.1: Rand/US Exchange Rate ................................................................. 14
Figure 2.2: Rand/US Exchange Rate ................................................................. 16
Figure 2.3: Rand/US Exchange Rate ................................................................. 17
Figure 2.4: JSE stock market transactions: Total value of shares traded on the JSE ........... 22
Figure 2.5: JSE stock market transactions: Total volume of shares traded on the JSE ........... 23
Figure 2.6: Market capitalization as a % of GDP .................................................... 25
Figure 2.7 All share index trend from 2000 to 2010.................................................... 27
Figure 5.1 Graphical Representation of the Variables in Levels................................. 81
Figure 5.2 Graphical Representation of the Variables in Levels................................. 82
Figure 5.3 Graphical Representation of the Variables after differencing ....................... 85
Figure 5.4 Graphical Representation of the Variables after differencing ....................... 86
List of tables

Table 3.1 Review of selected studies done in developed studies ........................................... 60
Table 3.2: Review of selected studies conducted around the globe ........................................ 63
Table 5.1: Descriptive statistics ............................................................................................... 77
Table 5.2 Matrix of correlation of independent variables .......................................................... 78
Table 5.3. ARCH test .............................................................................................................. 79
Table 5.4 Correlogram of squared residuals ........................................................................... 80
Table 5.5 Unit Root/ Stationarity Tests: ADF Test ................................................................. 83
Table 5.6 Presentation of results .............................................................................................. 88
Table 5.7 Normality test ......................................................................................................... 93
Table 5.8 ARCH test .............................................................................................................. 95
Table (s) 5.9 Correlogram squared residuals ......................................................................... 96
CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Exchange rate volatility is at the core of the raging debate on the performance of exchange rate regimes. This concern was reinforced by the large movements in nominal exchange rates that characterized world financial markets since the move to a managed floating exchange rate system in 1973 (Akpokodje and Omojimite, 2010). A major concern of policy makers at the demise of the Bretton Wood system is the consequence of exchange rate volatility perceived to be a prominent feature of a flexible exchange rate system. Currency volatility has considerable implications in the financial markets, especially the stock market.

The rand has been the most volatile among emerging currencies over the past few years. South Africa’s recent measures to reduce the rand’s volatility haven't had a desired impact as the currency's fluctuation is fueled by global economic instability and capital inflows from developed countries (Davies, 2010). South Africa has experienced considerable and continued currency volatility during the past few years despite of strong economic fundamentals. Pretorius and de Beer (2002) note that the worrying volatility of the rand resulted in the appointment of the Myburgh Commission of inquiry into the depreciation of the rand. Policymakers and academics have increasingly wondered about the nature of the currency volatility crises, the factors responsible for their spread and particularly whether a country with seemingly appropriate domestic and external fundamentals can suffer from currency crisis.

From January 1, 1996 to May 29, 2002, the value of the rand depreciated from R3.64 per US$ to R9.85, reaching an all-time low of R13.002 on December 20, 2001 (Pretorius and de Beer, 2002). Over the years, the rand exchange rate has continued to display a relatively high degree of volatility in response to erratic changes in global risk aversion. The currency plunged to a two-year low of R8.49 in late September (2011) from around R6.80 at the start of August and has since rebounded to R7.89 (Mail and Guardian, 2011). Nedbank (2012) further maintains that the rand rose by 0, 4% against the US dollar in May and June 2012 and later firmed against the US dollar by 0.7% in August and September 2012. All these statistics showed that the rand has been volatile and vulnerable to both local and international developments.
In the financial sector, South Africa is seen as having one of the best run emerging economies in the world, with efficiently managed world class companies. According to the United Nation Economic Commission for Africa (UNECA, 2008), the Johannesburg Stock Exchange (JSE) stands as an attractive vehicle for the infusion of foreign investments in Africa. The JSE (established in 1886) is the oldest stock exchange market in Africa. The UNECA (2008) maintains that the JSE, in its 120 years of existence, has developed into one of the biggest stock exchange in the world. African markets are usually characterized by low capitalization and are still regarded as infants in the world stock exchange. In contrast to this, the JSE has emerged as one of the best in the world. By March 2011, the JSE was ranked 20th in the world and the value of market capitalization was 6,785.6 billion dollars up from 6,143.2 dollars the previous year (JSE, 2011).

“The integration of the JSE into the world market has been boosted by the continued innovation and developments it has been making. Mboweni (2001) argues that during 2001, the JSE entered into two agreements with the London Stock Exchange (LSE) to provide for co-operation in respect of data dissemination and the possibility of remote membership and dual primary listings on both exchanges. The relations with the London Stock Exchange (LSE) have been strong and have largely improved the operations on the JSE. The JSE TradElect, which is the JSE’s fully automated trading system, is operated under the licence from the LSE. These and other developments have contributed to the JSE’s global standing and this has improved JSE’s efficiency and its chances of attracting investors both locally and abroad. This has made it to be one of the best performing stock exchanges in the world.

However, the JSE has been affected by exchange rate movements in recent years. “In the early 2000s, the South African Reserve Bank (SARB) tightened its monetary policy in a bid to keep inflation within the target band of 3-6%. Consequently, the SA rand appreciated significantly. However the strength of the rand led to a 10% decline in the JSE index in local currency terms and 24% increase in US dollar terms” (UNECA, 2008). High currency volatility makes it difficult for businesses to plan and budget. Currency risk presents a curious problem. On the one hand, currency movements will have a large impact on the rand value of cash flows from foreign projects. Further, to the extent that the project involves a mixture of local and international costs or revenues, currency changes will also alter the local currency cash flows (Stern and Chew, 2003).
It is acknowledged that South Africa’s nominal exchange rate volatility is among the highest of all commodity exporters and emerging markets and that, in time of “excessive volatility”, currency movements do not act as a shock absorber reflecting changes in relative prices, but as a “source of vulnerability” (Zhuwakinyu, 2010). In spite of major improvements in the administration of fiscal and monetary policy, currency volatility deters investors in tradable goods and services outside of the commodity sector. “The rand remains somewhat volatile, though the degree of volatility has been reduced. At present, the relative volatility is accompanied by a currency that is over-valued in the sense that economic resources are diverted into narrow areas of investment, laying an unsteady foundation for the future” (Accelerated and Shared Growth Initiative for South Africa (ASGISA), 2008)

The way the South African Reserve Bank monitors exchange rate developments has been blamed for the volatility of the rand. “The Reserve Bank also does not intervene in the market of foreign exchange to defend any specific level of the rand. This is rather left to supply and demand conditions in the foreign exchange market” (Van de Merwe and Mollentze, 2009). The freely floating exchange rate of the rand has accordingly resulted in substantial fluctuations in the external value of the rand.

Knedlik (2006) maintained that the increased volatility of exchange rates in emerging markets is also attributed to the smaller size of their economies and consequently the smaller size of the market for their currency. Higher exchange rate volatility in emerging market countries is therefore an understandable expectation and reflects fundamental differences in the structure of economies. Nonetheless, it is obvious that a major obstacle for efficient planning in the business sector, and the authorities would have preferred to have greater exchange rate stability. Yet, under the current circumstances, exchange rate fluctuations are probably unavoidable. Volatile financial flows sometimes caused by developments in other currencies make the achievement of exchange rate stability nearly impossible (Van de Merwe and Mollentze, 2009).

Benita and Lauterbach (2004) showed that exchange rate volatility have real economic costs that affect price stability, firm profitability and a country’s stability. Exchange rate volatility has implications for the financial system of a country especially the stock market. Exchange rate volatility generates air of uncertainty as the variance of expected profits rises and its net present value falls (Ogunleye, 2002). Stock market plays a very crucial role in assessing economic conditions of any country through improved stock returns usually signified by
higher profit to firms. This consequently engenders economic growth and vice versa. Basically stock exchange market serves as a channel through which surplus funds are moved from Lender-Savers to Borrower-Spenders who have shortages of funds (Mishkin 2000). Based on this premise, volatility in stock prices can significantly affect the performance of the financial sector as well as the entire economy.

Moreover, currency volatility leads to the problems of exchange rate risk. Exchange rate risk, or currency risk, is the risk that a business’s operations or an investment’s value will be affected by changes in exchange rates (Vaidya, 2006). For example, if money must be converted into a different currency to make certain investment, changes in the value of the currency relative to the US dollar will affect the total loss or gain on the investment when the money is converted back. This risk usually affects businesses but it can also affect individual investors who make international investments. Thus exchange risk is higher under conditions of exchange rate volatility (Vaidya, 2006).

1.2 Problem statement
The volatility of the rand has been seen as one of the biggest challenges the South African economy is facing. Although there have been calls by trade unions such as Congress of South African Trade Unions (COSATU) and other firms in the manufacturing industry to reduce the rand value, the stability in the rand’s exchange rate has also been seen as, by far, the preferable option for the financial sector and the industry at large. The rand has created a political economy dilemma for South Africa. Currency volatility was identified by ASGISA as one of the factors that is inhibiting economic growth in South Africa. The excessive volatility of the rand is driven largely by the tidal wave of structural shifts in the global economy. The volatility of the rand has affected almost every aspect of the South African economy including the stock market. Understanding the relationship between exchange rate volatility and stock prices is important from the point of view of policy makers, and the investment community in this changing global environment. This has, in turn creates a need to understand the link between exchange rates and stock prices to hedge the portfolio risk.

A large body of literature examines the relationship between stock prices and foreign exchange rates in developed as well as developing countries. However, there is no settled opinion with regard to the relationship between these variables. Controversy exists among economists and policy makers as to whether there is a positive or negative relationship between currency volatility and the stock market prices. This controversy makes the study of exchange rate volatility and the stock market interesting and challenging.
1.3 Objectives
The main objective of this study is to examine the impact of currency volatility on the stock market in South Africa. The study also has the following sub-objectives:

- To examine the trends between exchange rate movements and stock market capitalisation.
- To measure and analyze the extent of the relationship between exchange rate changes and stock market capitalisation.
- To investigate the dynamic relationship between foreign exchange market and stock market in South Africa.

1.4 Hypotheses
H₀: Exchange rate volatility has no significant impact on the stock market in South Africa
H₁: Exchange rate volatility has a significant impact on the stock market in South Africa

1.5 Significance of the study
South Africa’s floating exchange system has resulted in exchange rate instability. This has affected many businesses including the stock market. The degree with which exchange rate changes affect stock markets has been studied, but results have been inconsistent. Understanding the relationship between exchange rates and stock prices is important from the point of view of policymakers, and the investment community in this changing global environment. The rand's fluctuation is fueled by global economic instability and capital inflows from developed countries. Improved knowledge of volatility spillover effect between the rand and the stock markets, and consequently the degree of their integration, will expand the information set available to portfolio managers, multinational corporations, and policymakers for decision-making. Studies have been conducted but empirical evidence on the influence of foreign exchange market volatility on stock market is largely inconsistent. In the light of the somewhat mixed result achieved by earlier studies, this study shall take a deeper level of analysis to the discussion of exchange rates and stock markets and it is hoped that additional insight into the problem can be achieved.

Organisation of the study
Following this introduction, chapter two shall give an overview of trends in the relationship between exchange rate changes and the stock market between 1995 and 2010. Chapter three will review both the theoretical and empirical literature pertaining to the relationship between exchange rates and the stock market. Chapter four shall discuss the methodology and the
sources of the data to be used in this study. Chapter five shall estimate the regression model and interpret the results. The dissertation’s key findings, policy recommendations, suggestions for further research and conclusion are contained in chapter six.
CHAPTER TWO

An overview of the exchange and stock market developments in South Africa

2.1 Introduction
The aim of this chapter is to present an overview of the exchange rate movements and developments on the JSE over the period 2000 to 2010. The knowledge of the exchange rate policies and exchange movements helps to shed light on understanding the reason why the rand exchange rate is volatile. This chapter is divided into four sections. The first section of this chapter gives an overview of the exchange rate policy and rand exchange rate developments in South Africa. An understanding of the South African exchange rate policy and the behavior of the rand exchange rate is crucial to policy makers. The second section provides an analysis of the developments on the JSE. An overview of the JSE is necessary as it is the market which the stocks are determined. In addition to this, several economic indicators on the JSE are analyzed. The third section is a general assessment of the performance of the rand exchange rate and the stock market. This is vital in order to understand whether a relationship exists between the developments in the rand exchange rate and the economic indicators on the stock market. The chapter ends with some concluding remarks to serve as a summary of the whole chapter.

2.2 Exchange rate policy
Exchange rate policy is a fundamental aspect of policy arguments relating to global competitiveness and macroeconomics concerns. Farrell and Todani, (2004) argue that movements in exchange rates can have a significant impact on economic growth, employment, inflation and the balance of payments as well as on the well-being of individuals. Exchange rate changes affect macroeconomic factors such as inflation, economic growth, employment creation and income distribution. Monetary policy-makers therefore need to closely monitor exchange rate developments to make the right decision (Van De Merwe, 2004). Exchange rate developments are an important aspect of the economy which the government must always stand guard on. The result of having inappropriate exchange rate policies would be a misaligned exchange rate. This misalignment has been blamed for a series of economic disasters suffered by economies around the globe. The increase in globalization has also made the exchange rate policy to be one of the key determinants of both internal and external stability.
The globalization process has allowed financial transactions and money to relatively move across national boundaries and this has made the exchange rate to be one of the most important instruments for managing the country’s economy. South Africa is no exception to this. Hentz (2005:18) noted that as “transitional South Africa opened up, globalised exchange rates became a pivotal policy instrument”. Exchange rates have come to be one of the most important prices in the economy. As a result of this, general exchange rate policies are now being directed to some proximate objectives, including external balance, internal balance, and micro economic efficiency (Boker, Boraine, and Krafchik, 1993:138). The question, however, of achieving proximate objectives (for example internal and external balances) are very much decided by the choice of exchange rate regime.

The choice of exchange rate regimes has been a central decision facing policymakers in almost all economies around the globe. The exchange rate has important implications for trade, inflation, Gross Domestic Products (GDP), financial markets and many other aspects of the economy. Different exchange rate regimes can be operated to achieve the chosen objectives—these include fixed exchange rates, independent floating and a variety of intermediate regimes such as adjustable peg or crawling peg (Boker et al., 1993:138). The demise of Breton-Woods system of fixed exchange rates in 1973 made many countries to adopt the floating exchange rates. Several countries adopted flexible exchange rates regime despite its exposure to exchange rate volatility, which is a threat to the growth of international trade and macroeconomic stability (Sekantsi, 2008). South Africa is one of the countries that have a flexible exchange rate policy. Like in other countries that have flexible exchange rate policies, there has been excessive volatility in the South African economy. The continued fluctuation of the rand has been, largely, blamed on the exchange rate policy that is in place in South Africa. The next section shall look, in particular, at the exchange rate policy of South Africa.

2.3.1 South Africa’s exchange rate policy
In South Africa, exchange rate regimes have evolved from being fixed, to managed floating and finally to free floating in the year 2000. The adoption of the inflation targeting regime in the year 2000 had implications on the manner with which the exchange rate policy is conducted. The SARB chose to conduct inflation targeting and having a flexible exchange rate. The inflation targeting framework, like in any state where it is applied, has allowed the exchange rate to float and there are no exchange rate targets. Under a pure inflation targeting regime that the SARB chose to conduct, the central bank has limited control in the foreign
exchange market. Mohr and Fourie (2004) concur with the above assertion that during the last quarter of 2001, when the rand depreciated sharply against the main currencies, the SARB steadily refrained from intervening in the foreign exchange market to support the rand. The value of the rand exchange rate was and is still determined by the forces of demand and supply in the foreign exchange market. Although the exchange rate is perceived as an important transmission mechanism for monetary policy that could affect inflation and economic growth, the SARB is of the view that too much concern about exchange rate stability can induce the wrong policy response (Stone, Roger, Shimizo, Nordstrom, Kisinbay and Restrepo, 2009:57)

The SARB can, however, participate in this market by buying or selling other currencies. However, at present the policy is generally to stay out of the market and to allow market forces to determine the exchange rate (SARB, 2011). This does not mean that the Reserve Bank is not concerned about the exchange rate of the rand, because exchange rate changes impact on inflation (Van Der Merwe, 2003). This implies that the central bank has no specific target for the exchange rate of the rand and hence the value of the currency is determined by supply and demand in the domestic market for foreign currency. While the exchange rate control cannot be a main policy objective under inflation targeting, paying attention to exchange rate developments is warranted as it remains one of the key macroeconomic variables in South Africa (Organisation for Economic Co-operation and Development (OECD), 2010:73). The Central bank can intervene in the foreign exchange market. If the SARB is to intervene in the market, there must be circumstances (for example a rapid depreciation that would cause inflation to move out of its target band) that would be pushing it to intervene at that particular time. It would be doing so to ensure the efficient functioning of the economy not to really target the exchange rate per se.

When the SARB intervenes in the foreign exchange market it would be examining the exchange rate from the view of whether and how it affects the inflation rate and inflation forecast. This is done in order to maintain its purpose of achieving and maintaining price stability. Maintaining price stability is the Central Bank’s top priority and anything that affects price stability is acted upon immediately. This is done to create economic conditions that would be favourable for economic growth. Stone et al. (2009:57) argue that while allowing the exchange rate to be determined by the market, the SARB aims at creating underlying economic conditions that are conducive to exchange rate stability. This entails that at times, when it sees it fit, the SARB can intervene in the foreign exchange market. The
SARB intervenes in the foreign exchange market, also, to bolster its reserve position through purchases of dollars. The reason behind the intervention into the foreign exchange markets by the Central Bank is the instability of the exchange rate that it characterized in flexible exchange rate regimes. If the foreign exchange market is left to its own devices, exchange rates tend to fluctuate quite considerably, since the demand for and supply of foreign exchange is not synchronized on a day-to-day basis.

The freely floating exchange rate is very much vulnerable to speculation. This has caused the SARB to, at times; intervene in the foreign exchange market. In recent years the Bank has been building up foreign exchange reserves and this involves the purchase of foreign exchange from the market (SARB, 2011). Such actions are meant to create a conducive environment that would allow for exchange rate stability but this does not imply that the SARB has control over the exchange rate. Although the Central Bank can apply such actions to influence the exchange rate, it is not its objective to play a role in the foreign exchange market. However, this flexible exchange rate policy has been blamed for the excessive volatility. The SARB and the government, have, however maintained that it is the only exchange rate policy that South Africa can have at the present time. The reasons as to why the flexible exchange policy is best for South Africa are the focus of the next part of this section.

2.3.2 Reasons why South Africa adopted a flexible exchange rate regime

The decision on the adoption of a specific monetary policy stance depends on the underlying economic circumstances and it also depends on the government’s decision. The government can decide on a certain monetary policy after a perception of what it wants to achieve. Many countries such as South Africa and the United States have as a monetary objective the achievement of price stability. Some countries the United Kingdom decided to target inflation straight since it affects price stability. But it must be noted that the decision on the appropriate monetary policy stance is not always clear-cut. It depends on how the government wishes to monitor the activities in the economy. The government can target inflation and at the same time having a fixed exchange rate. It is the government that can choose to take whatever monetary policy stance it wishes to take. South Africa adopted the inflation targeting and decided not to intervene much in the exchange market in February 2000. They choose to do this for a number of reasons.
First, attempts in the past to maintain a fixed or semi-fixed exchange rate system by pegging the rand to the dollar, sterling and a basket of currencies were applied without any meaningful success (Van De Merwe, 2004). South Africa tried some other exchange rate policies but without much success. The Central Bank tried many exchange policies but all to no avail. The period between 1984 and 1995 saw the Reserve Bank entering into the foreign exchange market as an active participant. However, the reintegration of the South African economy, after 1994, into the world economy saw South Africa relaxing exchange rate controls. In the years after 1994 the Central Bank begun (1998) to adopt some inflation targeting aspects although they didn’t implement if fully. The Central Bank finally moved to inflation targeting in the year 2000 having seen that its benefits outweighed those of the monetary policy frameworks it had been using before.

Secondly, other monetary frameworks, such as exchange rate targeting, have failed in some other states and the government has been reluctant to try them fearing that they would cause some disasters. The main fear has been speculative attacks and contagion that other monetary policy frameworks can expose the economy to. Swanepol (2006:146) finds that “South Africa is the only country in the Sub-Saharan region with sophisticated financial markets and substantial private capital inflows and as a result is fully exposed to contagion”. Having seen what happened in Europe\(^1\), the government has been reluctant to adopt the exchange rate targeting framework. The issue of speculative attacks has been an area of concern to the government with regard to the adoption of exchange rate targeting.

Furthermore, monetary policy flexibility is effectively abandoned with the application of the various forms of fixed exchange rate regimes. For instance with a fixed peg or a currency board, short-term interest rates are to a large extent determined by the authorities of the country to which the domestic currency is pegged. The interest rate levels are therefore not necessarily appropriate to the needs of the domestic economy and may create general economic instability which could have more adverse effects than exchange rate instability. In the present international monetary system fluctuations in the exchange rate of a currency are unavoidable. The authorities can only aim at creating underlying economic conditions that are conducive to exchange rate stability.

Lastly, A “flexible exchange rate also works as a shock absorber, in particular for a country like South Africa which is frequently exposed to large terms of trade shocks” (OECD,\(^1\) Hungary (1992) and Sweden (2003)
A flexible exchange rate acts as a kind of shock absorber that helps to insulate against overseas disturbances. Edwards and Yeyati (2004) observed that flexible exchange rate arrangements indeed help reduce the real impact of terms of trade shocks, both in emerging and industrial economies. This is because the link between international transactions and the foreign exchange market runs in both directions.

Although the reasons cited above are advantageous to the South African economy, the flexible exchange regime has made policy makers in the business sector and even the government to worry. The main problem is that of causing the rand exchange rate to be volatile. The rand has been one of the most volatile currencies among the emerging markets. The next section shall focus more on the rand volatility.

2.4 Volatility of the rand
In South Africa the determination of the external value of the rand has been left to supply and demand conditions in the foreign exchange market. The SARB allows the exchange rate to be determined in the market while taking account of its impact on prices in the context of inflation targeting. The policy of a market-determined rand and the relaxation of exchange controls have exposed the currency to domestic and external shocks, consequently increasing its volatility (Karoro, Aziakpono and Cattaneo (2008). The rand remains vulnerable to the country’s large current account deficit, and exposure to commodity price movements. This causes concern about greater fluctuations in the exchange rate (Stone et al., 2009:58). The stability of the rand is much preferred by both the government and investors but under the current global economic trends, currency volatility is unavoidable.

Currency volatility was identified by the South African authorities as one of the constraints on growth in Accelerated and Shared Growth Initiative for South Africa (ASGISA) in 2006 (OECD, 2010:74). The sources of rand instability or volatility are exogenous. In effect, fundamental shifts in the dynamics of the global capital market, together with marginally high domestic interest rates, lead to sustained strength and volatility of the currency (Hale and Hughes, 2011:136). The instability or volatility of the rand has, also, been caused by large fluctuations in financial flows and this has made the achievement of the stability of the rand to be nearly impossible. Since the adoption of a floating exchange rate regime together with the inflation-targeting monetary policy framework, substantial swings have occurred in the exchange rate of the rand.
Exchange rate volatility usually impacts negatively on an economy. Fluctuations in the exchange rate of the rand obviously complicate monetary policy decision-making and the planning of enterprises involved in international trade. Farrell (2001) is of the opinion that volatility creates uncertainty regarding import and export prices, the valuation of foreign exchange reserves, and the repayment of debt and other open positions denominated in foreign currencies. This will in turn affect activities on the stock market because most companies that do trade are listed on the stock market. Rather than investing on the stock exchange, investors would rather take their business elsewhere. Farrell (2001) further maintains that risk-averse agents respond by directing their resources toward less risky activities, causing trade volumes to contract, and investment levels to be depressed. Locally, the volatility of the rand may have a strong adverse impact on the South African economy by being an impediment to the expansion of foreign trade, making inflation targeting trickier, hindering the development of domestic capital markets and ultimately turning South Africa into an “original sin” country (Grandes and Pinaud, 2005:92).

As a result of the rand volatility negative effects on business and the economy, stakeholders in the business sector have raised concerns to the government to the effect that the rand should be stable. They see the rand as too volatile and an unstable currency. Since the year 2000 the rand has undergone some periods of short term fluctuations. Grandes and Pinaud (2005:77) argued that the rand exchange rate has actually behaved according to a staircase adjustment process having featured periods of stability and strengthening followed by episodes of strong depreciation and downward overshooting. The international foreign exchange activity has accelerated in recent decades as a result of the rapid globalization of financial markets. Globalization together with the adoption of freely floating exchange rate regimes have made cross border capital flows swift and effortless. This has heralded an era of increased exchange rate volatility in global currency markets given the role exchange rates play in international transactions (Raputsoane, 2008). South African is no exception to this; the rand has been too volatile. From the year 2000 when the inflation targeting-flexible exchange regime was adopted, the rand has undergone an era of excessive volatility. This is reflected in Figure 2.1.
Figure 2.1: Rand/US Exchange Rate

Source: Own graph made from figures from the Department of Trade and Industry (2011)

Figure 2.1 shows that the rand experienced a sharp depreciation in the year 2000. An accelerated devaluation occurred from 2000 until 2002. The rand depreciated sharply in 2000 and it continued with the weakening trend in the year 2001. In 2001 the rand depreciated by 10.7% or an average of 1.3% per month during the first eight months, and from 1 September to 31 December, the rand weakened by 42%, an average of 10.5% per month. The rapid depreciation of the rand in of 2001 was a huge concern that the government was forced to make a formal inquiry in to the depreciation of the rand. The Myburgh Commission was tasked to investigate the causes of the rapid depreciation of the rand by the government. The final report of the commission was released on August 2002 and it pointed to several macroeconomic factors behind the depreciation. The reasons included slowdown in global economic activity, contagion from events in Argentina, and a worsening in the current account balance in the fourth quarter of 2001 (Bundia and Gottschalk, 2003:4).
The year 2002 saw the rand strengthening drastically and it maintained that trend in 2003. By mid 2003, the nominal effective exchange rate returned close to its end-2000 level—just before the start of the depreciation.

The period between 2000 and 2003, as shown by the graph, was marred by excessive volatility in the rand. The rand fluctuated significantly, starting with a rapid depreciation, and then later to be followed by an appreciation; the rand exchange rate was never stable. The SARB’s monetary policy of inflation targeting greatly influenced the way in which the rand behaved between 2002 and 2003. Samson, Ampoto, Mac Quene, Ndlebe and Van Niekerk (2003) argued that high interest rates employed for disinflation generate a South African premium over international interest rates, leading to capital inflows that tend to appreciate the rand. “The 5 percentage point increase in the interest rate differential explains between 5 to 15% of the rand’s appreciation. In addition, the increase in capital flows in 2002 explains between 2 and 5% of the rand’s appreciation in 2002 and 2003” (Samson et al., 2003).

The volatility trend continued in the following years. The exchange rate trends from the year 2004 to 2007 are shown in figure 2.2.
Figure 2.2: Rand/US Exchange Rate

![Rand/US exchange rate (Volatility)](image)

*Source: Own graph made from figures from the Department of Trade and Industry (2011)*

Figure 2.2 shows that the rand exchange rate was relatively volatile in 2004. It fluctuated moderately. It followed that trend in the year 2005. It depreciated in mid 2005 but later to gain strength again that same year. However, the magnitude with which it was depreciating and appreciating was small in the year 2005. Stone *et al.* (2009:57) noted that in 2005, the rand was supported by high commodity prices, foreign direct investment flows, and positive economic data for SA despite the growing current account deficit. After remaining relatively stable, the exchange rate encountered depreciation pressures in 2006. The rand weakened significantly towards the end of 2006. The reason behind the depreciation of the rand might have been the uncertainty in the direction of the interest rates in the United States. In 2007 the rand rallied modestly all year through. It was fluctuating with small margins and overall, it was relatively stable.

Although the rand could not depreciate and appreciate with high margins between 2004 and 2007, it should be noted that it was not stable hence we can conclude that it was volatile. The rand fluctuated considerably and it was never stable enough for volatility to be ruled out. The fact that it fluctuated in these years makes the rand to be deemed volatile between the 2004
and 2007 period. The volatility continued in the following years that are 2008, 2009 and 2010. This is shown in figure 2.3.

**Figure 2.3: Rand/US Exchange Rate**

![Graph showing Rand/US Exchange Rate](image)

*Source: Own graph made from figures from the Department of Trade and Industry (2011)*

As shown in Figure 2.3, in year 2008 the rand exchange rate was characterized by a depreciation trend. It strengthened moderately in the year 2008. Nxedlana (2009) argued that there was a marked depreciation of exchange rate of the rand in October 2008 as risk aversion took hold and investors sold of risky assets and sought safety in US government debt. This trend lasted only for 2008; in 2009 the rand began to strengthen. The rand strengthened modestly in the year 2009 and it continued with that trend in 2010 but it was relatively stable in the year 2010.

The period between 2008 and 2010 was marked by rand exchange rate volatility. Significant levels of volatility can be observed especially in the first two years - that is in the years 2008 and 2009. The rand fluctuated significantly in these years and it can be deemed volatile. However, although the rand was relatively stable in 2010, on a month to month basis, the rand was too volatile. In other words the rate with which it fluctuated from one month to the next was too much and this deems it volatile.
2. 5 The Johannesburg Stock Exchange (JSE)

2.5.1 Introduction
The JSE stands high as the engine-room of the South African economy. “From its establishment in 1886 to modern day, the JSE has played and continues to play a vital role in the commercial and economic development of the Republic of South Africa (Mkhize and Msweli-Mbanga, 2006). The Johannesburg Stock Exchange lists more than 400 companies and is licensed under the Securities Services Act of 2004.

2.5.2 Background of the JSE
The Johannesburg Stock Exchange is the oldest stock exchange market in Africa. The JSE dates back to the 19th century and although very large in terms of capitalization, liquidity were historically low due to the domination of share ownership by a few large conglomerates linked either to mining companies or financial holding companies (Jefferis and Smith, 2005). This has mainly been caused, in part, by the government of the day which had legislation that was not favorable to the local people. This in turn caused the global world to put economic sanction against South Africa. Macedo and Kabbaj (2002:118) concur with the above assertion by arguing that the concentration of ownership was partly a result of strict exchange controls on the capital account, which restricted South African firms from exporting capital and left them with little choice but to take over other domestic firms. However after 1994 (after the demise of apartheid regime), there have been some positive changes and these changes have led to sharp rises in liquidity and activity on the JSE.

The JSE has benefited from substantial inflows of foreign portfolio investment since the ending of apartheid and the lifting of sanctions in 1994 (Macedo and Kabbaj, 2002:118). Since 1994 there have also been considerable institutional reforms of the JSE. The positive changes that brought positive results on the JSE include the permission of foreign owned members and limited liability corporate membership. As a result of these changes, the JSE is now one of the most technologically advanced in emerging markets. Furthermore, it operates as part of a relatively sophisticated financial sector characterized by a wide range of financial institutions, markets, and information flows that in many respects is more representative of a developed than a developing country (Jefferis and Smith, 2005:66).

A number of initiatives were introduced in the late 1990s to improve the efficient functioning of the exchange. Yartely (2008:10) held that the first major change occurred in November 1995, when the Stock Exchanges Control Act of 2001 changed the way in which stocks were

18
traded in South Africa, opening the door to non-South Africans, and allowing brokers to buy and sell stock on their own accounts. With the passage of time there were series of enormous developments on the JSE. The London Stock Exchange and the JSE Securities Exchange announced, in 2001, the signing of Head of Terms, representing a new development between these two international exchanges. The deal comprises the provision of core technology services by the LSE to the JSE Securities Exchange and aims to achieve easier access to each other’s markets for both member firms and issuers (JSE, 2001). On 13 May 2002 the JET write in full first system gave way to the JSE Stock Exchange Trading System (SETS), a trading system implemented in conjunction with the London Stock Exchange (LSE). The JSE has been keeping up with technology to make it compete with other stock exchanges around the globe. Over the years it has been updating its activities and making them keep pace with those of international stock market exchanges such as the London Stock Exchanges and Chicago Stock exchange. The JSE makes use of sophisticated technology and one of these technologies it uses is the fully automatic electronic trading on the Johannesburg Equities Trading (JET). The system is an order driven automated trading system acquired from the Chicago Stock Exchange and modified to suit the JSE’s specialized needs (Obienugh, 2010:136).

These and many other developments have helped the JSE to be a world class stock exchange and it has managed to set a foot in the world financial economy. Today, the JSE stands among one of the largest stock exchanges in the world and provides capital to large listed entities with its Alternative Exchange offering access for small business, and its Social Responsibility Index supporting businesses that invest in socially, economically, and environmentally sustainable development (United Nations, 2007:44). Regulatory, structural, and technological changes over the past decade have remade the exchange. Today, the JSE Limited offers the investor a first world class trading environment, with world class technology.

2.5.3 The role of the JSE as a stock market in South Africa
The JSE is licensed as a stock exchange (for equities) and as a financial market (for financial and agricultural derivatives) (Yartey, 2008). The JSE (2012) describes itself as the "engine room" of the South African economy, providing an orderly market for dealing in securities. On the JSE, companies from across the spectrum of industry and commerce gather to raise
the public capital that will allow them to expand, and in the process creating new jobs, products, services, and opportunities. In addition to this, the JSE performs the following roles that promote economic growth:

(i) Its main function is to make possible the raising of primary capital by re-channelling cash resources into productive economic activity, and building the economy while enhancing job opportunities and wealth creation. Stock exchanges have an important role in creating growth, ensure that growth is shared, and to help people save. The JSE fulfills its main function - the raising of primary capital - by re-channeling cash resources into productive economic activity, thus building the economy while enhancing job opportunities and wealth creation (JSE, access to information manual, 2012). The JSE has been playing an obviously central role in the promotion of economic growth in South Africa.

(ii) The JSE also provides an effective link that makes the engagement of investors and issuers possible. “From ‘between the chains’ in 1887 to between markets and across continents in 2008, the JSE has become the financial link between investors, issuers and analysts (JSE, 2008). The JSE has managed to provide an efficient platform with which investors can use to trade and conduct their business. The JSE is like active hub of activity where expansion is encouraged, businesses are enhanced, performance is driven and shareholder value is created (JSE, 2008).

(iii) The JSE is a financial platform which provides an efficient allocation of resources; and channels resources to the productive sectors of the economy. Ndako (2010) argues that, while Greenwood and Smith (1997) equally suggest that stock market components of financial system play an important role in the efficient allocation of resources which helps in promoting specialization, reducing the cost of mobilizing savings and ultimately higher economic growth. The JSE has facilitated the savings process on a different platform. Levine and Zervos (1996) argue that a well-developed stock market may be able to offer other forms of financial services than those available from banking systems, and may, therefore, provide a different kind of impetus to investment and growth. Specifically, the authors argue that increased stock market capitalisation,
measured either by the ratio of the stock market value to GDP or by the number of listed companies, may improve an economy’s ability to mobilize capital and diversify risk. By facilitating savings, the JSE is making funds for investment available for those who wish to invest.

(iv) It also acts as a facilitator for trading in the shares issued. The JSE has been instrumental, over the years, in facilitating the trading of shares. The JSE provides a market where securities can by traded freely under a regulated procedure. The JSE has facilitated the trading of shares and this has in turn promoted economic growth and creating jobs. Grieven (2001:18) held that by buying a share in a company one would be giving his/her money to an entrepreneur to start business that provides services, employs people and provide income to families. The volume of shares traded on the JSE has been rising each and every year and the value of the shares of these shares has been ever increasing over the years.

(v) Ndako (2010), Bencivenga, Smith and Starr (1996) argue that through overlapping generation models indicate that stock market development facilitate reduction in transaction cost which helps in promoting economic growth making it easy for investors and savers to frequently sell and buy their assets.

(vi) The JSE does not only channels funds into the economy, but also provides investors with returns on investments in the form of dividends. In this regard, the JSE facilitates the creation of income because investors can get some returns from their investment. In other words the JSE is an income generating market.

South African Finance Minister, Mr Pravin Gordhan (2011) submits that the JSE “facilitates foreign investment into South Africa, as demonstrated by the many international companies listed on its board, and the very high share of foreign ownership on the JSE. It provides the ideal platform as a Gateway for Investing in Africa, and in the process, supporting the economic development of this continent”.

2.5.4 An analysis of the economic indicators on the JSE
Structural, regulatory and technological changes over the past decade have made the JSE to have many positive changes. Many positive developments have been noticed and as a result of this “the JSE is on the radar screen of many international investors today” (Oxford Business Group, 2008:59). Positive developments have been characterized by significant changes in the economic indicators mainly composed of, among other things, total volume
and value of shares traded on the JSE, All Share Index, Liquidity and market capitalisation. This section shall examine the trends that have been happening on the JSE in form of graphical and numerical analysis. Graphical and numerical analysis helps to analyse the trends in the economic indicators on the JSE. This will provide a yardstick of appraising the overall performance of the JSE. The total volume and value of shares traded on the JSE, market capitalisation, liquidity on the JSE, All Share Index are the economic indicators analyzed by this study.

2.5.4.1 Total value of shares traded on the JSE
This is the total number of shares traded multiplied by their respective matching prices on the JSE. The improvements on the JSE have resulted in the increase in total value of shares traded over the years. This is shown by the graph below.

Figure 2.4: JSE stock market transactions: Total value of shares traded on the JSE

![Total Value of Shares Traded on the JSE](source)

*Source: Own graph made from figures from the SARB (2011)*

Figure 2.4 shows statistical information showing the trends in stock market transactions on the JSE. The figure specifically examines the trends in total value of shares traded on the JSE from 2000 to 2010. The total value of shares steadily rose in 2001 and 2002 but later to
decline in 2003. However there was a sharp increase in the value of shares traded in 2004 and the value of shares steadily rose in 2005. The year 2006 saw a sharp increase in the value of shares; it almost doubled the value of shares from the previous year, 2005. The year 2007 was also marked by an increase in the value of shares and so was in 2008. However, the total value of shares fell in 2009 and later rose sharply in 2010. The fall of the total value of shares in 2009 was caused by the global financial crises that started in 2008. The global financial crises created an atmosphere of uncertainty in the financial markets and this affected the value of shares. However, the market regained its momentum in 2010 and the value of shares increased sharply that year.

2.5.4.2 Total volume of shares
This is the total number of shares on the JSE during a given period of time. In other words, it is the amount of shares that moves from sellers to buyers as a measure of activity. The higher the volume, the more competitive the market would be. The total volumes of share have been increasing considerably on the JSE. This is depicted in Figure 2.5.

Figure 2.5: JSE stock market transactions: Total volume of shares traded on the JSE

![Total Volume of Shares Traded on the JSE](Source: Own graph made from figures from the SARB (2011))
Figure 2.5 shows the total volume of shares traded on the JSE. The volume of shares rose in 2000 but fell sharply in 2001 and 2002 respectively. The volume of shares rose slightly in 2003 and trend continued till 2007. The volume of shares began to decline in the year 2008. Here, the global financial crisis played a huge role in the fall of the total value of shares traded on the JSE. It created uncertainty amongst investors and they were reluctant to invest further. Muchaonyerwa (2011) held that “stock markets globally faced extraordinary tests in 2008”. The JSE is no exception to this, the results of the “extraordinary tests were felt in 2009 on the JSE. This led to a contraction in the total volume of shares traded as witnessed by the table above.

The total value and volume of shares traded on the JSE has been developing from the year 2000 onward. Although they have been falling in some years, they speedily rose again in the following year and the increasing trend continued. Although the total value and volume of shares offers a good yardstick for measuring the performance of the JSE, there is also the total market capitalisation which is a good yardstick for measuring performance. Muchaonyerwa (2011) argues that the “market cap substantiates the all-inclusive value of the stock market at some particular point”. The JSE is as central as ever to South Africa’s rapidly expanding economy. The Oxford Business Group (2008:59) held that in 2006 the JSE’s market capitalisation has hit new highs. An examination of market capitalization on the JSE is the focus of the next section.

2.5.4.3 Market capitalization on the JSE

Morrel (2007:65) defines market capitalization as the market share price per share multiplied by the number of shares outstanding. Market capitalization will change in line with changes in share price and the number of shares issued. Investors determine a company’s share value by looking at its market capitalization. Muchaonyerwa (2011) held that the JSE “market cap value includes shares of the domestic market, shares of foreign companies which are exclusively listed on stock exchange, ordinary and preferred shares of domestic companies and shares without voting rights”. The JSE holds a treasured position as one of the top 20 exchanges in the world in terms of market capitalisation. Mining continues to dominate the exchange, accounting for more than a third of its market capitalisation (Oxford Business Group, 2008)

“The majority of this market capitalisation is based on the companies listed on the Main Board and the JSE’s top 40 stocks are also listed here. These stocks are highly regarded by
both local and international investors” (JSE, 2012). The JSE’s ability to attract international investors makes it to be the biggest stock exchange in Africa. By the year 2000 it had become by far the largest stock exchange in Africa with a market capitalization of approximately ten times the market capitalization of all other African stock markets (Mlambo and Biekpe, 2007). The IMF, Staff Country Report (2008) further maintained that market capitalisation of the JSE is the largest among emerging markets, reflecting South Africa’s inclusion in major investable global stock market indexes.

Figure 2.6: Market capitalization as a % of GDP

![Graph showing market capitalization as a % of GDP from 1999 to 2010](image)

*Source: Own graph made from figures from the SARB (2011)*

Figure 2.6 shows that market capitalisation decreased steadily from the year 2000 but it picked a rising trend in 2001. The rising trend continued in 2002, 2003 until 2007. The reason behind the increase in market capitalisation at the JSE has been the developments that have been occurring on Africa’s largest stock exchange. The developments include the developments between the London Stock Exchange and the JSE Securities Exchange², the

---

² The Head of terms. The Head of Terms deal was signed in 2001 between the JSE and the LSE. The deal comprises the provision of core technology services by the LSE to the JSE Securities Exchange and aims to achieve easier access to each other’s markets for both member firms and issuers.
JSE SETS (Stock Exchange Trading System), and many other developments that improved the way the JSE functions. All these developments have contributed to the increase in market capitalisation on the JSE. However there was a sharp fall in market capitalisation in the year 2008. This might have been caused by a decrease in investor activity because of the global financial crises of 2008. JSE Chairman, Mr Humphrey Borkum asserts that 2008 was the year of global market turbulence and uncertainty and 2009 was the year the year in which financial markets worldwide counted the cost of the crisis (Borkum, 2012). Following the depression in the market capitalisation in 2008 the JSE managed to shack off the chains of the global financial crises quickly in 2009 and the market capitalisation began to rise again in the year 2009. Borkum (2012) contends that the “global financial crisis highlighted the central role that well-functioning, properly regulated and risk-managed stock markets can and should fulfill and the JSE is alive to its responsibilities in this regard”. Borkum further contends that “we have systematically reviewed the services the JSE provides to ensure that these are at the appropriate level to enable us to implement our strategies to grow our market and our relevance”.

2.5.4.4 All share index

The Standard Bank Share Trading (2012) notes that the JSE All Share Index (ALSI) is the “main index of the local share market. It comprises 62 stocks in total. It is made of the top 40 shares by market capitalisation and another 22 shares across all industries and sectors”. The All Share Index represents the performance of the entire South African share market. Grieve (2001:19) held that the All Share Index measures the collective performance of all the ordinary shares of companies on the JSE Securities exchange. The index gives the best indication of general market direction because it includes shares from all sectors of the stock market. Makaonyerwa (2011) argues that a large quantity of the number of securities listed on the JSE is incorporated into the index and the ALSI is benchmarked against global standards and is basically an indicator of the general mood of the market. In other words it is an index figure based on the current market price of shares on a stock exchange. Over the past few years, the JSE has been on a remarkable bull run. This is illustrated in Figure 2.7.

---

3 A trading system implemented in conjunction with the London Stock Exchange (LSE).
Figure 2.7 shows that the ALSI was steadily rising between the year 2000 and 2003. It rose drastically in 2003 and it continued with the rising trend until 2007 when it fell sharply. The reason behind its fall in 2007 might have been the global financial crises which also caused other stock market indicators such as market capitalization to fall in 2007. Overall, the ALSI has been rising over the years. Between 2003 and 2007 the JSE All Share Index grew by 255% valuations and has been on an upward trend (Oxford Business Group, 2008:59). The performance of the JSE has been robust with significant increases in the All Share Index. The IMF, Staff Country Report (2008) held that the rise in the All Share Index was supported primarily by gains in the commodity sector (gold and platinum).

2.5.4.5 Liquidity on the JSE

“The capacity of a stock market to provide primary equity capital is dependent on the ability of the market to offer investors a high level of liquidity as a secondary market. This means that investors are able to buy and sell a large number of shares very quickly at the current price” (Correia, Flynn, Uliana and Wormald, 2007:13). The introduction of an automated trading system, low trading costs and other developments has resulted in a significant increase in the liquidity of the JSE. However the JSE still needs to improve on its liquidity. The JSE enjoys far less liquidity than other well developed stock exchanges such as the
London Stock Exchange and many other emerging market stock exchanges. The JSE ranked the 33rd most liquid exchange in the world in 2005 as compared to market capitalisation were it was ranked 17 in the whole world.

Lack of liquidity remains a problem at the JSE especially to small companies. Low levels of liquidity results in investors not being able to trade shares and may mean companies may be less willing to list on the JSE. Correia, et al (2007:13) argue that low liquidity may have been the reason why the number of companies on the JSE securities exchange fell from 668 in 1999 to 383 in 2006. As an effort to improve its market liquidity, in 2001, the Johannesburg Stock Exchange announced its intention to open its doors to international high-speed trading firms for the first time in an effort to boost liquidity. This and several other factors led to an increase in liquidity on the JSE. Pillay, Muller and Ward (2010) note that “liquidity improved from a level of around 5% between 1984 and 1994 to a peak of almost 60% in 2008. The increase in liquidity has a significant impact on fund size, because of the constraint imposed of a maximum holding for any share of one third of the prior year’s value traded”.

Leanne Parsons (JSE's chief operating officer and head of its equities market) announced that non-South African-based traders could become members of the exchange for the first time in a process known as "remote membership (Crave, 2011). The JSE expressed its desire to improve its technology and deal technologically with the London Stock Exchange. Parsons further maintained that they (at the JSE) believed there is a significant amount of liquidity they could attract to the market and they hoped that their new technological capabilities will attract more flow (Crave, 2011).

**2.6 General assessment of the rand exchange rate and stock market performance**

The Rand “remains one of the most volatile of emerging market currencies, and is prone to sharp movements” (Economist Intelligence Unit, 2007). The volatility of the rand appears to have an impact on the stock market and the financial sector. Clarke, Habyarimana, Ingram, Kaplan and Ramachandran (2007) held that South African firm’s share these concerns, as revealed by the World Bank (2007)’s South Africa Investment Climate Assessment, where concern about the exchange rate is rated the second most serious constraint to enterprise operations and growth for a representative sample of South African firms.

One of the many implications of the openness of the South African economy to trade is that changes in the rand/US$ exchange rate may impact local firms that export most of their output or those that import inputs in different ways. For example, in a situation where the
exchange rate depreciates competitiveness of local firms is increased as their output becomes cheaper on the international market and vice versa if the exchange rate appreciates. If firms lose their competitive edge, profits will fall due to drop in sales thus leading to a subsequent drop in stock prices. This will also lead to volatility on the stock market. Thus causation runs from the rand exchange rate to the exports then to the stock prices of the firms on the JSE.

The relationship between the foreign exchange value of the rand and the Johannesburg Stock Exchange (JSE) was put to a particularly interesting test over the period 2000 to 2003 when the rand first collapsed and then recovered. “Since 2001, when the rand first weakened dramatically and then recovered, the rand value of the JSE All Share index has responded very directly to changes in the exchange rate rising with rand weakness and falling with rand strength” (Barr and Kantor, 2005). This shows that there is a strong link between the rand exchange rate and the economic indicators on the JSE. Ocran (2007) concurs with the above assertion when he argues that the US and SA stock prices as well as the rand/US$ exchange rates have moved fairly together over the study period, for example the blip towards the end of 1987 in US stock is mirrored in SA stock as well.

2.7 Conclusion

This chapter provided a background to this study by analyzing developments in the rand exchange rate and by providing an overview of the JSE and its economic indicators. An overview of the developments of the rand exchange rate was necessary as it is through examining its developments that we can understand the causes of its volatility. The exchange rate in South Africa has been marked by considerable volatility. Since the shift to inflation targeting in 2000, the rand exchange rate has been characterized by excessive volatility. On the other hand, there have been considerable developments on the overall performance of the JSE. The economic indicators examined showed a significant improvement on the JSE. A general analysis of the performance of the rand exchange rate and the stock market was also conducted. An analysis of both the rand exchange rate and the economic indicators was also necessary to see the relationship that exists between the two. Clearly, the volatility of the rand drives the stocks on the JSE. Changes in the rand have considerable effects on the way in which the stock market operates. Reasons behind this relationship need to be examined and this is the focus of the next chapter. The next chapter shall provide a theoretical explanation of the relationship between the stock market and the exchange rate.
CHAPTER THREE
LITERATURE REVIEW

3.1 Introduction
The theoretical section of this study uncovers whether or not existing theories suggest that currency volatility has an impact on the stock market. There is no theoretical consensus neither on the existence of relationship between stock prices and exchange rates nor on the direction of the relationship. This chapter shall look at the theoretical literature as well as the empirical literature. The chapter shall first explore theoretical literature, with considerations being made to the flow oriented model, stock oriented model, asset pricing model, arbitrage pricing model and the efficient market hypothesis. The second part of this chapter shall look at the empirical literature that tries to explore the relationship between exchange rate and the stock market (stock prices).

3.2 Theoretical literature
Theories concerning exchange rate and the stock market have been provided by various theorists such as Dornsburch and Fischer (1980), Fama (1965), Ross (1976), Branson (1977) and many other theorists. There is no theoretical consensus neither on the existence of relationship between stock prices and exchange rates nor on the direction of the relationship. This theoretical section shall considered the flow oriented model, stock oriented model, asset pricing model, arbitrage pricing model and the efficient market hypothesis.

3.2.1 Flow oriented model
The flow oriented model is based on microeconomic foundations. The model maintains that a causal relationship runs from the exchange rate to the stock prices. In other words, exchange rate movements affect the stock prices. Flow oriented model considers the capital flows to have an impact on international competitiveness of enterprises and profits of firms. The profits and international competitiveness of firms will have an influence to stock market. In other words, the model suggests that fluctuation of exchange rate influences the share value of domestic and multinational firms. Saleh (2009:12) argue that the flow oriented model implies that currency movements affect international competitiveness and balance of trade positions and consequently the real output of the country, which in turn affects the current and future expected cash flow of firms and their stock prices. This is because many companies conduct their business on the international market and changes in the exchange rate will have either positive or negative effects on the business operations. Choi and
Papaioannou (2009:173) held that an appreciation of local currency under a floating regime may lead to decrease in company’s benefit and competitiveness of exporting products and thus its stock price.

Exchange rate changes affect the competitiveness of firms through their impact on input and output prices (Joseph, 2002). When the exchange rate appreciates, exporters will be negatively affected. An appreciation of the currency will cause their goods and services to be dearer on the international market. This will cause their exports to decline, as they will be seen as expensive by buyers on the international market. This will result in them losing competitiveness internationally. Consequently, their profits will decline and if profits decrease the firms will lose competitiveness on the domestic stock market. Their attractiveness on the domestic stock market will decrease and this will result in their stock prices decreasing in value. Resultantly, a negative relation between domestic currency and stock price can be confirmed. But for importing firms, the appreciation of exchange rate reduces input costs and this will be advantageous for importing firms. The reduction in costs will mean that there would be low prices for the final products and services. This will in turn increase their sales and profits will increase. When profits increase the firm will be attractive on the domestic stock market. This will boost the average level of stock prices. Therefore, the direction of the impact depends on whether the firm is predominantly an exporting or importing industry (Saleh, 2009:12).

### 3.2.3 Empirical validity of the flow oriented model

Aggarwal (1981) provided some evidence in support of the flow model. Aggarwal study examined the relationship between exchange rates and stock prices by looking at the correlation between changes in the US trade-weighted exchange rate and changes in US stock market indices each month for the period 1974 to 1978. The study found that the trade-weighted exchange rate and the US stock market indices were positively correlated during this period, leading Aggarwal (1981) to conclude that the two variables interacted in a manner consistent with the flow model. That is, movements in the exchange rate could directly affect the stock prices of multinational firms by influencing the value of its overseas operations, and indirectly affect domestic firms through influencing the prices of its exports and/or its imported inputs. Soenen and Hennigar (1988) found a significant negative correlation between the effective value of the US dollar and changes in US stock prices using
monthly data between the periods from 1980 to 1986. This provides evidence in support of the flow model.

A study by Ma and Kao (1990) examined the relationship between exchange rates and stock prices in six industrialised economies, including the UK, Canada, France, West Germany, Italy and Japan. Using monthly data between January 1973 and December 1983, the authors tested the degree of stock price reaction to exchange rate changes in each of the above jurisdictions. Their findings were consistent with the flow model, leading the authors to conclude that the relationship between exchange rates and stock prices hinged on the extent to which an economy depended on exports and imports.

Bahmani-Oskooee and Sohrabian (1992) utilized the tests of causality in examining the relationship between stock prices and exchange rates in the US context. They also used a much longer time period (15 years) and also utilised tests of co-integration. Using monthly data of the US S&P 500 index and the effective exchange rate of the US dollar, the authors employed an autoregressive framework, finding that US stocks and the exchange rate shared a dual or bi-causal relationship (changes in the exchange rate affected stock prices and vice versa) in the sampled period, 1973 to 1988. These results seemed to affirm both the portfolio and flow models. Fang and Miller (2002) found that currency depreciation affects stock market returns and that the variables were related, when they applied the test to Korea between 1997 and 2000.

Some other studies such as Franck and Young (1972), Solnik (1987), Chow et al. (1997), and Bhattacharya and Mukherjee (2003) found evidence that is inconsistent with the flow oriented model. They found no significant relationship between the variables. Bahmani-Oskooee and Sohrabian (1992), Nieh and Lee (2001) found no long-run relationship between the variables. Yu (1997) studied Hong Kong, Tokyo and Singapore markets by using daily data for a period of 1983-1994. They traced bidirectional relationship in Tokyo, no causation in the Singapore markets and also found that changes in exchange rates Granger cause changes in stock prices.

Solnik (1987) detected the impact of several economic variables including the exchange rates on stock prices. The author concluded that changes in exchange rates do not have any significant impact over stock prices. Bhattacharya and Mukherjee (2003) investigated Indian markets using the data on stock prices and macroeconomic aggregates in the foreign sector including exchange rate concluded that there is no significant relationship between stock
prices and exchange rates. In another study, Muhammad and Rasheed (2003) examined the relationship between stock prices and exchange rates of four South Asian countries named as Bangladesh, India, Pakistan and Sri-lanka and found that there is no significant relationship between the variables either in short-run or long-run in Pakistan and India.

The above analysis shows empirical findings of the flow oriented model. Studies by Aggarwal (1981), Soenen and Hennigar (1988) and Ma and Kao (1990) found evidence that support the flow oriented model. On the other hand, other studies such as those conducted by Franck and Young (1972), Solnik (1987), Chow et al. (1997), and Bhattacharya and Mukherjee (2003) found evidence that is not consistent with the flow oriented model. This shows that the flow oriented model might explain the relationship between exchange rate and stock market in South Africa. This makes the present study more interesting because its results can determine the applicability of the flow oriented model in South Africa.

3.2.4 Stock oriented model

Pilbeam (1992:159) points out an obvious problem with the flow oriented model as being that they have nothing to say about international capital movements, although it is known that international capital movements are very large and dominate the foreign currency market. This shortfall in flow models led to the development of fundamentalist models that stressed the role of the capital account of the balance of payments (often known as stock oriented models or asset models of exchange rate determination). Stock oriented models put much stress on the role of the financial (formerly capital) account in the exchange rates determination. Adjasi and Biekpe (2007) held that in the stock oriented model, “the exchange rate equates demand and supply for assets (bonds and stocks). Therefore, expectations of relative currency movements have a significant impact on price movements of financially held assets. Thus stock price movements may influence or be influenced by exchange rate movements”. These models can be divided into two: the monetary model and portfolio balance model.

3.2.5 Monetary models

The monetary model considers the supply and demand for currencies to be determined by stock equilibrium in the money market. The model implies that since the exchange rate is the price of one money in terms of another, it must be determined by the relative supplies of, and demands for, the two monies (Moosa, 2000). According to monetary model, the exchange rate is seen as a relative asset price. The present value of an asset is thought to be largely
influenced by its expected rate of return. The model suggests that the exchange rate is determined by three independent variables namely - relative money supply, relative interest rates and relative national output. The sticky price monetary price model assumes that price of goods are sticky in the short run, and purchasing power parity holds in the long run. Therefore a change in the nominal money supply causes a change in the real money supply, which in turn, results in interest rate changes and capital flows (Siddaiah, 2010:117). Changes in capital flows will then cause changes in the exchange rate.

Friedman (1988) developed a version of the monetary model that incorporates stock prices. Friedman (1988) showed how the demand for money is determined in part by the level of the stock market. The demand for money would be represented by the function:

\[ m_t = p_t + \alpha y_t - \beta i_t + \chi s_t \]  

Where \( m \) is the nominal demand for money, \( p \) is the price level, \( y \) is the real income level, \( i \) is the nominal rate of interest and \( s \) is the real level of the stock market. In this case the stock market will be positively influencing money supply. Friedman (1988) suggests possible channels through which stock prices might directly affect money demands. Firstly, a rise in stock prices reflects an increase in the expected return from risky assets relative to safe assets. The implied increase in portfolio risk can be offset by an adjustment away from other risky assets such as long term bonds toward safer assets including money. Secondly, a rise in stock prices reflects an increased level of financial transactions and thus an increase in the demand for money (Broome and Morley, 2003).

In this case the stock market, through its impact on money supply, influences the behavior of the exchange rate. Changes in the nominal money supply causes a change in the real money supply, which in turn, results in interest rate changes and capital flows. The monetary model implies that an increase in the demand for money will lead to the depreciation of its currency (Siddaiah, 2010:117). An increase in money supply might be met by monetary tightness (for example an increase in interest rate) by the Central Bank. This increase in interest rate will cause heavy capital inflows. Consequently, there would be an appreciation of the domestic currency. If the stock prices are increasing then we expect the money supply to increase and this will cause the interest rates to rise. Thereafter there would be an appreciation of the domestic currency. In this way, a positive relationship between stock prices and interest rates is witnessed.
3.2.6 Portfolio balance model

The Portfolio balance models postulate a negative relationship between stock prices and exchange rates and come to the conclusion that stock prices have an impact on exchange rates. Stavárek (2004) held that this model presumes an internationally diversified portfolios and the role of exchange rates to balance the demand for and the supply of domestic as well as foreign assets. A rise in domestic stocks prices leads to the appreciation of domestic currency through direct and indirect channel. A rise in prices encourages investors to buy more domestic assets selling simultaneously foreign assets to obtain domestic currency indispensable for buying new domestic stocks.

According to the portfolio balance model, an increase in domestic assets prices results in growth of wealth, which leads investors to increase their demand for money, which in turn raises domestic interest rates (Stavárek, 2004). Higher interest rates attract foreign capital and initiate an increase in foreign demand for domestic currency and its subsequent appreciation. According to monetary approach an exchange rate is the price of an asset (one unit of foreign currency) and therefore the actual exchange rate has to be determined by expected future exchange rate similarly like prices of other assets. Aydemir and Demirhan (2009) note that this approach states that stock price is expected to lead to an exchange rate with a negative correlation since a decrease in stock prices reduces domestic wealth, which leads to lower domestic money demand and interest rates. Also, the decrease in domestic stock prices leads foreign investors to lower demand for domestic assets and domestic currency. These shifts in demand and supply of currencies cause capital outflows and the depreciation of domestic currency. On the other hand, when stock prices rise, foreign investors become willing to invest in a country’s equity securities. Thus, they will get benefit from international diversification. This situation will lead to capital inflows and a currency appreciation (Aydemir and Demirhan (2009).

The portfolio balance approach focuses on the links between balance of payments and adjustments in asset stocks, emphasizing that models of the capital account should be rooted in behavioral models of the supplies of and demand for portfolio stocks. The portfolio balance approach is a model which, besides the foreign exchange, also incorporates the money market and the market of domestic and foreign securities. Market participants’ possess a wealth stock – with given stock of nominal money, domestic bonds and foreign bonds- for which investors choose the preferred portfolio structure, mainly based on the
(expected) returns of the alternative assets. The demand for domestic money, foreign securities or domestic securities depends both on domestic interest rate and the yield on foreign bonds. The markets included in the model are represented by the equation

\[ W = M + B + eF \]

Where Total wealth, \( W \), is the sum of money, \( M \), domestic bonds, \( B \), and foreign bonds \( eF \) (\( F \) is the stock of foreign bonds –denominated in foreign currency- in the country considered; \( e \) is the exchange rate notation. In a modified version of the Portfolio Balance approach, Welfens (2007) includes the stock market instead of the domestic bond market. In this model, the supply side of the stock market is given as the product of the real stock market index \( P'/P \) and capital stock. The demand for stocks (also for foreign bonds and money) depends on marginal utility of money, capital productivity, and expected growth rate of the stock market price.

The influence of the stock (market) price on the exchange rate can be taken into account through including transactions in the stock market in the money demand function. Referring to the onset of the Great Depression in the US (1920s), Field (1984) emphasized the importance of considering the significant impact of stock trading’s value on the demand to hold cash balances. Field asserts that the fact of having not recognized stock trading as a relevant argument in the demand for money (an expansion of the money supply) could be misjudged as expansionary while it might be neutralized even restrictive. For example, if rising turnover figures in asset markets fully absorb the additional liquidity. Hence, Field incorporates the stock market in his augmented money demand function namely, the transaction volume of stock markets multiplied by the stock prices.

Welfens (2010) notes that in a modern version of the Field argument, one may argue with respect to (FDI) write in full first that the demand for domestic money increases if foreign investors invest in domestic enterprises and raise the nominal amount of stock market transactions. On the one hand, stock price increases, on the other hand the interest rate increases as a consequence of increased money demand. Therefore, capital inflows are additionally favoured and domestic currency will appreciate under flexible exchange but may have an impact on foreign exchange reserves of the Central Bank, which is omitted to preserving the current value of the exchange rate. If domestic currency appreciates, the Central Bank is obliged to perform foreign exchange intervention.
Stock oriented models or the portfolio balance approach emphasize the capital account as the major determinant of exchange rate dynamics. The portfolio balance model is based on the notion that agents should allocate their entire wealth among domestic and foreign assets including currencies in their portfolio. Hence the exchange plays a role of balancing the demand and supply of assets. The logical deduction from negative effects of stock prices on exchanges (defined as domestic currency prices of foreign exchange) lead to the following: an increase in domestic stock prices lead individuals to demand for more domestic assets. To buy more domestic assets, they require selling foreign assets as they are relatively less attractive now. As a result, there is an appreciation of the domestic currency due to an increased demand of domestic assets. Alternatively, the argument implies that an increase in wealth due to a rise in domestic prices will lead investors to increase their demand for money, which in turn raises domestic interest rates. A higher interest rate will in turn attract foreign capital, resulting in an appreciation of the domestic currency (Saleh, 2009:12).

Portfolio balance model states that if prices of domestic stock rise, it will persuade investors to buy more domestic assets by selling foreign assets to obtain domestic currency. Increase in demand of domestic currency will lead to appreciation of domestic currency. On the other side, if the prices of domestic asset rise that will result in growth of wealth, which will also increase the demand for money by the investors that will give rise in domestic interest rates. More foreign capital will be attracted in this situation which will increase the foreign demand for domestic currency and ultimate result will be the appreciation of domestic currency. Thus according to portfolio balance model there is an inverse relationship between stock prices and exchange rates.

3.2.7 Empirical validity of the Portfolio balance models
Richards, Simpson and Evans (2009) examined the interaction between stock prices and exchange rates in Australia. In consistent with the portfolio balance model, Granger causality runs from stock prices to the exchange rates. Ajayi, Friedman, and Mehdian (1998) describe the relationship between the two variables. Their results showed that in industrialized countries, it is the stock markets that impact the currency markets.

Bahmani-Oskooee and Sohrabian (1992) utilized the tests of causality in examining the relationship between stock prices and exchange rates in the US context. Their finding that US stocks and the exchange rate shared a dual or bi-causal relationship (i.e. changes in the
exchange rate affected stock prices and vice versa) in the sample period, 1973 to 1988. These results seemed to affirm both the portfolio and flow models. In another study, Broome and Morley (2003) examined the relationship between the stock market and exchange rate applying the monetary model of exchange rate determination. The results indicate that in equilibrium, this version of the monetary model produces a cointegrating vector, in which stock prices are the most significant determinant. The dynamic results produce well specified error correction models, in which in the short-run stock prices are the most significant determinant of the exchange rate. However there is very little evidence that exchange rates have a significant effect on stock prices.

Franck and Young (1972), Ang and Ghallab (1976), Aggarwal (1981), and Soenen and Hennigar (1988) tested the goods market model by simply regressing stock prices on exchange rates. The results were not uniformly supportive of the stock oriented model. Franck and Young (1972) and Ang and Ghallab (1976) found no significant relationship; Aggarwal (1981) found a significant positive relationship but Soenen and Hennigar (1988) found a significant negative relationship for the US. Solnik (1987), testing the portfolio balance model for the world’s eighth largest economies, found only very weak evidence in support of the portfolio balance approach.

The empirical analysis of the portfolio balance approach showed mixed results. No concrete decision can be reached as to the validity of the portfolio balance approach. Studies conducted have shown mixed results. This makes this study more fascinating because its results shall make a conclusion with regard to the validity of the portfolio balance approach in South Africa.

3.2.8 Efficient Market Hypothesis
The hypothesis states that prices of securities fully reflect available information about securities. The hypothesis states that the capital market is efficient in processing information. Fama (1991) “takes market efficient hypothesis to be the simple statement that security prices fully reflect all available information”. An efficient capital market is one in which security prices equal their intrinsic values all times, and where most securities are correctly priced. Kevin (2005:26) argues that when someone refers to efficient capital markets, they mean that security prices fully reflect all available information. The prices of securities observed at any time are based on correct evaluation of all information available at that time. The efficient
market model is actually concerned with the speed with which information is incorporated into security prices. The technicians believe that past price sequence contains information about the future price movements because they believe that past price sequence contains information about the future price movements because they believe that information is slowly incorporated in security prices (Kevin, 2005:26)

The efficient market theory holds the view that in an efficient market, new information is processed and evaluated as it arrives and prices instantaneously adjust to new and correct levels. The efficient market hypothesis assumes that prices reflect the knowledge and the expectations of all investors. EMH proponents believe that it is not possible to beat the market consistently. Put another way, it is not possible to generate returns above the average market rate of return without inside information. The EMH has been expresses at three different levels, each testable to some degree. How widely available information needs to be there to be efficiency depends upon the form of the hypothesis (Kasper, 1997:15). The theory outlines three degrees of market efficiency;

3.2.8.1 Weak form efficiency

The weak-form hypothesis asserts that stock prices already reflect all information that can be derived by examining market trading data such as the history of past prices, trading volume, or short interest. The weak form of the efficient market hypothesis assumes that current stock prices fully reflect all security market information. Security market information includes historical price and volume data, as well as other market-generated information such as odd-lot trades and short interest. If the market value of stock reflects only historical information, market efficiency is weak. There is supposedly no virtue in estimating stock price trends based on past performance in a market that is weak form efficient.

A weaker and economically more sensitive version of the Efficient Hypothesis postulates that prices reflect information to the point where the marginal benefits of acting on the information of acting on information do not exceed the marginal cost (Jensen, cited in Fama, 1991). The market is efficient in the weak form when the price of a security reflects all historical price information and volume information. This level of market efficiency is consistent with technical analysis (TA) – the theory of historical price and volume charts (Caltado, 2003:47). The Open University (2012), a United Kingdom University, held that if the weak-form Efficient Market Hypothesis holds, security market information should have
no relationship with future returns. Technical analysis and trading rules should not allow investors to earn excess returns. The Open University (2012) further maintains that if a market is weak-form efficient, there is no correlation between successive prices, so that excess returns cannot consistently be achieved through the study of past price movements.

3.2.8.2 Semi-strong Efficiency

A market that is semi strong reflects all historical and publicly available information. When a market is this efficient, stock prices quickly respond to information found in annual and quarterly reports. Kevin (2005:26) argued that the market is consistent in the semi strong form when the price of a security reflects all historical information, including the historical price and volume presumed in the weak form. Therefore, the level of information presumed under weak form of market efficiency is fully nested in the semi strong level of market efficiency. Semi strong efficiency exists where share prices reflect all public information, but not private information (Caltado, 2003:47).

If a market is semi-strong efficient, the current market price is the best available unbiased predictor of a fair price, having regard to all publicly available information about the risk and return of an investment (The Open University, 2012)

3.2.8.3 Strong form efficiency

In a strong form market, stock prices reflect all public information and inside information. A precondition for this strong version of the hypothesis is that information and trading costs of getting prices to reflect information, is always zero (Grossman and Stiglitz cited in Fama, 1991). The market is efficient in the strong form when the price of a security reflects all information – public and private. Therefore, the level of information presumed under the semi strong form of market efficiency is fully nested in the strong level of market efficiency (Caltado, 2003:47).

The hypothesis concludes that stock prices cannot be predicted. This means that advice provided by many financial analyses is useless. If neither technical nor fundamental analysis can accurately predict stock prices, then it is time to throw darts. To support this, many authors argue that there is no evidence that, over the long term, the market has been beaten by anyone (Kevin, 2005:26). Each of the three forms of EMH has different consequences in the context of the search for excess returns, that is, for returns in excess of what is justified by the risks incurred in holding particular investments. These forms all assume that the cost of credit
is linear and uniform for all investors, and that transaction costs do not exist and that information asymmetry does not exist.

3.2.9 Empirical validity of the Efficient market Hypothesis
Empirical evidence in support of the EMH comes from studies showing that the return of market averages exceeds the return of actively managed mutual funds. Thus, to the extent that markets are inefficient, the benefits realized by seizing upon the inefficiencies are outweighed by the internal fund costs involved in finding them, acting upon them. Mandal (2009) held that studies by Firth (1976, 1979 and 1980) in the United Kingdom have compared the share prices existing after a takeover announcement with the bid offer. Firth found that the share prices were fully and instantaneously adjusted to their correct levels, thus concluding that the UK stock market was semi strong-form efficient.

Volkart (2005) investigated the implications of the Efficient Market Hypothesis in the Swiss Equity Funds Market. The author sought to determine whether a group of investors, in this specific case mutual funds managers, is able to forecast the future security price, using all its skills and information it wishes to employ, to increase returns on the portfolio and consequently to beat the market. The result of Volkart work was that the evidence of the funds’ performance discussed in his thesis reported that on average the active funds managers are not able to predict the security prices well enough to outperform the market and consequently, the passive funds. The evidence discussed in Volkart’s thesis, however, states that funds managers on average do not have some particular ability in forecasting the security prices and consequently the market seems to be efficient.

The EMH was found to be inconsistent by Hawawini (1988). Hawawini (1988) lists two observable facts that the EMH is inconsistent on. These are:

(i) There is evidence of recurrent seasonality in common stock returns in the US and foreign markets. Stock market returns differ, on average, depending on which day of week they are measured or which month of the year they are calculated. This phenomena is inconsistent with the weak form of market efficiency since investors can predict higher or lower returns for specific days of the week or months of the year.

(ii) There is also evidence that portfolios constructed on the basis of firm size have different average returns. Small portfolios tend to perform their larger counterparts even after returns are adjusted for the difference in the level of risk.
that may exist between small and large companies. This size effect is inconsistent with the semi-strong form of market efficiency since investors can predict a higher average return for a portfolio constructed on the basis of publicly available information (market capitalisation).

The above analysis showed that there are contrasting results across the body of literature regarding the validity of the efficient market hypothesis on the stock markets. The contrasting results leave a question on the applicability of the efficient market hypothesis on the JSE. The validity of the EMH can be only be determined by the results of this study.

### 3.2.10 Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM), which was developed in the mid 1960's, uses various assumptions about markets and investor behaviour to give a set of equilibrium conditions that allow us to predict the return of an asset for its level of systematic (or non-diversifiable) risk. CAPM defines the market as the universe of all assets in the world. CAPM is based on the portfolio theory which was the work of Harry Markowitz. This theory models the uncertainty in the price of an asset by the variance of the returns of the asset \( \sigma^2 \) where \( \sigma \) is the standard deviation of the returns of the asset (Herekar, 2006).

#### 3.2.10.1 Assumptions of the CAPM

Taylor (2005) argues that various assumptions must be defined in order to arrive at the CAPM equilibrium, these include:

1. Investors maximize expected utility of wealth.
2. Investors have homogenous expectations and use the same input list.
3. Markets are frictionless—the borrowing rate is equal to the lending rate.
4. There are many investors, each with an endowment of wealth which is small compared to the total endowment of all investors (investors are price-takers).
5. All investors plan for one identical holding period.

Herekar (2006) maintains that an investor faces two risks when investing in assets. One is the asset specific risk. For example, this is the risk which one faces when one holds a certain stock. The other risk, which the investor faces, is the market risk. This is the risk which is common to all securities. Say for example, a recession might be a type of market risk in
which all stocks might get a beating. Market risk is also called systemic risk (Herekar, 2006). From the portfolio theory we see that if we diversify enough, the only risk that we face is the market risk and not the asset specific risk. In other words, what CAPM suggests is that asset specific risk is diversifiable and can be eliminated and hence need not be compensated for (Herekar, 2006).

The CAPM builds on the model of portfolio choice developed by Harry Markowitz (1959). In Markowitz’s model, an investor selects a portfolio at time \( t - 1 \) that produces a stochastic return at \( t \). The model assumes investors are risk averse and, when choosing among portfolios, they care only about the mean and variance of their one-period investment return. As a result, investors choose “mean variance-efficient” portfolios, in the sense that the portfolios 1) minimize the variance of portfolio return, given expected return, and 2) maximize expected return, given variance. Thus, the Markowitz approach is often called a “mean variance model” (Fama and French, 2004)

### 3.2.10.2 Measuring risk using the CAPM

The CAPM determine the expected returns of financial assets based on their sensitivity to market risk or systematic risk. It relies on the fact that investors, regardless of their risk aversion, choose efficient portfolios in terms of mean variance. For a given level of risk, investors prefer the portfolio that has the highest expected return and for a given return, investors prefer the portfolio that has the lowest risk (Arouri, Jawadi and Nguyen, 2010:56).

Arouri, Jawadi and Nguyen (2010:56) further maintain that the CAPM measure of the risk of any stock when held in a portfolio is called a beta coefficient and is calculated with this formula

\[
\beta_i = \frac{\text{Covariance}_{im}}{\text{Variance}_m} \tag{3.3}
\]

This formula holds that the beta coefficient for any stock, \( I \), is calculated as the covariance between the stock market, \( m \), the covariance of returns between a stock and the overall stock market is the multiplication of three terms; the correlation between the returns of the stock and the returns of the market, the standard deviation of returns of the stock, and the standard deviation of returns of the market. If the numerator in the beta calculation is larger than the denominator, it means the correlation between the stock and the market is high and the stock
is highly volatile, having a large standard deviation of returns. This tells us the stock tends to more in the same direction as the overall market and these movements are of greater magnitude (Grossman and Livingstone, 138).

3.2.10.3 The CAPM equation

The expected return of any stock is calculated as the expected risk free return, plus an additional return based on the expected risk premium for investing in the market, times the beta coefficient of the stock. Grosman and Livingstone (2009) note that the CAPM equation for the expected return of any stock looks like this

\[
E(R_i) = R_f + \left[ E(R_m) - R_f \right] \times B_i
\]

The formula suggests that, to begin with, the expected return of any risky stock must at least equal the return earned by investing in risk free securities, \( R_f \). No one would invest in a risky stock if its expected return was less than the risk-free rate of return. To entice investors to buy risky stocks instead of risk free securities there must be some positive expected premium, and the right side of the CAPM equation represents premium. The term in the brackets is called the market risk premium as it is the difference between the expected return on an investment in the overall stock \( E(R_m) \) minus the risk free rate of return, \( R_f \). The CAPM gives the equilibrium return on individual securities in the market portfolio. The CAPM actually says that only the systematic (market risk) affects the equilibrium return on a risky asset, while the unsystematic risk can be diversified away and is therefore not compensated (Belke and Polleit, 2009:306).

3.2.11 Empirical validity of the CAPM

After the CAPM was developed, several empirical tests of the model were conducted to test its validity. Several of these showed that the CAPM didn’t hold in many situations and was often inaccurate or unsuitable in predicting asset values. In 1977, Richard Roll asserted that the CAPM holds theoretically but is hard to test empirically since stock indexes and other measures of the market are poor proxies for the CAPM variables. This came to be known as Roll’s critique (Taylor, 2005).

Banz (1981) tested the CAPM by checking whether the size of firms can explain the residual variation in average returns across assets that remain unexplained by the CAPM’s beta. He
challenged the CAPM by demonstrating that firm size does explain the cross-sectional variation in average returns on a particular collection of assets better than beta. The author concluded that the average returns on stocks of small firms (those with low market values of equity) were higher than the average returns on stocks of large firms (those with high market values of equity). This finding has become known as the size effect (Michailidis et al., 2006).

Rosenberg, Reid and Lanstein (1983) and Chan, Hamao, Lakonishok (1991) studies have all been utilized in testing the validity of CAPM. Michailidis, Tsopoglou, Papanastasiou and Mariola (2006) held that Fama and French (1992) used the same procedure as Fama and McBeth (1973) but arrived at very different conclusions. Fama and McBeth (1973) found a positive relation between return and risk while Fama and French (1992) found no relation at all. Using a large sample of cross-sectional stock data including many small-cap stocks and stocks with large book values, they analyzed the accuracy of the CAPM and looked for other factors that explained stock prices (besides systematic risk). They found that while the CAPM's measure of systematic risk was unreliable, firm size and book to market value ratios were more dependable (Taylor, 2005).

Michailidis et al. (2006) examined the Capital Asset Pricing Model (CAPM) for the Greek stock market using weekly stock returns from 100 companies listed on the Athens stock exchange for the period of January 1998 to December 2002. In order to diversify away the firm-specific part of returns thereby enhancing the precision of the beta estimates, the securities were grouped into portfolios. The findings of their article are not supportive of the theory’s basic statement that higher risk (beta) is associated with higher levels of return. Moreover, the results of their study offer evidence against the CAPM. The tests conducted to examine the nonlinearity of the relationship between return and betas support the hypothesis that the expected return-beta relationship is linear. They also investigated whether the CAPM adequately captures all-important determinants of returns including the residual variance of stocks. The results demonstrated that residual risk has no effect on the expected returns of portfolios.

Choudhary and Choudhary (2010) examined the Capital Asset Pricing Model (CAPM) for the Indian stock market using monthly stock returns from 278 companies of BSE 500 Index listed on the Bombay stock exchange for the period of January 1996 to December 2009. The
findings of their study are not substantiating the theory’s basic result that higher risk (beta) is associated with higher levels of return.

Reddy and Thomson (2011) tested the empirical validity of the Capital Asset Pricing Model (CAPM) for the South African share market. For the investigation, quarterly total returns from ten sectoral indices listed on the JSE Securities Exchange from 30 June 1995 to 30 June 2009, were used. As expressed in the securities market line, the CAPM suggests that higher risk, as measured by beta, is associated with higher expected returns. In addition the theoretical underpinnings of the CAPM are that it explains expected excess return, and that the relationship between expected return and beta is linear (Reddy, and Thomson, 2011). In their investigation, direct tests of the securities market line were made, using both prior betas and in-period betas. A nonparametric test was also made. Regression analysis was used to test hypotheses based on both individual sectoral indices and portfolios constructed from those indices according to their betas. These tests were made for individual years as well as for all periods combined. It was found that while, on the assumption that the residuals of the return-generating function are normally distributed, the CAPM could be rejected for certain periods, and the use of the CAPM for long-term actuarial modelling in the South African market can be reasonably justified.

The above analysis showed that there are contrasting results across the body of literature regarding the validity of the CAPM on the stock markets. The contrasting results leave a question on the applicability of the efficient market hypothesis on the JSE. However, a study by Reddy, and Thomson (2011) showed that the use of the CAPM could be justified only in the long run but it could be rejected for certain periods.

3.2.12 Arbitrage Pricing Theory (APT)
Drake and Fabozzi (2009:272) argue that the APT model postulates that an asset’s expected return is influenced by a variety of risk factors, as opposed to just market risk of the CAPM. That is, the APT model asserts that return on an asset is linearly related to H factors. The APT does not specify what these factors are, but it is assumed that the relationship between asset returns and factors is linear. Specifically, the APT model asserts that the rate of return on asset, i, is given by the following relationship (Drake and Fabozzi, 2009:272). Forcadi, Kolm and Fabozzi (2004:88) argue that the APT postulates that an asset’s expected return is influenced by a variety of risk factors as opposed to just market risk as assumed by the
CAPM. The APT model states that the return on a security is linearly related to \( H \) systematic risk factors. However, the APT model does not specify what the systematic risk factors, but it is assumed that the relationship between asset returns and the risk factors is linear. The APT model as given asserts that investors want to be compensated for all the risk factors that systematically affect the return of a security. The compensation is the sum of the product of each risk factor’s systematic and the risk premium assigned to it by the capital market.

### 3.2.12.1 Assumptions

The Arbitrage Pricing Theory assumes that:

1. Only the systematic risk is relevant in determining expected returns (similar to CAPM). However, there may be several non-diversifiable risk factors (different from CAPM, since CAPM assumes only one risk factor) that are systematic or macroeconomic in nature and thus affect the returns of all stocks to some degree (Boenme, 2009).

2. Firm specific risk, since it is easily diversified out of any well-diversified portfolio, is not relevant in determining the expected returns of securities (similar to CAPM) (Boehme, 2009). If investors can invest recklessly and earn more than the riskless rate, they have found an arbitrage opportunity. The premise of the APT is that investors take advantage of such arbitrage opportunities, and in the process eliminate them (Damodaran, 2002:72). If two portfolios have the same exposure to risk but offer different expected returns, investors will buy the portfolio that has the higher expected returns and sell the portfolio that has the lower expected returns, and earn the difference as a riskless profit. To prevent this arbitrage from occurring, the two portfolios have to earn the same expected return.

### 3.2.12.2 The APT equation

Vernimmen, Quiry, Fur, Dallochio and Salvi (2005) held that the return on a stock can be calculated by the following APT formula stated by Ross (1976):

\[
\text{Expected Return} = r_f + b_1 \times (\text{factor 1}) + b_2 \times (\text{factor 2}) \ldots b_n \times (\text{factor n})
\]

Where:

- \( r_f \) = The risk free interest rate (interest rate the investor would expect to receive from a risk free investment)
- \( b \) = The sensitivity of the stock to each factor
- \( \text{factor} \) = the risk premium associated with each factor
The Risk premium is a function of several variables, not just one, and these variables can be macroeconomic variables. The model does not stipulate which factors are to be used. They can be changes in the Yield curve, exchange rates, and any other macroeconomic factors.

3.2.12.3. Macroeconomic Variables of the APT and Stock market activities

Isenmila and Erah (2012) note that though the Arbitrage pricing theory does not provide a clear basis for identifying the macroeconomic factors that are related to stock returns with respect to causality, there are however, several variables have been identified in the literature as important determinants of stock returns. The exchange rate, GDP and interest rates are some of these variables. Chen et al. (1986) in Iqbal and Haider (2005) argue that risk factors (in the APT) arise from changes in some fundamental economic and financial variables such as interest rates, inflation, real business activity, exchange rate among other variables. The relationship between interest rate and exchange rate and stock returns indicates several issues that may serve as intermediaries or transmission mechanism through which the effect may be observed.

Abdul and Karachi (2007) held that according to the Arbitrage theory, a rise in real interest rate reduces the present value of a firm’s future cash flows and causes stock prices to fall. But at the same time, a higher interest rate stimulates the capital inflow, and therefore exchange rate falls. So the real interest rate disturbance may be a factor of a positive relationship between the average level of stock prices and exchange rates. Like the CAPM, the APM begins by breaking risk down into firm specific and market risk components. As in the CAPM, firm specific risk covers information that affects primarily the firm. Market risk affects many or all firms and would include unanticipated changes in a number of economic variables, including GNP, inflation, and exchange rates. In this regard, the model assumes that macroeconomic variables such as exchange rate can have an effect on the stock market. Moreover, the dividend discount model postulates that the current share price equivalents the present value of future cash flows, which depends on the growth of a company. As a company’s growth depends on domestic macroeconomic condition as well as its major trading partners, the co-movement of macroeconomic variables across countries may influence the co-movement of stock prices in those countries. The exchange rate is also one of the macroeconomic factors that could influence stock prices; hence it affects activities on the stock market.

Whether or not exchange rate volatility should be priced into stock return or not requires a precise definition of risk and how exchange rate exposure is related to the different kinds of
risk. Korsgaard (2009) notes that three main categories of risk can be identified when evaluating an investment scheme and these are;

(i) Firm specific risk is related to the specific company in question. Meaning exogenous risk to that of both industry and country risk.

(ii) Industry risk may be defined as the risk specific to an industry, not only to the individual company.

(iii). Country specific risk is the risk across industries, also denoted as the market risk. Country specific risk is closely related to political risk. Political risk is among other changes in the fiscal and monetary policies pursued by the specific country

Korsgaard (2009) further maintains that the essence of this hypothesis of whether or not exchange rate movements should be independently priced into stock return is dependent on the residence of exchange rate risk. Should currency risk be considered a country specific risk e.g. a general market risk, meaning that the premium of the risk is already priced into the market risk, thus not adding extra risk to any individual company. The other possible outcome is that the exchange rate risk is deemed to be a specific risk to the company, resulting in the return of that individual stock being more sensitive to exchange rate change than the general market return.

The interaction of other macroeconomic variables with the stock market can also lead to a causal relationship between the stock market and the exchange rate. Rashid and Karachi (2007) held that according to the Arbitrage theory, a rise in real interest rate reduces the present value of a firm’s future cash flows and causes stock prices to fall. But at the same time, a higher interest rate stimulates the capital inflow, and therefore exchange rate falls. So the real interest rate disturbance may be a factor of a positive relationship between the average level of stock prices and exchange rates.

Jorion (1991) held that the APT suggests that if the economy is described by a small number of persuasive factors then these factors may well be priced in the sense that investors will be willing to pay a premium to avoid these sources of risk. In this framework, hedging policies can affect the cost of capital if the exchange rate is one of those factors. Still, in a situation where the pricing of risk is consistent across the stock market and the foreign exchange market, hedging may decrease the cost of capital for the firm but will also entail ex ante costs, besides transaction costs, such that the overall risk adjusted value of the firm is
unchanged. Thus hedging will be valuable to investors only if foreign exchange risk is priced in the stock market and if some type of market segmentation occurs (Jorion, 1991). For example, if foreign exchange risk is priced in the stock market but not in the foreign exchange market – that is, if forward rates do not contain a risk premium – then hedging could change the cost of capital for the firm.

3.2.13 Empirical validity of the Arbitrage Pricing Theory

Cho, Eun and Senbet (1986) tested the arbitrage pricing theory (APT) in an international setting. Inter-battery factor analysis was used to estimate the international common factors and the Chow test was used in testing the validity of the APT. Their inter-battery factor analysis results showed that the number of common factors between a pair of countries ranges from one to five, and their cross-sectional test results led them to reject the joint hypothesis that the international capital market is integrated and that the APT is internationally valid. Their results, however, do not rule out the possibility that the APT holds locally or regionally in segmented capital markets. Finally, the basic results of both the inter-battery factor analysis and the cross-sectional tests are largely invariant to the numéraire currency chosen.

Javed and Aziz (2005) examined the validity of the Arbitrage Pricing Theory (APT) model on returns from 24 actively trading stocks in Karachi Stock Exchange using monthly data from January 1997 to December 2003. Explanatory factor analysis approach indicates two factors governing stock return. Pre-specified macroeconomic approach identifies these two factors as the anticipated and unanticipated inflation and market index and dividend yield. Some evidence of instability is found. The overall finding of two significant priced factors at least for a sub period supports APT for an emerging capital market.

Pooya, Cheng, Shamsher and Bany’s study in 2011 provided weak evidence in support for the application of Arbitrage Pricing Theory (APT) on the Iranian stock market. Tests conducted using the principal component analysis and canonical correlation model showed that at least one to three factors that can explain the cross-section of expected returns in this market. Financial and economic sanctions possibly explained the negative stock market returns which reflected the reaction of investors to the announcement of sanctions. Overall, the results suggested that there are four groups of macroeconomic variables in the test period that affect stock returns for the test period, 1991 to 2008, but the significance of these factors
was not consistent over time. In general the findings document a weak applicability of APT in this market.

The above analysis showed that there are contrasting results across the body of literature regarding the validity of the ABT on the stock markets. The contrasting results leave a question on the validity of the efficient market hypothesis on the JSE. This can only be seen from the results of the study.

3.3 Empirical literature

The behavior of volatility of stock market has been extensively studied using the ARCH-GARCH framework pioneered by Engel (1982) and further developed by Bollerslev (1986), and others. These studies attempted to investigate the interaction between stock prices and exchange rates in the industrialized countries and emerging financial markets. However, the results of some of these studies are inconclusive. The present study shall look at studies that have been done in developing countries, emerging markets and in developed countries.

3.3.1 Developing countries

Adjasi and Biekpe (2007) investigated the relationship between stock prices and exchange rate movement in Ghana, South Africa, Egypt, Kenya, Mauritius and Nigeria. They used vector autoregressive (VAR) cointegration and impulse response analysis to determine the long- and short-run linkages between stock prices and exchange rates. Findings from their study indicated a long-run relationship between stock prices and the exchange rate in Tunisia, where exchange rate depreciation drove down stock prices. A short-run error-correction model also showed similar results. Impulse response analyses for other countries showed that stock returns in Ghana, Kenya, Mauritius and Nigeria reduced when induced by exchange rate shocks but increased in Egypt and South Africa. Shocks induced by either stock prices or the exchange rate are more protracted in Ghana, Kenya, Mauritius and Nigeria than in South Africa and Egypt. However, results also showed that, there was no long-run stable relationship between stock market prices and exchange rates for Egypt, Ghana, Kenya, Mauritius, Nigeria and South Africa.

Adjasi, Harvey and Agyapong (2008) used the Exponential Generalised Autoregressive Conditional Heteroskedascity (EGARCH) model in establishing the relationship between exchange rate volatility and stock market volatility in Ghana. In their study, it was found that there was negative relationship between exchange rate volatility and stock market returns,
depreciation in the local currency leads to an increase in stock market returns in the long run. Additionally, there was volatility persistence in most of the macroeconomic variables; current period’s rate had an effect on forecast variance of future rate. It was also revealed that an increase (decrease) in trade deficit and expectation in future rise in trade deficit will decrease (increase) stock market volatility. In addition, the consumer price index showed a strong relationship with stock market volatility. This meant that an increase in consumer price led to a rise in stock market volatility. Finally, there was the presence of leverage effect and volatility shocks in stock returns on the Ghana Stock Exchange.

Pilinkus and Boguslauskas (2009) investigated the short-run relationship between stock market prices and macroeconomic variables in Lithuania. One of their macroeconomic variables was exchange rate. The Augmented Dickey Fuller test was employed to check the stationarity of the selected time series since a spurious regression may occur if a time series is not stationary. The study used the Impulse response function to test the existence of the short-run relationship between stock market prices and macroeconomic variables. As the results of the Impulse response function are reliable only with a stationary time series the data was turned into stationary after the second difference. The results of the study clearly indicated that macroeconomic variables are significant determinants for stock market prices in Lithuania. Their study concluded that unemployment rate, exchange rate, and short-term interest rates negatively influence stock market prices.

Through the Error Correction model, Subair and Salihu (2010) investigated the effects of exchange rate volatility on the Nigeria stock markets. It was found that the exchange rate volatility generated via GARCH process exerts a stronger negative impact on the Nigeria stock markets. However, the rate of inflation and interest rate did not have long run relationship with stock market capitalization since the major participant in the market was the government. Based on this, it was recommended that a coordinated monetary and fiscal policy should be put in place to checkmate the fluctuation of exchange rate in order to deepen the depth of the Stock Market.

Muhammad and Rasheed (2011) conducted a study on the relationship between Stock Prices and Exchange Rates in South Asian countries. Their study used monthly data on four South Asian countries; Pakistan, India, Bangladesh and Sri Lanka, for the period January 1994 to December 2000. The study employed cointegration, vector error correction modeling
technique and standard Granger causality tests to examine the long-run and short-run association between stock prices and exchange rates. Results of the study showed no short-run association between the variables for all four countries. There was no long-run relationship between stock prices and exchange rates for Pakistan and India as well. However, for Bangladesh and Sri Lanka, there appeared to be a bi-directional causality between these two financial variables.

Olugbenga (2012) examined the long-run and short-run effects of exchange rate on stock market development in Nigeria over 1985:1–2009:4 using the Johansen cointegration tests. A bi-variate model was specified and empirical results showed a significant positive stock market performance to exchange rate in the short-run and a significant negative stock market performance to exchange rate in the long-run. The Granger causality test showed strong evidence that the causation runs from exchange rate to stock market performance. This implied that variations in the Nigerian stock market are explained by exchange rate volatility. The study concluded that the negative influence of exchange rate on Nigerian stock market performance could have been a result of heavy devaluation of the currency since the introduction of the structural adjustment programme in 1986.

3.3.2 General evaluation of empirical literature from developing countries
An analysis of studies from developing countries was conducted and it was observed that there is no general consensus with regard to the link between exchange rate and the stock market. Whilst some studies (Subair and Salihu, 2010 and Olugbenga, 2012) found that exchange rate volatility exerts a stronger negative impact on the stock markets, others (Muhammad and Rasheed (2011) found that there is no relationship between these two variables. It was also observed that different studies applied different approaches to achieve their objectives. Evidence of notable links between exchange rates and the stock market has been observed in a number of African countries. However, due to the different methodologies that were used by different studies and also the fact that studies were conducted in different countries, different results could be obtained.

3.3.3 Emerging markets
Abdalla and Murinde (1997) investigated interactions between exchange rates and stock prices in the emerging financial markets of India, Korea, Pakistan and the Philippines. The motivation was to establish the causal linkages between leading prices in the foreign exchange market and the stock market; the linkages had implications for the on-going
attempts to develop stock markets in emerging economies simultaneously with a policy shift towards independently floating exchange rates. A bivariate vector autoregressive model was applied as an estimation technique and the study used monthly observations on the IFC stock price index and the real effective exchange rate over 1985:01 - 1994:07. The results showed unidirectional causality from exchange rates to stock prices in all the sample countries, except the Philippines. Their finding has policy implications; it suggested that respective governments should be cautious in their implementation of exchange rate policies, given that such policies have ramifications on their stock markets.

Smyth and Nandha (2003) examined the relationship between exchange rates and stock prices in Bangladesh, India, Pakistan and Sri Lanka using daily data over a six-year period from 1995 to 2001. Both the Engle–Granger two-step and Johansen cointegration methods suggested that there is no long-run equilibrium relationship between these two financial variables in any of the four countries. Granger causality tests were employed and it was found that there is uni-directional causality running from exchange rates to stock prices in India and Sri Lanka, but in Bangladesh and Pakistan exchange rates and stock prices were independent.

Karoui (2006) used a GARCH model to estimate the stock return and the exchange rate volatility. The basic intuition behind Karoui’s investigation was that the volatility of the stock returns could be partially explained by the volatility of the currency rates. The study focused on the following 18 emerging countries: Argentina, Brazil, Chile, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Poland, Philippines, Russia, South Africa, South Korea, Taiwan, Thailand, and Turkey. The study found a significant relationship between currency rate volatility and stocks returns volatility for a large part of the indexes studied. Moreover, a positive relationship between the foreign exchange rate volatility and the stock return volatility in a large part of the sector indexes studied was found.

Morales (2008) investigated the extent of volatility spillovers between stock returns and exchange rate changes for six Latin American financial markets namely: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela and one European financial market, and Spain in the 1998-2006 period. The study divided the sample into sub periods, prior to and after the introduction of the Euro and it applied the EGARCH methodology to model volatility. The results showed that the volatility of stock returns affects the volatility of exchange rates; however, no evidence of volatility transmission in the opposite direction was found. The
results of the study are consistent with those of Kanas (2000) and Yang and Doong (2004) who both found evidence of volatility spillovers from stock returns to exchange rates. However the results differ on the evidence of spillovers in the opposite direction from exchange rates to stock markets. Morales’s (2008) study found that although volatility spillovers are much less prevalent from the various bilateral exchange rates to the stock markets in the countries examined, as well as less consistent across countries and over time than the spillovers from stock markets to exchange rates.

Rahman and Uddin (2009) investigated the interactions between stock prices and exchange rates in three emerging countries of South Asia namely Bangladesh, India and Pakistan. Their study considered average monthly nominal exchange rates of US dollar in terms of Bangladeshi Taka, Indian Rupee and Pakistani Rupee and monthly values of Dhaka Stock Exchange General Index, Bombay Stock Exchange Index and Karachi Stock Exchange All Share Price Index for period of January 2003 to June 2008 to conduct the study. Empirical result showed that exchange rates and stock prices data series are non-stationary and integrated of order one. They also applied the Johansen procedure to test for the possibility of a cointegrating relationship. Result showed that there was no cointegrating relationship between stock prices and exchange rates. Finally they applied Granger causality test to find out any causal relationship between stock prices and exchange rates. Outcome showed there was no causal relationship between stock prices and exchange rates in the countries.

Agrawal and Srivastav (2010) empirically examined the dynamics between the volatility of stock returns and movement of Rupee-Dollar exchange rates, in terms of the extent of interdependency and causality. Absolute values of data were converted to log normal forms and checked for normality. Application of Jarque-Bera test yielded statistics that affirmed non-normal distribution of both the variables. This posed questions on the stationarity of the two series. Stationarity of the two series was checked with ADF test and the results showed stationarity at level forms for both the series. The coefficient of correlation between the two variables was computed, which indicated slight negative correlation between them. This made way for determining the direction of influence between the two variables. Granger Causality test was applied to the two variables and it proved unidirectional causality running from stock returns to exchange rates, that is, an increase in the returns of Nifty caused a decline in the exchange rates but the converse was not found to be true
Eissa, Chortareas and Cipollini (2010) examined the presence of volatility spillovers between nominal exchange rates and stock returns in three countries: Egypt, Morocco and Turkey. The study considered daily sector indexes in Egypt, Morocco and Turkey. The multivariate GARCH model that was used did not produce evidence of cross-market effects for the general stock indices returns. But it was seen that a bidirectional shock and volatility spillovers between exchange rates and stock returns existed at the industry sector level. These findings were much more pronounced in Egypt and Turkey. The different results were due to the different exchange rate regimes/policies adopted by the three countries. While exchange rates in Egypt and Turkey were allowed to float, Morocco followed a more tightly managed exchange rate regime.

In another study in Turkey, Yıldız and Ulusoy (2011) examined the effect of exchange rate volatility on Turkish stock returns using monthly data for the period 1987-2010. The squared residuals from the Autoregressive Moving Average (ARMA) models were used to generate a measure of exchange rate volatility and then tested against Turkish stock returns. The monthly closing index values of the Istanbul Stock Exchange 100 Index (ISE) were used in order to obtain Turkish stock returns. The results of the study emphasized that Turkish exporters did not consider exchange rate uncertainty as a crucial problem.

Kutty (2010) examined the relationship between stock prices and exchange rates in Mexico. The Granger causality test showed that stock prices led exchange rates in the short run, and there was no long run relationship between these two variables. Kutty also some short run relationship between stock prices and exchange rates. The Granger causality tests revealed that stock prices lead exchange rates in the short run, and there was no long run relationship between these two financial variables.

3.3.4 General evaluation of empirical literature from emerging economies

The above analysis of empirical literature in emerging markets showed that there is no empirical harmony among the studies conducted to examine the impact exchange rates on stock market in emerging markets. Several methods have been used with different approaches to test the link between exchange rates and the stock market. Techniques such as the Engel-Granger Causality, Johansen Cointegration, GARCH, and ARMA were used by various studies. However, results from these studies are inconclusive; there are mixed results with regard to the link between the two variables. There are contrasting results and a conclusion
cannot be drawn with regard to the relationship between exchange rate and the stock market. This justifies the need of more research in this area to contribute to existing literature.

3.3.5 Developed countries

Aggarwal (1981) examined the relationship between exchange rates and stock prices by looking at the correlation between changes in the US trade-weighted exchange rate and changes in US stock market indices each month for the period 1974 to 1978. The study found that the trade-weighted exchange rate and the US stock market indices were positively correlated during this period. The study concluded that movements in the exchange rate could directly affect the stock prices of multinational firms by influencing the value of its overseas operations, and indirectly effect domestic firms through influencing the prices of its exports and/or its imported inputs.

Nieh and Lee (2001) examined the relationship between stock prices and exchange rates for G-7 countries. They took daily closing stock market indices and foreign exchange rates for the period from October 1, 1993 to February 15, 1996. Their study employed cointegration and VECM models and found that there is no long-run equilibrium relationship between stock prices and exchange rates for each G-7 countries. While one day’s short-run significant relationship has been found in certain G-7 countries, there was no significant correlation in the United States. In another study, Mun (2004) analysed the contribution of exchange rate fluctuations to international stock market fundamentals for eight mature markets in relation to the US market (UK, France, Germany, Italy, Australia, Hong Kong, Japan, and Singapore). The data set analyzed was weekly series for the period from January 8, 1990 to September 5, 2003, providing a sample size of 714 observations. Dynamic movements of the stock market volatility and cross-market correlations were examined within an EGARCH framework.

Results showed that countries like France, Germany, and Hong Kong do not exhibit strong evidence of positive contribution to exchange rate fluctuations. This implied that depreciating local currencies are associated with rising US stock markets, suggesting a negative impact of exchange rate fluctuations on the US/local equity market correlation. Statistical evidence presented in Mun’s (2004) study indicated that higher exchange rate variability, for the most part, contributed to higher local equity market volatility but to a lower US equity market volatility.
Morales (2007) examined the dynamic relationship between exchange rates and stock prices in four Eastern European markets, Czech Republic, Hungary, Poland and Slovakia, using stock price and exchange rate data from these countries, as well as stock prices from the United States, Germany and the United Kingdom. The data set consisted of daily data over a 7 year period from 1999 to 2006. Both the long-run and the short-run association between these variables were analyzed. The study employed the Johansen cointegration technique, Vector Error Correction Modeling and the standard Granger causality test to analyze the relationship between these two financial variables. The findings of the study showed that there is no evidence of stock prices and exchange rates moving together either in the long-run or in the short-run, with the exception of Slovakia, where cointegrating relationships were found.

In terms of their causality analysis, Morales’ (2007) results showed a unidirectional causal relationship from the exchange rates to the stock prices in the case of Hungary, Poland and Czech Republic. There was also evidence of causality from the Hungarian exchange rate to the United Kingdom stock prices, from the Polish exchange rates to the United Kingdom stock prices, from the Czech Republic exchange rate to the United Kingdom stock prices and from the Slovakian exchange rates to the United Kingdom stock prices. Finally, the study also found evidence of causality from the stock prices to the stock prices in the case of Hungary to United Kingdom, United Kingdom to Poland, and the United States to Poland.

In another study, Korsgaard (2009) examined the relationship between firm value and exchange rate volatility in the following European countries; Denmark, Spain and Germany. A different multiple regression models was generated and resultantly, the normal Ordinary Least Squared (OLS) method was replaced by the Newey-West standard errors test. The data on Danish, Spanish and German companies was synchronized such that the time span went from May 2001 to October 2008. Exchange rate volatility was tested against stock returns. The findings suggested that stock returns are to a certain degree sensitive to exchange rate volatility.

Further study by Alagidede, Panagiotidis and Zhang (2010) investigated the nature of the causal linkage between stock markets and foreign exchange markets in Australia, Canada, Japan, Switzerland, and UK from 1992:1 to 2005:12. Recently developed cointegration tests were employed and no evidence of a long-run relationship between the variables was found. Three variations of the Granger causality test were carried out and causality from exchange
rates to stock prices was found for Canada, Switzerland, and United Kingdom; weak causality in the other direction was found only for Switzerland. Their paper examined the causality between exchange rates and stock prices in Australia, Canada, Japan, Switzerland, and UK in a linear and nonlinear framework. They provided evidence that there is no long-run relationship between the two variables using two cointegration approaches and an extended datasets.

Choi, Fang and Fu (2010) applied the EGARCH model to volatility spillovers to empirically test volatility spillovers between stock market returns and exchange rate changes in New Zealand. Their sample period spans from January 1990 to December 2004. And resultantly there were 3,866 observations. They examined whether the effect of volatility spillover changes over time by performing the test in the sub-periods using the EGARCH model. The study found that there is significant volatility spillovers from exchanges rate changes to stock market returns; volatility spillovers from stock market returns to exchange rate changes is marginally significant and changes from negative before the 1987 stock crash to positive after the crash.

Sekmen (2011) examined the effects of exchange rate volatility, using the squared residuals from the autoregressive moving average (ARMA) models, on stock returns for the U.S. for the period 1980 to 2008. The study tested the effect of exchange rate volatility on the profits of firms in the U.S. using the squared residuals from the ARMA model to generate estimates of volatility. Overall, the study found that exchange rate volatility negatively affected U.S. stock returns since the availability of hedging instruments could not lessen the negative effect of exchange rate volatility on trade volume.

3.3.6 General evaluation of empirical literature from developed countries
Studies from developing countries showed a mixed view of the relationship between exchange rate volatility and the stock market. A review of selected studies done in developed studies is presented in the table below.
Table 3.1 Review of selected studies done in developed studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Methodology</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choi, Fang, and Yong Fu (2009)</td>
<td>EGARCH</td>
<td>The exchange rate affected the stock market.</td>
</tr>
<tr>
<td>(New Zealand)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morales (2007)</td>
<td>Johansen cointegration technique, Vector Error Correction Modeling and the standard Granger causality test</td>
<td>No evidence of stock prices and exchange rates moving together either in the long-run or in the short-run was found.</td>
</tr>
<tr>
<td>(Czech Republic, Hungary, Poland and Slovakia)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alagidede, Panagiotidis and Zhang (2010)</td>
<td>cointegration tests and Granger causality test</td>
<td>There is no long-run relationship between the two variables.</td>
</tr>
<tr>
<td>Sekmen (2011)</td>
<td>ARMA</td>
<td>Exchange rate volatility negatively affected U.S. stock returns</td>
</tr>
</tbody>
</table>

Table 3.1 shows that different techniques were used by different studies to obtain results. Studies used the EGARCH, Johansen method, Granger Causality Tests and the Autoregressive moving average (ARMA) models for estimation purposes. Different results were obtained in developed countries. This might have been caused by different factors and different economic circumstances that each country was exposed to. Studies conducted in developed countries are inconclusive; the results are mixed. Some studies such as those by Aggarwal (1981) support the view that there is a relationship between exchange rate and stock markets. Others by Morales (2007), Nieh and Lee (2001) and Alagidede, Panagiotidis and Zhang (2010) indicate that there is no relationship between exchange rates and the stock market. This justifies this study in examining the impact of exchange rate and stock market in South Africa.

3.3.7 Empirical Evidence from South Africa

Alam and Taufique (2007) examined the empirical relationship between exchange rate and stock prices on the JSE. The sample of the study included the daily price indices of all securities listed on the JSE for the period since January 2000 to December 2004. The hypothesis of the study was whether the Johannesburg stock exchange is informationally efficient (Weak form and Semi-strong forms). The results from the unit root test, the ADF test and the causality test at the Granger sense provide evidence that the Johannesburg Stock
Exchange (JSE) is informationally efficient such that nobody can use the exchange rate to forecast or predict stock prices in the Johannesburg Stock Exchange. This showed that there is a relationship between the two variables. However, Alam and Tafiques (2007) admitted that their study deserves continuous research in this area in order to reach the ultimate conclusion about the level of efficiency of emerging markets.

Adjasi and Biekpe (2007) investigated the links between stock market development and key economic growth variables in selected African countries including South Africa. Impulse response analyses were conducted within the vector autoregression (VAR) framework to identify the response and behaviour of stock market returns to shocks induced by exchange rate movements. Results from their study showed that there was a short run relationship between exchange rate movements and stock market returns. For Egypt and South Africa the stock market returns responded positively to a shock induced by the exchange rate within the first month of the shock. However, results also showed that, there was no long-run stable relationship between stock market prices and exchange rates for Egypt, Ghana, Kenya, Mauritius, Nigeria and South Africa.

In another study, Dube (2008) investigated the empirical validity of the monetary model of the exchange rate (Rand/Dollar) using a technique (ARDL Bounds test) capable of testing for the existence of a long-run relationship regardless of whether the underlying time series are individually I(1) or I(0). Monetary fundamental variables (money supply, income, interest rate) were augmented by the stock market prices. The study found evidence supporting the existence of a long-run relationship between the ZAR/$ exchange rate and fundamental variables, including stock prices.

In South Africa, few studies have been conducted so far to investigate the relationship between stock prices and exchange rate volatility and this motivated the present study to examine the impact of exchange rate on the stock market in South Africa.

3.3.8 An overall analysis of empirical literature
Empirical literature investigated by the study showed that there is a relationship between the two variables. Studies conducted in developing countries were analysed and it was observed that there is a mixed view over the link between exchange rate and the stock market. Different studies variously found positive correlation, negative correlation, and existence or
nonexistence of causality. Hence, it can be deduced that there are mixed views on the link between the two variables. An analysis of the methodologies applied in these studies was examined and it was seen that the GARCH, Johansen Cointegration Tests and the Granger Causality tests were the most widely used tools in examining the link between the exchange rate and stock market. An analysis of studies conducted in emerging economies was also examined and it can be noted that there is a mixed view over the relationship between exchange rates and the stock market. In developed countries, there is no general consensus with regard to the link between the exchange rate and the stock market. Table 3.2 provides a review of selected studies conducted around the globe.
Table 3.2: Review of selected studies conducted around the globe

<table>
<thead>
<tr>
<th>Study</th>
<th>Methodology</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdalla and Murinde (1997)</td>
<td>Bivariate vector autoregressive model</td>
<td>Results showed unidirectional causality from exchange rates to stock prices</td>
</tr>
<tr>
<td>Morales (2007)</td>
<td>Johansen cointegration technique, Vector Error Correction Modeling and the standard Granger causality test</td>
<td>No evidence of stock prices and exchange rates moving together either in the long-run or in the short-run was found.</td>
</tr>
<tr>
<td>Adjasi, Harvey and Agyapong (2008)</td>
<td>EGARCH</td>
<td>Depreciation in the local currency leads to an increase in stock market returns.</td>
</tr>
<tr>
<td>Smyth and Nandha (2003)</td>
<td>Engle–Granger two-step and Johansen cointegration</td>
<td>There is uni-directional causality running from exchange rates to stock prices in India and Sri Lanka, but in Bangladesh and Pakistan exchange rates and stock prices were independent</td>
</tr>
<tr>
<td>Karoui (2006)</td>
<td>GARCH</td>
<td>Positive relationship between the FX rate volatility and the stock return volatility was found</td>
</tr>
</tbody>
</table>

Table 3.2 shows that different methodologies were used by different studies. The adoption of a certain methodology depended on the objectives of the studies and this might have resulted
in the achievement of different results. Pilinkus and Boguslauskas (2009) argue that scientists who employ the Impulse response function mainly analyzed the short-run relationship between macroeconomic variables and stock market prices. This shows that the objective of the study determines the instrument that would be used to achieve such an objective. Hence this might result in having mixed results.

However, interesting to note is that some studies like that of Alam and Tafiques (2007) admit that there is need for continuous research in the area of exchange rates and stock markets. This makes the investigation of the impact of exchange rate volatility on the stock market more challenging and interesting. Studies in other countries also provided room for further research. Morales (2008) also admitted that further research along these lines is required in order to establish more comprehensively the true nature of spillovers from exchange rates to equity markets.

3.4 Conclusion
This chapter reviewed literature relating to the relationship between exchange rates and the stock market. Consideration was given to the flow oriented model, stock oriented model, CAPM, EMH, and the APT. All these theories explain the relationship that exists between the exchange rate and the stock market. Empirical studies that examined the link between exchange rates and stock markets were also assessed. Results from various studies conducted to examine the relationship or the effect of exchange rates and the stock market are not really conclusive. There is no theoretical consensus neither on the existence of a relationship between stock prices and exchange rates nor on the direction of the relationship. This study overlaps with, and draws on, relevant aspects of the foregoing studies but defines its scope somewhat differently.

---

4 Exchange rate and stock market.
CHAPTER FOUR

METHODOLOGY

4.1 Introduction
This chapter provides the methodology employed in finding the impact of currency volatility on the stock market in South Africa. The structure of this chapter shall be as follows: section 4.2 considers the General auto regressive conditional heteroscedasticity (GARCH) model that connects the rand volatility and the stock market. Furthermore, section 4.2 will also define the variables that are used and the expected priori. Section 4.3 outlines the data sources and analysis. Following section 4.3 is section 4.4 that identifies the stationary tests. Following this section is section 4.5 which provides the causality tests that are used for the study. Section 4.6 presents the diagnostic tests employed by the study. Following this section a review of the estimation technique shall be presented in section 4.7. Lastly is section 4.8 which concludes the chapter.

4.2 Model specification
In order to measure the impact of currency volatility on the stock market in South Africa, this study followed Subair’s (2009) model. Subair (2009) used the GARCH model to investigate the impact of exchange rate volatility on the stock market performance in Nigeria. His study employed the following model:

\[ LSSMC = f(RANDVOL, LGGDP, INF, IR) \] \hspace{1cm} (4.1.1)

The exchange rate volatility was generated using the GARCH technique. Hence stock market capitalization (SSMC) was expressed as a function of exchange rate volatility (RANDVOL), interest rate (IR), inflation rate (INF) and gross domestic product (LGGDP). The “L” in the denotation above stands for natural log.

This present study shall modify Subair’s (2009) model. The explanatory variables that are included in this study’s model are: the prime overdraft interest rate, total mining production, exports, and US interest rates. The model shall, therefore, take the form:

\[ LSMC = f (RANDVOL, TMP, INT, M3, USINT) \] \hspace{1cm} (4.1.2)

In this model, LSMC is a function of the exchange rate volatility (RANDVOL), total mining production (TMP), interest rates (INT), money supply (M3) and United States interest rates (USINT).
This model can be expressed in its linear form as:

\[ LSMC = \beta_0 + \beta_1 L\text{RANDVOL}_t + \beta_2 L\text{TMP}_t + \beta_3 L\text{MINT}_t + \beta_4 L\text{M3T}_t + \beta_5 L\text{USINT}_t + \varepsilon_t \]

\[ \ldots \ldots (4.1.3) \]

Where \( \varepsilon_t \) is a white noise error term and the L in the above model stands for natural logs.

4.2.1 Definition of Variables

**LSMC** is the natural logarithm of the stock market capitalisation (JSE). Market capitalization is the market share price per share multiplied by the number of shares outstanding. Market capitalization will change in line with changes in share price and the number of shares issued. Investors determine a company’s share value by looking at its market capitalization. Olalere (2006) held that, in South Africa, the exchange rate has a greater impact on the market capitalization than stock prices. This is the reason why market capitalization rather than stock prices is chosen in this study.

**LPOR** is the natural logarithm of the prime overdraft interest rate. This rate of interest is very crucial in determining the level of investment in the economy. Interest rates are very relevant to the study because they determine the extent of borrowing by investors, which impact on investment. Adjasi and Biekpe (2007) argued that interest rate policies are also becoming important tools for directing macroeconomic policies in African economies and therefore, interest rate changes in Africa could, therefore, influence stock market returns significantly. Korsgaard (2009) and Subair (2009) used a similar assessment in examining the impact of currency volatility and exchange rate in Denmark and Nigeria respectively.

**Randvol** is the US/Rand Exchange rate - The US dollar has been used in view of the dominance of the dollar in international transaction as well as close links between the South African and US economies. Since 2001 the JSE performance follows the rand exchange rate (Terblanche, 2008).

**TMP** is the Total mining production – Developments in the mining sector have a huge impact on the JSE. Mining companies constitute almost half of the total market capitalisation on the JSE. The market capitalisation of mining companies listed on the JSE is 43% of the total capitalisation of the JSE (Hofmeyr, 2012:21). This gives the mining sector a strong ground to have a huge influence on the activities of the JSE. Hence, it is important to examine the impact of the mining sector on the JSE.
M3 is used to capture money supply. M3 is used to be an indication of the total amount of money supply available in the economy. M is the broadest measure of money hence it is used to estimate the entire supply of money within an economy. Bhattacharya and Mukherjee (2002) also used this variable when they were conducting a study on the nature of the causal relationship between stock market and macroeconomic aggregates in India.

US interest rates - The increased openness of the South African economy allows the USA economic developments to play a crucial role in equity prices in South Africa. The US interest rates have been playing a huge role in determining investment in emerging markets. The JSE attracts a large measure of foreign participation from institutional investors in the developed world, including the US (Ocran, 2010). Therefore changes (especially decreases in interest rates) in the US interest rates will make investors to move away from the US and seek attractive investment destinations such as South Africa. Hence the United States interest rates are important in explaining the share price on the JSE.

4.2.2 Expected priori

Total Mining Production: The sign of the total volume of production in the mining sector is expected to be positive. There would be a positive relationship between the total mining production and the All Share Index. When the total volume of production in the mining sector increases, the stocks prices are expected to increase. The increase in the volume of production in the mining sector reflects efficiency and increased productivity of the sector. This will attract investors to invest more on the mining firms hence their stock prices will increase. Therefore a positive relationship would exist between the two variables.

Money Supply - The sign of M3 is expected to be positive. Higher M3 also imparts extra liquidity to the stock markets since the excess money is channelized into the stock markets, thus pushing up the market capitalisation. Hence, stock valuations move up as an immediate reaction to an increase in M3. The efficient market hypothesis (EMH), as formalized by Fama (1970), suggests that changes in macroeconomic variables such as money supply can influence the behaviour of stock market activities. In an efficient market, current as well as past information on the growth of these important macro-variables are fully reflected in asset prices (Bhattacharya and Mukherjee, 2002).
US interest rates: The US interest rates sign is expected to be negative. A decrease in the US interest rate is expected to cause the stock prices to rise. When US interest rates fall, investors shift their investment from the US to South Africa since it is an emerging market. This increase in investment will cause the stock prices to rise due to the availability of many buyers on the stock exchange. Thus a negative relationship is expected to exist between the US interest rates and the stock market prices.

Prime overdraft rate: The sign of the interest rates is expected to be negative, although the relationship between interest rates and the stock prices might move in opposite directions. When the interest rate falls, businesses tend to invest more. Their cost of borrowing will decrease and this will make them to invest more and their profitability will increase. This will in turn lead to higher stock prices. This shows that a negative relationship might exist between interest rates and stock prices. Dimitrios (1998) and Kadir, Selamat, Masuga, and Taudii (2011) also indicated that there is a negative relationship between interest rates and stock prices.

Rand Volatility: The sign of the rand volatility is expected to be negative. When there is increased volatility, investors will not invest much on the stock market. It would be risky to invest and they will take their investment elsewhere. This will cause stock prices to decrease. Thus a negative relationship is noticed on the stock prices. Adjasi (2008) and Subair (2009) (also found a negative relationship between exchange rate fluctuations and the Nigerian stock market returns.

4.3 Data sources and analysis
Data for the study shall be obtained from secondary sources such as the Johannesburg Stock Exchange and the South African Revenue Services, Statistics South Africa, South African Reserve Bank, and Department of Trade and Industry. Nominal figures shall be used for the study. The study employs monthly South African data for the period 2000 – 2010. The data frequency selected shall be monthly so as to ensure an adequate number of observations. An observation lower than this (yearly or quarterly) will not provide enough observation of which a reliable conclusion can be drawn as the data will not be an adequate representation of volatility while a higher frequency will be affected by effects of settlements and clearing delays which affect returns over a shorter sampling intervals. The results from monthly data
are more precise and are better able to capture the dynamics between exchange rates and the JSE. The data shall first test for stationary or the order of integration of the data series in order to eliminate spurious regression results. This shall be done using the Augmented Dickey Fuller method and the Phillip Peron test. This is the focus of the next section.

4.4 Testing for stationarity / Unit root

Stationary tests are run to assess whether or not the underlying stochastic process of the time series can be assumed to be invariant over time. If the mean and variance of a time series are constant over time, then the time series is said to be stationary. Time series data is said to be non-stationary if the variance and or the mean in not constant over time. This study applies two unit root tests to check whether a series is stationary or not. The most basic test is the Dickey Fuller test. But unfortunately it is the least powerful unit root test (Alexander, 2008:216). As a result of this weakness the Augmented Dickey Fuller and the Phillips Peron test are used by this study. The main difference between each test is how each calculates the unit root test statistics.

4.4.1 The ADF Test

Mernard (2008:585) held that the Dickey Fuller tests calculate an autoregressive model and test whether the coefficient $\phi_1$ is statistically different from one. If it is not, it will be necessary to difference the series to achieve stationarity. The Dickey Fuller test is of the model:

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \epsilon_t$$

Where $\gamma = \rho - 1$ and the null alternative hypotheses are:

$$H_0 : \gamma = 0$$

$$H_1 : \gamma > 1$$

A major problem with ordinary D-F test is that their critical values are biased if there is autocorrelation in the residuals of the D-F regression. To correct this, Dickey and Fuller (1981) came up with the augmented version of the Dickey Fuller Test. They included as many lagged variables as necessary to remove any autocorrelation in the residuals. The ADF approach controls for higher-order correlation by adding lagged differences terms of the dependent variables to the right hand side of the regression (Sarkar, 2012:19). Mishra and Sethi (2008:573) held that the Augmented Dickey Fuller will, then, take the form:
This augmented specification is then tested for:

\[ H_0: \gamma = 0 \]

\[ H_1: \gamma > 0 \]

For the purposes of this study the Augmented Dickey Fuller is used.

### 4.4.2 Phillips Peron test

Although the ADF is one of the most commonly used tests\(^5\), it sometimes behaves poorly, especially in the presence of serial correlation. As a result of this, Phillips and Peron developed a more comprehensive theory of unit root non stationarity. The tests are similar to the ADF tests, but they incorporated automatic correction to the DF procedure to allow for autocorrelated residuals. The Phillips Peron test performs better than (or at least as well as) the ADF test in terms of comparative power and yields tighter confidence intervals (Cashins and McDermott, 2003:328). In addition to this, the Phillips and Peron tests are non-parametric tests of the null of the unit root and are considered more powerful, as they use consistent estimators of the variance. (Sarris and Hallan, 2006:202). The Phillips Perron unit root test differs from the ADF tests mainly in how they deal with serial correlation and heteroscedasticity in the errors. The Phillips Peron test is based on the model:

\[ X_t = \eta + \beta_t + \pi X_{t-1} + \psi_t \]

With the unit root null hypothesis expressed by \( H_0 : \pi = 1 \); the stationary process \( \psi_t \) is not assumed to be white noise and serial correlation and heteroscedasticity in the \( \psi_t \) term are handled in the test statistic (Donner and Barbosa, 2008:160).

### 4.5 Testing for ARCH effects (Heteroscedasticity Test)

Before estimating a GARCH model it is of paramount importance to first check if there are ARCH effects (heteroscedasticity) in the residuals of the model. This is done by the ARCH test of heteroscedasticity. Engel (1982) proposed a LM test for ARCH based on the \( R^2 \) of an equation in which the squared residuals from an original regression (\( \hat{\mu}_t^2 \)) are regressed on their lags (\( \hat{\mu}_{t-1}^2 \) ............ \( \hat{\mu}_{t-k}^2 \)) and an intercept term (Armstrong, 2001:329). The test is based on the regression of squared residuals on lagged, squared residuals. Choi and Doukas (1998:213) held that the statistic is distributed as \( \chi^2 \) and provides a test of the hypothesis

\(^5\) Farag (2009)
that the coefficients of the lagged squared residuals are all zero – that is no ARCH. The
statistic is the outcome of the Langrange Multiplier (LM) test and has an asymptotic
distribution with degrees of freedom equal to the number of lagged squared residuals.

4.6 Diagnostic tests
Gujarati (2004:516) argues that diagnostic tests should be performed so that the model finally
chosen is a good model in the sense that all the estimated coefficients have the right signs,
they are statistically significant on the basis of the \( t \) and \( F \) tests, and the R-Squared value is
reasonably high. In this regard, this study shall employ the Histogram and Normality test, and
the Ramsey test, and Serial Correlation LM test.

4.6.1 Normality Test
Jarque-Bera is a test statistic for testing whether the series is normally distributed. The test
statistic measures the difference of the skewness and kurtosis of the series with those from
the normal distribution. The Jarque-Bera test is based on the fact that skewness and kurtosis
of normal distribution equal zero. Therefore, the absolute value of these parameters could be
a measure of deviation of the distribution from normal. Jarque and Bera proposed a normality
test using classical skewness and kurtosis coefficients. The Jarque Bera test is a goodness of
fit measure to departure from normality, based on the sample kurtosis and skewness.
Machiwal and Jha (2012:48) states that the test statistic \( JB \) is defined as

\[
JB = \frac{n}{6} \left( S^2 + \frac{k-3^2}{4} \right)
\]

Where \( n \) = number of observations, \( S \) = sample skeness and \( k \) = sample kurtosis.
The \( JB \) test is based on the result that a normally distributed random variable has skewness
equal to zero and kurtosis equal to 3. In other words, the test of normality compares skewness
and kurtosis to 0 and 3, their values under normality. The test statistic is \( JB \). The statistic \( JB \)
has an asymptotic chi-square distribution with two degrees of freedom and can be used to test
the null hypothesis that the data are from a normal distribution. Machiwal and Jha (2012:48)
further maintain that for a normally distributed variable, \( S = 0 \) and \( K = 3 \). Therefore, the \( JB \) test
of normality is a test of the joint hypothesis that \( S \) and \( K \) are 0 and 3 respectively. In this
study, the Jarque-Bera (\( JB \)) test is used to test whether stock returns and exchange rates
individually follow the normal probability distribution.
4.6.2 Residual Diagnostics/Correlogram-Q-statistics

A test whether a volatility model has adequately captured all of the persistence in the variance of returns is to look at the correlogram of the standardized squared residuals. If the model is adequate then the standardized squared residuals should be serial uncorrelated (Knight and Satchell, 2007:56). The q-statistic of squared residuals looks as follows:

\[ Q^* = T (T + 2) \sum_{k=1}^{m} \frac{\tau_k^2(\alpha_t^2)}{T-K} \]

Where \( T \) is the sample size, \( m \) represents the maximum length and \( \tau_k \) are the correlation coefficients. The null hypothesis is \( H_0: \beta_1 = \ldots \ldots \beta_m = 0 \), where \( \beta_i \) is the coefficient of \( \alpha_{t-1}^2 \) of linear regression:

\[ \alpha_t^2 = \beta_0 + \beta_1 \alpha_{t-1}^2 + \ldots + \beta_m \alpha_{t-m}^2 + \epsilon_t \]

for \( t = m + 1, \ldots, T \).

If there is no serial correlation in the residuals, the autocorrelations and partial autocorrelations at all lags should be nearly zero, and all \( Q \)-statistics should be insignificant with large \( p \)-values (Knight and Satchell, 2007:56).

4.6.3 Serial Correlation Test

Serial correlation occurs when there is dependence between error terms. Error terms of the equation estimate must be distributed independently of each other and hence the covariance between any pair of error or residual terms must be zero (Lhabitant, 2004). Serial correlation occurs when the covariance is not zero. The use of time series data often leads to the problem of autocorrelation, which means, in this study that after a positive stock return for one month there follows a positive stock return for the subsequent month. Serial correlation is a problem because standard errors (even heteroskedastic robusts) are not consistent, affecting statistical inferences (hypothesis testing). Durbin-Watson is the most commonly used test in time series. However, it is important to know that it is not relevant in many instances, for instance if the error distribution is not normal, or if there is a dependent variable in a lagged form as an independent variable this is not an appropriate test for autocorrelation. A test that is suggested that does not have these limitations is the Lagrange Multiplier test (LM test).

4.6.3.1 LM Test

Song, Witt and Li (2009:53) held that the calculation of the LM test is based on an auxiliary equation of the form:
\[ \hat{\varepsilon}_t = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t} + \ldots + \beta_k X_{kt} + \rho_1 \hat{\varepsilon}_{t-1} + \rho_2 \hat{\varepsilon}_{t-2} + \ldots + \rho_p \hat{\varepsilon}_{t-p} + \mu_t \]

Where \( X_{it} \) s are explanatory variables, the \( \beta_i \) s and \( \rho_j \) s are parameters and the \( \hat{\varepsilon}_t \) s are the lagged residuals from the regression model. Under the null hypothesis of no auto-correlation:

\[ H_0: p_1 = p_2 = \ldots = p_p = 0 \]

Song, Witt and Li (2009:53) further maintain that the test statistic is \( n R^2 \), where \( n \) is the sample size. In large samples, the test statistic has a \( \chi^2 \) distribution with \( p \) degrees of freedom. If the value of \( n R^2 \) exceeds the critical value of \( \chi^2 \), this suggests the presence of auto-correlation.

4.7 Estimation Techniques

Econometric models wishing to estimate relevant parameters for volatility of financial time series data are increasingly relying on the ARCH and GARCH models. Studies dealing with financial time series have often been estimated through these approaches. For this reason, the GARCH model by Bollerslev (1986) has been chosen to determine the impact of currency volatility on the stock market.

4.7.1 GARCH Model

One of the assumptions of the least squares model is that the expected value of all error terms, when squared, is the same at any given point. This assumption is called homoskedasticity. When the expected value of all error terms squared, is not the same there exists a problem of heteroskedasticity. Engel (2001) notes that “data in which the variances of the error terms are not equal, in which the error terms may reasonably be expected to be larger for some points or ranges of the data than for others, are said to suffer from heteroskedasticity. Instead of considering this as a problem to be corrected, GARCH models treat heteroskedasticity as a variance to be modeled. As a result, not only are the deficiencies of least squares corrected, but a prediction is computed for the variance of each error term.

This study employs the GARCH model to estimate the impact of exchange rate volatility on the stock market. The origins of the GARCH model can be found in the ARCH model which was developed by Engel in 1982. To describe data series with time varying volatility, an ARCH model allows the variance of error terms to change over time. Engel (1982) defined
the $\varepsilon_t$ terms of the ARMA mean equation as an autoregressive conditional heteroskedastic (ARCH) process where all $\varepsilon_t$ are of the form:

$$\varepsilon_t = z_t \sigma_t \tag{4.10.1}$$

and

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 \tag{4.10.2}$$

Where $z_t$ is an independent and identically distributed (i.i.d) variable has a distribution with a zero mean and a unit variance (Piot-Lepeti and M’Barek, 2011:88). Although $\varepsilon_t$ is serially uncorrelated, its conditional variance $\sigma_t^2$ may change over time. However, the ARCH model has two shortcomings. Firstly, the ARCH ($p$) model is regarded as a short memory process because only recent $p$ residuals have an effect on the current variance. The ARCH specification looked more like a moving average specification but with an auto regression. The GARCH lets the conditional variance be a function of the squares of previous observations and past variances. It improves an autoregressive structure on the conditional variance allowing shocks to persist over time. Bouchet, Clark and Lambert (2003:120) held that the GARCH (1,1) model is based on the fact that over time the variance tends to get pulled back to the long-run average level and it can be can be written as:

$$\sigma_t^2 = yV + \alpha \sigma_{t-1}^2 + \beta \mu_{t-1}^2 \tag{4.10.3}$$

With the constant $y + \alpha + \beta = 1$. The model is usually estimated in the form:

$$\sigma^2 = \omega + \alpha \sigma_{t-1}^2 + \beta \mu_{t-1}^2 \tag{4.10.4}$$

For a stable GARCH, $\alpha + \beta < 1$ and $y = 1 - (\alpha + \beta)$ (Bouchet et al., 2003:120).

In this way, the error term has a conditional variance that is a function of the magnitudes of past errors. The 1,1 in the GRACH (1,1) mean that the conditional variance depends on the 1 most recent squared residuals and the 1 most recent conditional variances.

Piot-Lepeti and M’Barek (2011:88) held that the GARCH model allows a longer memory process in which all the past residuals can affect the current variance either directly or indirectly through the lagged variance terms. The GARCH estimates are used to identify periods of high volatility and high clustering. The GARCH have become widespread tools for dealing with time series heteroskedastic models. The goal of such models is to provide a
Many financial time series such as stock returns and exchange rates, exhibit changes in volatility in time and these changes tend to be serially correlated. Moreover, evidence shows the distribution of time series data such as stock prices is characterized by leptokurtosis, fat tails, skewness and volatility clustering (Lee, 2003). GARCH models accounts for fat tails, leptokurtosis and volatility clustering that are commonly associated with financial time series. Dowd (2005:132) argues that the GARCH model is tailor made for volatility clustering, and this clustering produces returns with fatter than normal tails even if the innovations- the random shocks are themselves normally distributed. Generally the presence of leptokurtic tendencies on the time series returns suggests the presence of volatility clustering; hence, the modeling of such phenomena is recommended through use of the GARCH. In the GARCH, effects such as volatility clustering and leptokurtosis are captured by letting the conditional variance be a function of the squares of previous observations and past variances.

4.8 Conclusion
This chapter laid down the model which determines the impact of currency volatility on the stock market. Included in this model are variables that are likely to affect the operation of the stock market. These variables are the domestic interest rates, US interest rates, rand volatility, total mining production and exports. For stationarity/unit roots purposes, the model employed the Dickey-Fuller and the Phillips Perron tests. Diagnostic tests such as the Normality test, Ramsey RESET test and the LM test were discussed. The GARCH (1.1) technique has been chosen as the estimation technique for the impact of currency volatility on the stock market in South Africa. The succeeding chapter will run the discussed preliminary examination of the data and the final GARCH model using the econometric package EVIEWS 7. Finally, diagnostic tests shall be performed on the residuals.
CHAPTER FIVE

5.1 Introduction

The previous chapter set the analytical framework and reviewed the model and estimation techniques to be used in this study. This chapter presents the main results of regression on monthly data for the period from January 2000 to December 2010. The impact of exchange rate volatility on stock market is estimated using five macroeconomic variables. It is through this chapter that the objective of this study can be achieved. The main objective of this study has been to investigate the impact of currency volatility on the stock market in South Africa. This chapter is divided into seven sub-sections. The first presents the results of descriptive statistics. Collinearity test and Arch tests are conducted in the second section, followed by stationarity tests in the third section. Results and diagnostic tests are presented in the fourth section and fifth section, respectively. Discussions of results and conclusion are presented in the sixth section.

5.2 Descriptive statistics of monthly changes of stock market capitalisation and exchange rate

Xuezheng, Rusell and Tiao (2001) held that many financial series, such as returns on stocks and foreign exchange rates, exhibit leptokurtosis and time-varying volatility. These two features have been the subject of extensive studies ever since Mandelbrot (1963) and Fama (1965) first reported them. In this regard it is necessary to perform some descriptive statistics to examine if the Randvol and MC exhibit time varying volatility and leptokurtosis characteristics. The two main variables of the study are examined because these variables determine the estimation technique for the study. The statistics of the Randvol and MC series are displayed in Table 5.1 below.
Table 5.1: Descriptive statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Randvol</th>
<th>MC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.04</td>
<td>267176.3</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>6.21</td>
<td>193372.5</td>
</tr>
<tr>
<td>Skewness</td>
<td>8.2</td>
<td>4.26</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>69.63</td>
<td>28.2</td>
</tr>
<tr>
<td>J.B p-value</td>
<td>39.83</td>
<td>14.57</td>
</tr>
<tr>
<td></td>
<td>0.000</td>
<td>0.000684</td>
</tr>
</tbody>
</table>

Table 5.1 shows the descriptive statistics of the randvol variable. Under the null hypothesis of normal distribution, the p-value of J-B statistic is 0. The J-B value of 39.83 deviated from normal distribution. Similarly, skewness and kurtosis represent the nature of departure from normality. Emenike (2010) argues that in a normally distributed series, skewness is 0 and kurtosis is 3. The coefficient of skewness measures asymmetry. The randvol value for skewness is 8.2 and it reflects positive skewness. A positive skew indicates that the tail on the right side is longer than the left side and the bulk of the values lie to the left of the mean. Moreover, if skewness is positive, the average magnitude of positive deviations is larger than the average magnitude of negative deviations. The coefficient of the randvol variable indicates that there is asymmetry in the randvol. A variable that follows a normal distribution should be symmetric.

The coefficient of kurtosis measures the peakedness of distribution. The value for kurtosis is 69.63 and this suggests that there is peakedness in the randvol. Kurtosis coefficients have values greater than 3, also the Jarque-Bera statistic is significant at 5% level, and this indicates much higher distributions than the normal distribution. From this it can be observed that the randvol variable exhibits significant deviations from normality. The coefficient of kurtosis is 69.63 and it is larger than three. This demonstrates significant lerptokurtosis. A distribution with a coefficient larger than 3 is said to be leptokurtic and one with a coefficient smaller than 3 is platykurtic. The MC variable reflects positive skewness with a value of 4.26 and this shows that there is asymmetry in the MC variable. Defusco, Mcleavy, Pinto, Runkle (2006) held that some researchers believe that investors prefer positive skewness, all else
equal—that is, they should prefer portfolios with distributions offering a relatively large frequency of unusually large payoffs. The value of kurtosis shows that the MC variable has high distribution than a normal distribution. The kurtosis value is 28.2 and this indicates leptokurtosis.

From the monthly standard deviation, it can be seen that the MC is much more volatile than the randvol hence there is need for it to be captured under the GARCH model. On the whole, both the randvol and MC variables do not conform to normal distribution but display negative skewness and leptokurtic distributions. Deviations from normality of time series data has been observed by previous studies. Emenike (2010) observed that the Nigerian Stock return series do not conform to normal distribution but display negative skewness and leptokurtic distribution. Agrawal and Srivastava, (2010) also noticed that these variables are non-normally distributed.

5.3 Testing for collinearity
Collinearity was performed to see in there is no linear correlation between explanatory variables. Logic behind assumption of no multicollinearity is if two variables are collinear it becomes difficult to separate the individual effect of each variable on the dependent variable. In order to check multicollinearity among independent variables, a correlation analysis was performed. The closer the r coefficient approaches ± 1, regardless of the direction, the stronger is the existing association indicating a more linear relationship between the two variables. However, a suggested rule of thumb is that if the pair wise correlation between two regressors is very high, in excess of 0.8, multicollinearity may pose serious problem. The correlation analysis results are reported in Table 5.2 below.

Table 5.2 Matrix of correlation of independent variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>M3</th>
<th>POR</th>
<th>RANDVOL</th>
<th>TMP</th>
<th>USINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>1.000000</td>
<td>-0.387885</td>
<td>-0.154699</td>
<td>-0.142761</td>
<td>-0.412176</td>
</tr>
<tr>
<td>POR</td>
<td>-0.387885</td>
<td>1.000000</td>
<td>0.095612</td>
<td>-0.272444</td>
<td>0.161525</td>
</tr>
<tr>
<td>RANDVOL</td>
<td>-0.154699</td>
<td>0.095612</td>
<td>1.000000</td>
<td>-0.048397</td>
<td>0.200183</td>
</tr>
<tr>
<td>TMP</td>
<td>-0.142761</td>
<td>-0.272444</td>
<td>-0.048397</td>
<td>1.000000</td>
<td>0.190812</td>
</tr>
<tr>
<td>USINT</td>
<td>-0.412176</td>
<td>0.161525</td>
<td>0.200183</td>
<td>0.190812</td>
<td>1.000000</td>
</tr>
</tbody>
</table>
Table 5.2 shows that the highest correlation coefficient value is 0.4122 which is quite low. It is well below 0.8. Since the highest correlation numbers are lower than 0.8, the results clearly show that none of the independent variables are highly correlated and no multicollinearity amongst independent variables exist.

### 5.4 Testing for ARCH effects

Brooks (389) argues that before estimating a GARCH-type model, it is sensible first to compute the Engel (1982) test for ARCH to make sure that this class of models is appropriate for the data. In this regard, the ARCH test was used to test for ARCH effects on the residuals. The results are presented by table 5.3 below.

#### Table 5.3. ARCH test

<table>
<thead>
<tr>
<th>Heteroscedasticity Test: ARCH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>7.447</td>
</tr>
<tr>
<td>Prob.F (5, 121)</td>
<td>0.0000</td>
</tr>
<tr>
<td>Obs*R-squared</td>
<td>29.885</td>
</tr>
<tr>
<td>Prob. Chi-Square(5)</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Table 5.3 shows that the statistic labelled “Obs*R-squared” is the ARCH test of autocorrelation in the squared residuals. The p-value (0.0000) indicates that we can reject our null hypothesis of no heteroscedasticity in the residuals. In other words, the zero probability value strongly shows the presence of heteroscedasticity in the residuals. The presence of heteroscedasticity makes the use of GARCH more apparent in this study. The correlogram of squared residuals was also conducted to complement the ARCH test in detecting heteroscedasticity. The table 5.4 below shows the results of the correlogram of squared residuals.
Table 5.4 Correlogram of squared residuals

<table>
<thead>
<tr>
<th>Lags</th>
<th>AC</th>
<th>PAC</th>
<th>Q-Stat</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-0.008</td>
<td>-0.008</td>
<td>0.0079</td>
<td>0.929</td>
</tr>
<tr>
<td>2</td>
<td>0.001</td>
<td>0.001</td>
<td>0.0081</td>
<td>0.996</td>
</tr>
<tr>
<td>3</td>
<td>-0.007</td>
<td>-0.007</td>
<td>0.0144</td>
<td>1.000</td>
</tr>
<tr>
<td>4</td>
<td>0.474</td>
<td>0.474</td>
<td>31.104</td>
<td>0.000</td>
</tr>
<tr>
<td>5</td>
<td>-0.003</td>
<td>0.004</td>
<td>31.105</td>
<td>0.000</td>
</tr>
<tr>
<td>6</td>
<td>-0.004</td>
<td>-0.007</td>
<td>31.108</td>
<td>0.000</td>
</tr>
<tr>
<td>7</td>
<td>-0.004</td>
<td>0.001</td>
<td>31.110</td>
<td>0.000</td>
</tr>
<tr>
<td>8</td>
<td>-0.007</td>
<td>-0.300</td>
<td>31.117</td>
<td>0.000</td>
</tr>
<tr>
<td>9</td>
<td>-0.005</td>
<td>-0.011</td>
<td>31.122</td>
<td>0.000</td>
</tr>
<tr>
<td>10</td>
<td>-0.004</td>
<td>0.003</td>
<td>31.124</td>
<td>0.001</td>
</tr>
<tr>
<td>11</td>
<td>-0.006</td>
<td>-0.007</td>
<td>31.128</td>
<td>0.001</td>
</tr>
<tr>
<td>12</td>
<td>-0.008</td>
<td>0.196</td>
<td>31.137</td>
<td>0.002</td>
</tr>
<tr>
<td>13</td>
<td>-0.009</td>
<td>0.000</td>
<td>31.148</td>
<td>0.003</td>
</tr>
<tr>
<td>14</td>
<td>-0.002</td>
<td>-0.005</td>
<td>31.149</td>
<td>0.005</td>
</tr>
<tr>
<td>15</td>
<td>-0.003</td>
<td>0.004</td>
<td>31.150</td>
<td>0.008</td>
</tr>
<tr>
<td>16</td>
<td>-0.003</td>
<td>-0.138</td>
<td>31.152</td>
<td>0.013</td>
</tr>
<tr>
<td>17</td>
<td>-0.003</td>
<td>0.000</td>
<td>31.153</td>
<td>0.019</td>
</tr>
</tbody>
</table>

Table 5.4 provides evidence of ARCH effects as judged by the autocorrelations of the squared residuals. The first order autocorrelation is -0.008, and they gradually decline to 0.003 after 15 lags. There is no autocorrelation up to the 3rd lag, thereafter autocorrelation is present. The test p-values are all significant, and resultantly the no ARCH hypothesis is rejected. Meyer (2011) argues that “autocorrelation of squared residuals or absolute returns suggest the presence of strong dependencies in higher moments, something that in turn is indicative of conditional heteroscedasticity”. Since autocorrelation has been observed, it means that there is heteroscedasticity in the residuals. The autocorrelation of squared or absolute returns suggest the presence of strong dependencies in higher moments, something that in turn is indicative of conditional heteroscedasticity. This, also, points to the need for the GARCH model.
5.5.1 Testing for stationarity

If the mean and variance are constant over time, then the series is stationary. Stationarity is essential for standard econometric theory. Without it we cannot obtain consistent estimators. One way of telling if a process is stationary is to plot the series against time. Graphical representations taking the form of time series plots gives us particularly useful ways of envisioning information and conducting comparative analyses over time. If the graph crosses the mean of the sample many times, chances are that the variable is stationary; otherwise that is an indication of persistent trends away from the mean of the series. If the mean and variance change, then the series is non-stationary. To detect if a series is stationary graphical plots were done on observed values of the data. Figure 5.1 shows the RANDVOL and MC plots.

Figure 5.1 Graphical Representation of the Variables in Levels

![Graphical Representation of the Variables in Levels](image)

Figure 5.1 suggests that the Randvol variable shows fluctuations over time. The level data show no tendency to return to its mean indicating the need for differencing. The sequence plot of the MC data indicates that the series is fluctuating over time. This indicates that it is not stationary. The two variables have a time variant mean and variance suggesting that they are not stationary in their levels. The MC series has a fluctuating behaviour and with such a fluctuating pattern, a time series is non-stationary, it does not show a tendency of mean reversion.

Graphical representations taking the form of time series plots was also done on the other explanatory variables; POR, M3, USINT and TMP. Their graphs are displayed in Figure 5.2 below.
Figure 5.2 shows that the M3 data series is strongly linearly trended and hence it is thus non-stationary. The series also shows no tendency of returning to its mean. The USINT data series shows some sharp linear fluctuations over time and hence it can be concluded that they are not stationary. The TMP level data show no tendency to return to its mean indicating the need for differencing. The POR variables, like the USINT shows some sharp fluctuations over time. All the variables have a time variant mean and variance suggesting that they are not stationary in their levels.

In addition to visual inspection, formal econometric tests were applied to unambiguously decide the actual nature of time series. Primary inspection of graphical presentation of the data indicated possible non-stationary of the variables which facilitates for unit root testing. This study followed the standard procedure of unit root testing by employing the Augmented Dickey Fuller (ADF) test. Since the ADF test is often criticized for low power, the study complements this test with the Phillips Perron (PP) test. Results from these tests are shown in the tables below.
5.5.2 Augmented Dickey Fuller Results

The results from the ADF tests are given in Table 5.5. The results are tabulated according to level data series and for first differences in the data series.

Table 5.5 Unit Root/Stationarity Tests: ADF Test

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF Test (Intercept)</th>
<th>ADF (Trend and intercept)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level</td>
<td>1st Difference</td>
</tr>
<tr>
<td>M3 (P value)</td>
<td>1.931176</td>
<td>9.723775**</td>
</tr>
<tr>
<td></td>
<td>0.9998</td>
<td>0.0000</td>
</tr>
<tr>
<td>RANDOL (P value)</td>
<td>2.224457</td>
<td>8.076612**</td>
</tr>
<tr>
<td></td>
<td>0.1987</td>
<td>0.0000</td>
</tr>
<tr>
<td>TMP (P value)</td>
<td>-2.635181</td>
<td>-20.42861**</td>
</tr>
<tr>
<td></td>
<td>0.0886</td>
<td>0.0000</td>
</tr>
<tr>
<td>USINT (P value)</td>
<td>-1.769695</td>
<td>-4.679856**</td>
</tr>
<tr>
<td></td>
<td>0.3941</td>
<td>0.0002</td>
</tr>
<tr>
<td>POR (P value)</td>
<td>2.431617</td>
<td>-3.107962*</td>
</tr>
<tr>
<td></td>
<td>0.1352</td>
<td>0.0284</td>
</tr>
<tr>
<td>MC (P value)</td>
<td>-0.786105</td>
<td>-6.921686**</td>
</tr>
<tr>
<td></td>
<td>0.8191</td>
<td>0.0000</td>
</tr>
<tr>
<td>Critical Values</td>
<td>1%</td>
<td>3.485586</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>-2.885654</td>
</tr>
</tbody>
</table>

** and * denotes rejection of the null hypothesis at 1% and 5% respectively.

Table 5.5 shows that all variables were not stationary in levels. The p-values of the variables all being greater than 0.05 indicate that we could not reject the null hypothesis of the existence of unit root in levels for all variables. However, the variables are stationary after first differencing them. The magnitude of the p-values (less than 0.05) are significant, indicating that the variables are stationary at first difference.

5.5.3 Phillips Peron test results

The results from the Phillip Perron test are given in Table 5.6 below.
Table 5.6 Unit Root/ Stationarity Tests: Phillips Peron Test

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level (P value)</th>
<th>1st Difference Level (Trend and intercept)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>1.194002 0.9980</td>
<td>-10.49386 0.0000 -2.122939 0.5279 -10.59217 0.0000</td>
</tr>
<tr>
<td>MC</td>
<td>10.51483 0.0000</td>
<td>-11.11609 0.0000</td>
</tr>
<tr>
<td>POR</td>
<td>1.417308 0.5720</td>
<td>-10.72564 0.0000 1.898069 0.6499 -10.73697 0.0000</td>
</tr>
<tr>
<td>RANDVOL</td>
<td>-2.143811 0.2281</td>
<td>-8.037357 0.0000 -2.245581 0.4602 -8.046197 0.0000</td>
</tr>
<tr>
<td>TMP</td>
<td>4.730044 0.0000</td>
<td>-4.708536 0.0000</td>
</tr>
<tr>
<td>USINT</td>
<td>1.357667 0.6011</td>
<td>-4.581038 0.0002 -1.467586 0.8358 4.527591 0.0020</td>
</tr>
</tbody>
</table>
| Critical Values | | ** and * denotes rejection of the null hypothesis at 1% and 5% respectively

In applying the Phillips Peron test to the variables, MC and TMP were found to be stationary at levels. However, the test statistic of M3, POR, USINT and RANDVOL were less than the critical value at 1% and 5% respectively and hence not stationary. However, these variables attained stationarity after the first differencing. The critical values at 1% and 5% were 3.480818 and 2.883579 respectively.

After the stationary tests, graphical plots were done to observe the nature of the mean and variance of the stationary data. The graphical plots of the differenced variables are shown below.
Figure 5.3 Graphical Representation of the Variables after differencing

Figure 5.3 shows that the first differenced variables show sign of returning to its mean suggesting that the series are weakly stationary. After differencing, the run sequence plot indicates that the data have a constant location and variance, although the pattern of the residuals shows that the data depart from the model in an orderly way. The same is observed in the other four explanatory variables. Their graphs are shown in Figure 5.4 below.
In Figure 5.4 the variables seem to be hovering around their means, and their variances are clearly constant over time. Thus, based on this analysis, the stationarity status of the variables is clear.

5.6 The GARCH Model: Presentation of results

5.6.1 Non normal Conditional Returns: choosing an appropriate GARCH model

The descriptive statistics in section 5.2 showed that there was skewness in the two main variables; exchange rate and market capitalisation. Moreover, excess skewness and kurtosis was observed for the two variables, leading to high Jarque-Bera statistics indicating non-normality. In order to better model the excess kurtosis we observe with the Randvol and MC
series, there is need to relax the assumption that the conditional returns are normally distributed. We can assume the Randvol and MC series follow a student's t-distribution. This has been done by a number of studies. To model both skewness and kurtosis Fernandez and Steel (1998) used the skewed Student’s t-distribution which was later extended to the GARCH framework by Lambert and Laurent (2000, 2001). Harris and Yilmaz (2004) also used the skewed generalized Student’s t-distribution to capture the skewness and leverage effects of daily returns.

This study’s GARCH (1,1) model should assume Student-t distribution because it relaxes the assumption that the conditional returns and the exchange rate series are not normally distributed. The normal GARCH model is inconsistent with the large leptokurtosis typically observed in asset returns. However, Xuezheng, Rusell and Tiao (2001) demonstrated that a conditional non-normal GARCH model can capture both the volatility clustering and the exceeding large kurtosis typically observed in the financial series.

Results from the normal GARCH model proved to be better than those from the GARCH with student t-distribution. The normal GARCH model was better in modelling the problems of fat tails and it also managed to bring the non-normal distribution of the residuals close to normality. This is shown in table 5.7and 5.9. As a result of this, this study used the normal GARCH for estimation purposes.

5.6.2 Presentation and Interpretation of results

The hypothesis of interest is the extent to which changes in the conditional mean of the variables are associated with changes in the MC. Table 5.7 presents the results from the estimated normal GARCH (1.1) model.
Table 5.7 Presentation of results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>z-statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1.148068</td>
<td>1.964997</td>
<td>0.584260</td>
<td>0.5590</td>
</tr>
<tr>
<td>LRANDVOL</td>
<td>0.169477</td>
<td>0.039213</td>
<td>4.321909</td>
<td>0.0000</td>
</tr>
<tr>
<td>LPOR</td>
<td>-0.317900</td>
<td>0.074122</td>
<td>-4.288871</td>
<td>0.0000</td>
</tr>
<tr>
<td>LM3</td>
<td>0.975359</td>
<td>0.026799</td>
<td>36.39507</td>
<td>0.0000</td>
</tr>
<tr>
<td>LTMP</td>
<td>-1.463509</td>
<td>0.226221</td>
<td>-6.469388</td>
<td>0.0000</td>
</tr>
<tr>
<td>LUSINT</td>
<td>0.651993</td>
<td>0.042028</td>
<td>15.51345</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variance Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
</tr>
<tr>
<td>RESID(-1)^2</td>
</tr>
<tr>
<td>GARCH(-1)</td>
</tr>
<tr>
<td>LRANDVOL</td>
</tr>
<tr>
<td>LM3</td>
</tr>
</tbody>
</table>

R-Squared          | 0.623359      |
Adjusted R-squared | 0.608413      |
Durbin-Watson Statistic | 2.445675 |
5.6.2.1 Mean equation

As expected, the sign of the interest rates is negative; a one percentage point increase of interest rates (POR) decreases market capitalisation (MC) by 0.32 percentage points. Results indicated that there is a negative relationship between interest rates and market capitalisation. The value of interest rate is statistically significant and it’s negative; meaning that an increase in interest rate will lead to a fall in market capitalisation on the stock market. Büyükşalvarcı (2010) notes that the intuition regarding the relationship between interest rates and stock prices is well established, suggesting that an increase in interest rates increases the opportunity cost of holding money and thus substitution between stocks and interest bearing securities and hence falling stock prices. Thus, a change in nominal interest rates should move asset prices in the opposite direction.

From these results it can be observed that interest rate represents alternative investment opportunities. Rises in interest rates compel investors to invest less in stocks and this consequently, lead to a fall in market capitalisation. Büyükşalvarcı (2010) further maintains that a negative relationship between interest rates and market capitalisation has been observed by several studies such as those of Tan, Loh and Zainudin (2006) and Kandir (2008). In a study conducted in South Africa and other countries, Adjasi and Biekpe (2007) found that in South Africa there is a negative “long-run relationship between stock market prices and interest rate. Thus increases in the interest rates have adverse impacts on stock market activity, resulting in the diversion of funds away from the market”.

A one percentage point increase of total mining production (TMP) decreases market capitalisation (MC) by 1.46 percentage points. The coefficient of TMP is negative and statistically significant indicating that increases in TMP dampens stock market activities. The sign was expected to be positive, but surprisingly it has turned out to be negative. In other words, an increase in TMP volatility will lead to a fall in market capitalisation. Mayowa (2011) in his analysis of the long run co-movements between financial system development and mining production in South Africa also came with a similar result. Mawowa’s (2011) study showed that there is a negative relationship between total mining production and stock market capitalisation. One reason for this might be the fact that mining companies will be channelling their proceeds to other forms of investment. Mayowa (2011) held that this relationship may be an indication that with the growth of the South African stock market, more investment is directed towards the development of the other sector. Another reason may
be the fact that South African mining companies are now investing in attractive destinations abroad. Increases in mining production means increases in revenue and this revenue is being channelled abroad for investment purposes. Woolfery (2013) supports the above assertion by arguing that “while South Africa is a major destination for foreign investment, South African firms are themselves becoming increasingly significant investors abroad – and especially in the rest of Africa”. Moreover there has been evidence\(^6\) that shows that companies are move their primary listings from the JSE Securities Exchange SA (JSE) to the London Stock Exchange (LSE).

A one percentage point increase of money supply (M3) increases market capitalisation by 0.97 percentage points. The coefficient of M3 is positive and statistically significant indicating that increases in money supply increases stock market activities. Increase in money supply leads to increase in liquidity that ultimately results in upward movement of nominal equity prices. Li (2012) found a similar result in a study that investigated the relationship between money supply and stock market in Europe. Results from the study showed that money supply has positive impact on stock market capitalisation. The positive relationship between money supply and the stock market is that the price of a stock is determined by the present value of the cash flows. The present value of the future cash flows is calculated by discounting the future cash flows at a discount rate. Money supply has a significant relationship with the discount rate and hence with the present value of cash flows. Maskay (2007) analysed the relationship between change in money supply and stock market capitalisation and showed that there is a positive relation.

The sign of the Randvol turned out to be positive; a one percentage decrease in the rand increase market capitalisation by 0.169477. This is consistent with economic theory. The flow oriented model maintains that a causal relationship runs from the exchange rate to the stock prices. According to this theory, exchange rate movements affect the stock prices. Exchange rate changes affect the competitiveness of firms through their impact on input and output prices (Joseph, 2002). When the rand depreciates, exporters will be positively affected. A depreciation of the currency will cause their goods and services to be cheaper on the international market. This will cause their exports to increase, as they will be seen as cheap by buyers on the international market. This will result in them gaining competitiveness

\(^6\) Walters and Prinsloo (2002)
internationally. Consequently, their profits will increase and if profits increase the firms will gain competitiveness on the domestic stock market. Their attractiveness on the domestic stock market will increase and this will result in their stock prices and market capitalisation decreasing in value.

A one percentage point increase of US interest rates (USINT) increase market capitalisation by 0.65 percentage points. The value of the US interest rates is positive; meaning that an increase in US interest rates will lead to a rise in market capitalisation. The US interest rates sign was expected to be negative but results have shown the positive. It is expected that, when US interest rates rise, there would be a shift of investment from economies with low interest rates towards those with high interest rates (US). However, Kaminsky and Schmukler (2002) held that if there is a positive probability that a government will not pay its debt, increases in U.S. rates will prompt a higher rise in the interest rate of the government’s debt. The higher increase is to compensate the probability of no repayment. In fact, governments can levy taxes on corporations if they face higher debt payments. Therefore, we expect that U.S. interest rates negatively affect stock activities.

5.6.2.2 The variance equation
The variance equation represents the GARCH model and it is in this equation that the volatility of the rand volatility and M3 were captured. The interpretation of the results is as follows;

Contrary to the expected priori (that the sign of the rand volatility was expected to be negative), the randvol sign is positive. Results show that a one percentage point increase of rand volatility increases market capitalisation by 0.004 percentage points. This shows that currency volatility has a very weak but positive impact on stock market activities. An increase in currency volatility will cause a very small increase in market capitalisation. Conditions of exchange rate volatility create uncertainty about the health of an economy and this will in turn lead people to invest in markets that are less likely to be affected by the exchange rate such as the stock market. However, when there is increased volatility, investors will not invest much on the stock market.

While the outcome of a positive sign of the rand volatility disagrees with the expected priori, it goes hand in hand with results from other studies that investigated the relationship between these two variables. The result of this study goes hand in hand with that of Karoui (2006) and
that of Adjasi and Biekpe (2007). Karoui (2006) used a GARCH model to estimate the stock return and the exchange rate volatility. The basic intuition behind his investigation was that the volatility of the stock returns is partially explained by the volatility of the currency rates. The study focused on the following 18 emerging countries: Argentina, Brazil, Chile, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Poland, Philippines, Russia, South Africa, South Korea, Taiwan, Thailand, and Turkey. The study found a significant relationship between currency rate volatility and stocks returns volatility for a large part of the indexes studied. Moreover, he found a positive relationship between the foreign exchange rate volatility and the stock return volatility.

Adjasi and Biekpe (2005) investigated the links between stock market development and key economic growth variables in selected African countries including South Africa. They used the vector autoregression (VAR) framework to identify the response and behaviour of stock market returns to shocks induced by exchange rate movements’ results. Results from their study also showed that, there was no long-run stable relationship between stock market prices and exchange rates for Egypt, Ghana, Kenya, Mauritius, Nigeria and South Africa. The findings of this study do not differ much from Adjasi and Biekpe’s (2007) findings in the sense that this study found a very weak relationship and Adjasi and Biekpe found no relationship.

The volatility of money supply has a very weak negative and significant relationship. A one percentage point increase of money supply (M3) decreases market capitalisation by 0.001 percentage points. The coefficient of M3 is negative and statistically significant indicating that fluctuations in money supply decreases stock market activities. However the impact is too small. This result is consistent with the findings of Flannery and Protopapadakis (2002). Flannery and Protopapadakis (2002) argued that money supply affects both the level and volatility of equity returns. In addition to this, Geske and Roll (1983) also documented that aggregate stock returns are negatively related to money growth.

The ARCH term represented in the equation as RESID (-1) ^2 is significant. It has a p-value of 0.0386 which is below 0.05. The 2.067 t-statistic is, in absolute terms, more than the standard value of |2| which also entails the statistical significance of the ARCH term in explaining the volatility of the MC. The GARCH term represented in the equation as GARCH (-1) is significant. It has a p-value of 0 that is below 0.05. Moreover, the 5.33 t-
value is greater than the standard value of $2$ thereby reinforcing the statistical significance of the GARCH model in explaining volatility in MC. This shows that the GARCH model was able to capture volatility.

5.7 Diagnostic Tests

Gujarati (2004:516) argues that diagnostic tests should be performed so that the model finally chosen is a good model in the sense that all the estimated coefficients have the right signs, they are statistically significant on the basis of the $t$ and $F$ tests. In this regard, this study employs the Histogram and Normality test, Correlogram of Squared Residual Test, and the Heteroscedasticity\textsuperscript{7} test as its diagnostic tests.

5.7.1 Normality test

Normality test was conducted to test the residuals’ normality. Economic theory expects the residuals to be normally distributed. Table 5.7 shows the results from the Normality test.

<table>
<thead>
<tr>
<th>Table 5.7 Normality Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLS</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>Skewness</td>
</tr>
<tr>
<td>Kurtosis</td>
</tr>
<tr>
<td>J.B (Probability)</td>
</tr>
<tr>
<td>(Probability)</td>
</tr>
</tbody>
</table>

Table 5.7 presents the Normality test. Results from the Normality test show that the normal GARCH model best reduced the problems of fat tails and volatility clustering. The student distribution had been chosen best in reducing the problems of fat tails. However results show that the normal GARCH can model these problems better. The kurtosis and skewness are smaller under the normal GARCH model ($7.42$ and $1.3$ respectively) and they are high under the student $t$-distribution GARCH ($54.68$ and $6.87$). The kurtosis of the Student $t$-distribution GARCH model is almost $17$ times higher than the normal GARCH model. This shows the normal GARCH model better modelled the problem of fat tails and resultantly it was chosen for the estimation purposes.

\textsuperscript{7} This is important to see if the normal GARCH model has eliminated heteroscedasticity well.
Although the normal GARCH is chosen, it must be noted that there is still some asymmetry in the residuals as shown by the kurtosis coefficient (7.42) and some positive skewness as shown by the skewness coefficient (1.3). However it must be realised that before the GARCH was used in the study, there was excess kurtosis. The kurtosis coefficient was 43.677 reflecting some fat tails. There was also asymmetry in the residuals as shown by the skewness coefficient (5.89). However with the use of the GARCH excess skewness and kurtosis were reduced. The standardized residuals are closer to a normal distribution, with a kurtosis coefficient of 7.42 approximately six times smaller than that of the original return series. The standardized residuals also show that the JB value has been reduced from 9863 to 90.79. The p-value turned to be 0.000. Gujarati (2004:149) argues that if the computed p value of the JB statistic in an application is sufficiently low, which will happen if the value of the statistic is very different from zero, one can reject the hypothesis that the residuals are normally distributed. In this regard, it can be concluded that the residuals are not normally distributed.

However, it must be noted that the residuals have been drawn towards normality. The non-normality of residuals in volatile time series data has been observed in various studies. Arouri, Jaqdi, and Nguyen (2010) also came up with a similar result in a research on “the dynamics of emerging stock markets”. A study by Edison, Cashin, Liang (2003) on foreign exchange intervention and the Australian dollar also showed that, after applying the GARCH, the extent of non-normality in the standard residuals was much less than in the unadjusted residuals. The study also concluded that the results provided strong support for the ability of GARCH models to correct the heteroscedasticity in the exchange rate and other variables.

5.7.2 Heteroscedasticity test

The ARCH test was conducted to check the presence of heteroscedasticity in the residuals. Initially, it was observed that there was the problem of heteroscedasticity in the residuals. This prompted the use of the GARCH model. Table 5.8 shows the ARCH test after using the GARCH model.
Table 5.8 ARCH test

<table>
<thead>
<tr>
<th>Heteroscedasticity Test: ARCH</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>0.187667</td>
<td>Prob.F (5, 121)</td>
<td>0.6656</td>
</tr>
<tr>
<td>Obs*R-squared</td>
<td>0.190300</td>
<td>Prob. Chi-Square(5)</td>
<td>0.6627</td>
</tr>
</tbody>
</table>

Table 5.8 presents results for the ARCH test. Engle’s LM test indicates that there are no more ARCH effects. The p value of the Obs*R-squared in not significant; it is greater than 0.05 and this indicates that there is no ARCH present. The p-value is 0.6627 and this shows that there is no heteroscedasticity in the residual. In other words, the ARCH test results strongly suggest the absence of ARCH in the residuals. This provides strong support that the GARCH can eliminate the problem of heteroscedasticity. Initially, with OLS, there was the presence of ARCH in the residuals. This made the use of the GARCH necessary and with the use of the GARCH technique, the ARCH effects in the residuals were eliminated.

5.7.3 Testing for autocorrelation

5.7.3.1 Q-statistic Test

Andersen, Davis, KreiB and Mikosch (2009) held that the stylized fact of volatility clustering in returns manifests itself as autocorrelation in the residuals from the estimated conditional mean equation. The significance of these autocorrelation may be tested using the Q – statistic. In this regard, the Q-statistic Test was conducted to check if there was no correlation in the residuals after the application of the GARCH techniques. Table 5.9 presents results from the Q-statistic Test.
Table 5.9 Correlogram squared residuals

<table>
<thead>
<tr>
<th></th>
<th>AC</th>
<th>PAC</th>
<th>Q-Stat</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-0.038</td>
<td>-0.038</td>
<td>0.1960</td>
<td>0.658</td>
</tr>
<tr>
<td>2</td>
<td>-0.066</td>
<td>-0.068</td>
<td>0.7904</td>
<td>0.674</td>
</tr>
<tr>
<td>3</td>
<td>-0.017</td>
<td>-0.023</td>
<td>0.8323</td>
<td>0.842</td>
</tr>
<tr>
<td>4</td>
<td>0.265</td>
<td>0.260</td>
<td>10.506</td>
<td>0.033</td>
</tr>
<tr>
<td>5</td>
<td>-0.022</td>
<td>-0.005</td>
<td>10.575</td>
<td>0.060</td>
</tr>
<tr>
<td>6</td>
<td>-0.011</td>
<td>0.020</td>
<td>10.592</td>
<td>0.102</td>
</tr>
<tr>
<td>7</td>
<td>-0.047</td>
<td>-0.043</td>
<td>10.898</td>
<td>0.143</td>
</tr>
<tr>
<td>8</td>
<td>-0.083</td>
<td>-0.168</td>
<td>11.887</td>
<td>0.156</td>
</tr>
<tr>
<td>9</td>
<td>-0.025</td>
<td>-0.035</td>
<td>11.974</td>
<td>0.215</td>
</tr>
<tr>
<td>10</td>
<td>0.030</td>
<td>0.013</td>
<td>12.106</td>
<td>0.278</td>
</tr>
<tr>
<td>11</td>
<td>-0.036</td>
<td>-0.014</td>
<td>12.292</td>
<td>0.342</td>
</tr>
<tr>
<td>12</td>
<td>-0.037</td>
<td>0.035</td>
<td>12.497</td>
<td>0.407</td>
</tr>
<tr>
<td>13</td>
<td>-0.005</td>
<td>0.006</td>
<td>12.500</td>
<td>0.487</td>
</tr>
<tr>
<td>14</td>
<td>0.049</td>
<td>0.035</td>
<td>12.858</td>
<td>0.538</td>
</tr>
<tr>
<td>15</td>
<td>-0.033</td>
<td>-0.029</td>
<td>13.018</td>
<td>0.601</td>
</tr>
<tr>
<td>16</td>
<td>-0.016</td>
<td>-0.034</td>
<td>13.058</td>
<td>0.669</td>
</tr>
<tr>
<td>17</td>
<td>-0.021</td>
<td>-0.034</td>
<td>13.126</td>
<td>0.728</td>
</tr>
<tr>
<td>18</td>
<td>-0.032</td>
<td>-0.065</td>
<td>13.286</td>
<td>0.774</td>
</tr>
<tr>
<td>19</td>
<td>-0.020</td>
<td>-0.016</td>
<td>13.349</td>
<td>0.820</td>
</tr>
<tr>
<td>20</td>
<td>-0.018</td>
<td>-0.017</td>
<td>13.399</td>
<td>0.860</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>AC</th>
<th>PAC</th>
<th>Q-Stat</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-0.017</td>
<td>-0.017</td>
<td>0.0384</td>
<td>0.845</td>
</tr>
<tr>
<td>2</td>
<td>-0.015</td>
<td>-0.016</td>
<td>0.0701</td>
<td>0.966</td>
</tr>
<tr>
<td>3</td>
<td>-0.015</td>
<td>-0.016</td>
<td>0.1021</td>
<td>0.992</td>
</tr>
<tr>
<td>4</td>
<td>0.440</td>
<td>0.439</td>
<td>26.814</td>
<td>0.000</td>
</tr>
<tr>
<td>5</td>
<td>-0.016</td>
<td>-0.006</td>
<td>26.852</td>
<td>0.000</td>
</tr>
<tr>
<td>6</td>
<td>-0.016</td>
<td>-0.007</td>
<td>26.887</td>
<td>0.000</td>
</tr>
<tr>
<td>7</td>
<td>-0.016</td>
<td>-0.008</td>
<td>26.925</td>
<td>0.000</td>
</tr>
<tr>
<td>8</td>
<td>-0.017</td>
<td>-0.261</td>
<td>26.966</td>
<td>0.001</td>
</tr>
<tr>
<td>9</td>
<td>-0.015</td>
<td>-0.011</td>
<td>27.000</td>
<td>0.001</td>
</tr>
<tr>
<td>10</td>
<td>-0.006</td>
<td>0.002</td>
<td>27.005</td>
<td>0.003</td>
</tr>
<tr>
<td>11</td>
<td>-0.008</td>
<td>0.001</td>
<td>27.015</td>
<td>0.005</td>
</tr>
<tr>
<td>12</td>
<td>-0.007</td>
<td>0.156</td>
<td>27.022</td>
<td>0.008</td>
</tr>
<tr>
<td>13</td>
<td>-0.005</td>
<td>0.006</td>
<td>27.026</td>
<td>0.012</td>
</tr>
<tr>
<td>14</td>
<td>0.001</td>
<td>-0.001</td>
<td>27.026</td>
<td>0.019</td>
</tr>
<tr>
<td>15</td>
<td>-0.003</td>
<td>-0.004</td>
<td>27.027</td>
<td>0.029</td>
</tr>
<tr>
<td>16</td>
<td>-0.000</td>
<td>-0.097</td>
<td>27.027</td>
<td>0.041</td>
</tr>
<tr>
<td>17</td>
<td>-0.002</td>
<td>-0.008</td>
<td>27.028</td>
<td>0.058</td>
</tr>
<tr>
<td>18</td>
<td>-0.003</td>
<td>-0.005</td>
<td>27.029</td>
<td>0.078</td>
</tr>
<tr>
<td>19</td>
<td>-0.003</td>
<td>-0.001</td>
<td>27.031</td>
<td>0.104</td>
</tr>
<tr>
<td>20</td>
<td>-0.003</td>
<td>0.057</td>
<td>27.032</td>
<td>0.134</td>
</tr>
</tbody>
</table>

Table 5.9 shows that the $Q$-statistics are all significant at all lags under the normal GARCH model, indicating that there is no significant serial correlation in the residuals. With the student t-distribution GARCH model some of the residuals had serial correlation. Residuals are serially correlated from the 4th until the 16th lag. Resultantly, the null hypothesis of no serial correlation is rejected. This shows that the model was not good. With the normal GARCH model, all p-values are above 0.05 and as a result of this the null hypothesis of no serial correlation is not rejected. This shows that there is no correlation in the residuals. The test, therefore, accepts the hypothesis of no serial correlation up to order twenty. This shows that the mean equation was correctly specified. Ur (2005) held that if the mean equation (conditional variance equation) is correctly specified, all Q-statistics of standardised residuals should be insignificant with no observable autocorrelation.

### 5.8 Conclusion and discussion of results

The main focus of this chapter was to present the results of the study. To achieve this, the chapter started by examining the descriptive statistics of the two major variables; Randvol and Market capitalisation. The two variables were found to have fat tails. Furthermore, the variables also showed excess kurtosis and as a result of this they were not normally
distributed. This, in turn, raised questions about the stationary of these and other variables of the study. Stationary tests were conducted and all the variables (MC, Randvol, USint, POR, TMP and M3) were not stationary at levels. However, they were stationary after first differencing. A collinearity test was performed to observe if there was any correlation between the explanatory variables. The collinearity test showed that the variables were not strongly correlated. As a result of this all the variables were included in the estimation model.

The normal GARCH model was chosen for estimation purposes. The normal GARCH was chosen in place of the non-normal GARCH because it modelled well the problems of fat tails and asymmetry in the variables. The normal GARCH proved to be better than the non-normal GARCH. This was proved by the normality tests and the Q-statistics test. The normality test showed that the normal GARCH model reduced the problems of non-normality in the variables seven times than the non-normal GARCH model. Moreover the normal GARCH model eliminated the problem of serial correlation.

Diagnostic tests were conducted and they all showed that the model was good. However, the normality test showed that the residuals were not normally distributed. Various studies in the past have also faced a similar scenario. The non-normality of exchange rate and financial time series data has been observed by various studies. The Q-statistic test showed that there was no serial correlation in the residuals. Problems of ARCH were also eliminated by the GARCH model. Findings from this study showed that all of the variables were statistically significant in explaining the changes in Market capitalisation. The volatility of the rand was seen to have a small but positive impact on Market capitalisation. The volatility of money supply was seen to have a very small negative relationship with the Market capitalisation. Prime overdraft rate and total mining production were seen to have a negative impact on the Market capitalisation. Surprisingly, US interest rates were seen to have a positive impact on Market capitalisation. Results from this study were all supported by existing studies and by prevailing economic theory.
CHAPTER SIX

SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

6.1 Summary of the study and conclusions
The main objective driving this study has been to examine the impact of currency volatility on the stock market in South Africa. To achieve this objective, several assessments were performed. Firstly, an overview of the developments of the rand and the stock market was done. An overview of the developments of the rand exchange rate and the stock market was necessary as this provides a basis for our understanding of the causes of its volatility. The exchange rate in South Africa has been characterised by considerable volatility and these were seen to spill into the stock market. Changes in the rand have considerable effects on the way with which the stock market operates.

An assessment of literature on exchange rate volatility and stock markets was conducted and from it an empirical model was specified. It was seen that there is a mixed opinion with regard to the relationship that exist between exchange rate and the stock market. The study employed monthly South African data for the period 2000 – 2010. The data frequency selected ensured an adequate number of observations. The variables used in the study were rand exchange rate, market capitalisation; money supply, prime overdraft rate and United States interest rate. Descriptive statistics were employed to investigate the statistical properties of the two main variables; exchange rate and market capitalisation. Results showed that these two variables were positively skewed and in addition to this they had fat tails. The study employed the GARCH model to estimate the impact of exchange rate volatility on the stock market.

The important insights of the results can be summarized as follows:
First, the analysis reported weak relationship between exchange rate volatility and the stock market. This result is not supportive of the presumption that the uncertainty surrounding exchange rate market distorts efficient investment allocation. Markets that are exposed to currency volatility usually face considerable uncertainty about the returns of investment projects. This can lead to disruption of these companies on the stock market. Volatility affects the flow of information about the quality of projects to investors and hence distorts resource allocation (Cavallo, Galindo, Izquierdo and León, 2010).
Results from this study did not find any evidence that support the above assertion. On the contrary, volatility was seen to bring positive impacts on the stock market in South Africa. This might be a result of the following:

1. The firms on the JSE have come to realise the negative impacts of currency volatility and as a result have developed measures that cushion against the effects of currency volatility. Cavallo et al. (2010) held that “doing business in an economy that is periodically exposed to turmoil in relative prices means that entrepreneurs must face substantial uncertainty about the profitability of alternative projects. Under this scenario, a key feature is the ability to adapt to a volatile environment”. Companies and firms operating on the JSE have taken various instruments to hedge against exchange rate risk.

2. Results from this study suggest that the JSE has approached towards informational efficiency at least with respect to exchange rate and money supply volatility. The weak relationship between currency volatility and the stock market seem to provide evidence that the JSE is not an efficient market. Results suggest that firms on the JSE are able to use exchange rate information to predict the future behaviour of the stock market. This results in the firms’ ability to forecast the movements that the rand would take in the future thus enabling them to cushion against the future fluctuations of the rand. As a result of this, currency volatility will not affect the stock operations on the JSE.

3. The weak relationship between exchange rate volatility and the stock market might have been caused by the different factors that affect each of these markets. The factors/news that causes changes in exchange rates may be different from the factors that cause changes in stock prices. Under such scenario, there should be no link between the said variables (Muhammad and Rasheed, 2011). If there were common factors that influence both exchange rate volatility and stock market, then a strong association between these two financial variables would have been found.

Second, the stock market was seen to be affected by other macroeconomic variables namely: interest rates, total mining production, money supply and the United States interest rates. Interest rates were seen to have a negative impact on the stock market. This is supported both by economic theory and a number of studies including that of Alam and Uddin (2010). Increases in interest rates increases the opportunity cost of holding money and thus substitution between stocks and interest bearing securities and hence falling stock prices. In
other words, rises in interest rates compel investors to invest less in stocks and this, consequently, lead to a fall in market capitalisation.

Total mining production was also seen to have a negative impact on stock market capitalisation; an increase in total mining production led to a decline in stock market capitalisation. A study conducted in South Africa by Mayowa’s (2011) also showed that there is a negative relationship between total mining production and stock market capitalisation. An increase in the supply of money was seen to have a positive impact on the stock market. Increase in money supply leads to increase in liquidity that ultimately results in upward movement of nominal equity prices. Li (2012) found a similar result in a study that investigated the relationship between money supply and stock market in Europe.

Lastly, the results indicated that there is a positive relationship between US interest rates and market capitalisation. The value of the US interest rates was positive; meaning that an increase in US interest rates will lead to a rise in market capitalisation. The US interest rates sign was expected to be negative but results have shown the positive. This might be the fact that emerging markets like South Africa are still seen as attractive by investors regardless of other macroeconomic factors such as world interest rates.

Diagnostic tests on the model showed a stable and robust model. The Q-statistic test showed that there was no serial correlation in the residuals. Problems of ARCH were also eliminated by the GARCH model. However, the normality test showed that the residuals were not normally distributed and this scenario is faced by several studies.

6.2 Policy Implications and Recommendations
The findings from this study have a number of policy implications. Firstly, the weak volatility transmission from the rand to stock market may be indicative of increased use of hedging instruments by firms on the JSE. More hedging instruments needs to be put in place to ensure the elimination of negative effects of rand volatility. These hedging instruments should be efficient and they should not distort the normal functioning of the JSE. There has been sizeable evidence in support of theories suggesting that relative price volatility provides incentives for entrepreneurs to adopt more “malleable” but less productive production
technologies, enabling them to accommodate currency volatility\(^8\). Hedging operations are, at times, costly and can decrease the performance of the firms.

Secondly, Since the South African stock market is not really exposed to the negative effects of currency volatility. Relevant policy-makers in government can use exchange rate as a policy tool to attract foreign portfolio investment. Moreover, the ability of the JSE to hedge against the negative effects of currency volatility can be used as a tool to attract foreign investors to the stock market. The ability of stock markets to cushion against macroeconomic uncertainties has been associated with developed countries’ stock markets such as the United States and United Kingdom. However, this has also been observed, in this study, and this indicates that the JSE can be marketed as a safe market for foreign investors. The weak volatility transmission from the exchange rate market to the stock market indicates that there is prospect for foreign investors to diversify their investments in these two markets.

Thirdly, The JSE needs to maintain its co-operation with world class stock markets such as the LSE. This might be one of the reasons the JSE is able to cushion negative effects of currency volatility. Macroeconomic spillovers from developed countries are usually hard to deal with but if there is some integration between the JSE and developed countries, news about any possible developments in these markets will reach the JSE fast and measures to deal with any possible effects of these macroeconomic developments will be put in place way before the markets are affected.

Lastly, Investors, bankers and portfolio managers still need to be vigilant on the spillovers from the foreign exchange rate into the stock market. Although there is a weak relationship between rand volatility and the stock market in South Africa, this does not necessarily mean that investors and portfolio managers need not monitor the developments between these two variables. Various approaches to protect the stock market from the harmful effects of currency volatility need to be brought into the stock market. These instruments would then be used to further hedge against exchange risk. Exchange rate induced uncertainty is a pressing problem in South Africa and many other countries that have flexible exchange rate regimes.

\(^8\) Cavallo et al (2010) and several studies have proved that hedging instruments may lead to decreases in profits and productivity.
6.3 Possible areas for further research
Most of the studies that sought to examine the relationship between exchange rate volatility and the stock market, including this one, concentrated on using monthly data to examine the relationship that exists between the two variables. However, it must be noted that daily data or weekly data provide more useful results that monthly data. It is therefore, suggested that the significance of this study’s results can be improved by applying daily or weekly data. Using more frequent observations better captures dynamics of exchange rate and stock market interrelationships.
References


Akpokodje, G and Omojimite, B.U. 2010. A Comparative Analysis of the Effect of Exchange Rate Volatility on Exports in the CFA and Non-CFA Countries of Africa [Online]. Available at:
[Accessed 6 August 2011]

Alagidede, P., Panagiotidis, T and Zhang, X. 2010. Causal Relationship between Stock Prices and Exchange Rates [Online]. Available at:
https://dspace.stir.ac.uk/handle/1893/2096
[Accessed 18 June 2011]

http://www.academia.edu/822774/The_Relationships_between_Exchange_Rates_and_Stock_Prices_Empirical_Investigation_from_Johannesburg_Stock_Exchange
[Accessed 6 August 2011]


[Accessed 3 February 2012]

[Accessed 4 August 2011]


[Accessed 23 August 2012]

[Accessed 1 October 2011]

[Accessed 26 October 2011]


Eissa, M.A, Chortareas, G and Cipollini, A. 2010. *Stock Returns and Exchange Rate Volatility Spillovers in the MENA Region* [Online]. Available at:
http://emf.sagepub.com/content/9/3/257.abstract
[Accessed 13 June 2012]

[Accessed 7 July 2012]

[Accessed 17 July 2011]

[Accessed 7 July 2012]


[Accessed 13 September 2011]


seminar “How to reduce debt costs in Southern Africa? Bond Exchange of South Africa [Online]. Available at:
[Accessed 13 May 2011]

http://www.jstor.org/stable/2669632
[Accessed 1 April 2012]

[Accessed 16 June 2011]

Florin, E. 2010. *Causality Measures between neural signals from invasively and non invasively obtained local field potentials in humans*. Forschungszentrum, Netherlands

Franck, P. & Young, A. 1972. *Stock Price Reaction of Multinational Firms to Exchange Realignments* [Online]. Available at:
http://www.jstor.org/stable/3665374
[Accessed 13 July 2011]


Geske, R and Roll, R. 1983. *The Fiscal and Monetary Linkage between Stock Returns and Inflation*[Online]. Available at:
http://ideas.repec.org/a/bla/jfinan/v38y1983i1p1-33.html
[Accessed 13 May 2012]

Gordhan, P. 2011. *SA: Gordhan: Address by the Minister of Finance*. World Federation of exchanges 2011 General Assembly and annual meeting [Online]. Available at:
federation-of-exchanges-2011-general-assembly-and-annual-meeting-12102011-2011-10-12
[Accessed 11 June 2012]


http://www.eurojournals.com/IRJFE4%207%20grigoris.pdf  
[Accessed 12 November 2011]  


[Accessed 13 May 2012]  


www.arrow.dit.ie/cgi/viewcontent.cgi?article=1007&cont  
[Accessed 13 May 2012]  

Morales, L. 2008. *Volatility Spillovers between Equity and Currency Markets: Evidence from Major LatinAmerican Countries* [Online]. Available at: 
[Accessed 13 May 2012]  


[Accessed 2 February 2012]


[Accessed 15 September 2011]

[Accessed 15 September 2011]


[Accessed 15 September 2011]


Olugbenga, A.A. 2012. *Exchange Rate Volatility and Stock Market Behaviour: The Nigerian Experience* [Online]. Available at:


[Accessed 5 April 2012]

http://www.tips.org.za/node/230  
[Accessed 3 March 2011]


Raputsoane, L.  2008. Exchange rate volatility spillovers and the South African currency [Online]. Available at: 
[Accessed 17 July 2011]

http://mpra.ub.uni-muenchen.de/27209/1/MPRA_paper_27209.pdf  
[Accessed 17 July 2011]

Reddy, T.L and Thomson, R.J. 2011. The capital-asset pricing model: the case of South Africa [Online]. Available at: 
[Accessed 15 May 2012]


http://economics.fundamentalfinance.com/capm.php
[Accessed 1 September 2011]

Terblanche, R.C. 2009. *Market timing on the JSE using exchange rate fluctuations using exchange rate fluctuations* [Online]. Available at: 
[Accessed 1 November 2011]

http://www.academia.edu/195536/An_Empirical_Evidence_of_Relationships_between_Exchange_Rate_and_Stock_Prices_of_Johannesburg_Stock_Exchange_JSE_in_South_Africa
[Accessed March 6 2012]


[Online]. Available at:
Van der Merwe, E and Mollentze, S. 2009. Monetary economics in South Africa [Online]. Available at:
[Accessed 4 April 2011]


Volkart, R. 2005. Empirical evidence on the implications of the Efficient Market Hypothesis in the Swiss Equity Funds Market [Online]. Available at:
www.bf.uzh.ch/publikationen/pdf/publ_1135.pdf
[Accessed 8 March 2012]

http://www.resbank.co.za/Lists/News%20and%20Publications/Attachments/4778/Article%20-%20The%20impact%20of%20offshore%20listings%20on%20the%20SA%20economy
[Accessed 16 March 2013]

Wasen, S., and Lehmann, F.N. 2009. Poverty, Inequality and Policy in Latin America. USA, Massachusetts Institute of Technology


Woolfrey, S. 2013. South Africa’s new investment policy framework and protection for SA firms investing abroad. [Online]. Available at:
[Accessed 16 March 2013]

[Accessed 13 May 2012]


[Accessed 19 October 2011]


[Accessed 15 July 2011]
Appendices

Appendix 1 Data used in the regressions

<table>
<thead>
<tr>
<th>Years</th>
<th>RANDVOL</th>
<th>USINT</th>
<th>TMP</th>
<th>M3</th>
<th>MC</th>
<th>POR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000M01</td>
<td>6.13</td>
<td>8.5</td>
<td>88.8</td>
<td>485242</td>
<td>150947.7</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M02</td>
<td>6.32</td>
<td>8.73</td>
<td>93.2</td>
<td>485009</td>
<td>143428.6</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M03</td>
<td>6.47</td>
<td>8.83</td>
<td>89.3</td>
<td>480461</td>
<td>140552.1</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M04</td>
<td>6.65</td>
<td>9</td>
<td>87.8</td>
<td>484186</td>
<td>131820.6</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M05</td>
<td>7.02</td>
<td>9.24</td>
<td>84.6</td>
<td>476016</td>
<td>129842.2</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M06</td>
<td>6.91</td>
<td>9.5</td>
<td>91.2</td>
<td>483668</td>
<td>136149.5</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M07</td>
<td>6.9</td>
<td>9.5</td>
<td>87.5</td>
<td>480966</td>
<td>138467.3</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M08</td>
<td>6.96</td>
<td>9.5</td>
<td>90.1</td>
<td>489042</td>
<td>152001.2</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M09</td>
<td>7.18</td>
<td>9.5</td>
<td>90.6</td>
<td>499609</td>
<td>148432.9</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M10</td>
<td>7.49</td>
<td>9.5</td>
<td>88.8</td>
<td>501149</td>
<td>1453240</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M11</td>
<td>7.69</td>
<td>9.5</td>
<td>92.1</td>
<td>500501</td>
<td>139625.9</td>
<td>14.5</td>
</tr>
<tr>
<td>2000M12</td>
<td>7.64</td>
<td>9.5</td>
<td>90.6</td>
<td>515750</td>
<td>147483.9</td>
<td>14.5</td>
</tr>
<tr>
<td>2001M01</td>
<td>7.78</td>
<td>9.05</td>
<td>91.4</td>
<td>526833</td>
<td>161338.4</td>
<td>14.5</td>
</tr>
<tr>
<td>2001M02</td>
<td>7.82</td>
<td>8.5</td>
<td>92.5</td>
<td>531108</td>
<td>1603950</td>
<td>14.5</td>
</tr>
<tr>
<td>2001M03</td>
<td>7.9</td>
<td>8.32</td>
<td>92.3</td>
<td>543610</td>
<td>145148.6</td>
<td>14.5</td>
</tr>
<tr>
<td>2001M04</td>
<td>8.08</td>
<td>7.8</td>
<td>91.3</td>
<td>543582</td>
<td>159196.4</td>
<td>14.5</td>
</tr>
<tr>
<td>2001M05</td>
<td>7.98</td>
<td>7.24</td>
<td>92.2</td>
<td>550204</td>
<td>152486.2</td>
<td>14.5</td>
</tr>
<tr>
<td>2001M06</td>
<td>8.06</td>
<td>6.98</td>
<td>93.1</td>
<td>554866</td>
<td>147876.5</td>
<td>13.75</td>
</tr>
<tr>
<td>2001M07</td>
<td>8.21</td>
<td>6.75</td>
<td>86.8</td>
<td>568423</td>
<td>137058.1</td>
<td>13.5</td>
</tr>
<tr>
<td>2001M08</td>
<td>8.31</td>
<td>6.67</td>
<td>92.8</td>
<td>583910</td>
<td>143767.4</td>
<td>13.5</td>
</tr>
<tr>
<td>2001M09</td>
<td>8.68</td>
<td>6.28</td>
<td>88.6</td>
<td>573950</td>
<td>130299.7</td>
<td>13</td>
</tr>
<tr>
<td>2001M10</td>
<td>9.28</td>
<td>5.53</td>
<td>91.3</td>
<td>578179</td>
<td>136673.9</td>
<td>13</td>
</tr>
<tr>
<td>2001M11</td>
<td>9.74</td>
<td>5.1</td>
<td>88.7</td>
<td>585809</td>
<td>151040.8</td>
<td>13</td>
</tr>
<tr>
<td>2001M12</td>
<td>11.68</td>
<td>4.84</td>
<td>89.1</td>
<td>594077</td>
<td>167629.6</td>
<td>13</td>
</tr>
<tr>
<td>2002M01</td>
<td>11.63</td>
<td>4.75</td>
<td>86.8</td>
<td>631812</td>
<td>136574.9</td>
<td>14</td>
</tr>
<tr>
<td>2002M02</td>
<td>11.49</td>
<td>4.75</td>
<td>90.6</td>
<td>640474</td>
<td>143750</td>
<td>14</td>
</tr>
<tr>
<td>2002M03</td>
<td>11.49</td>
<td>4.75</td>
<td>91</td>
<td>649060</td>
<td>145882</td>
<td>15</td>
</tr>
<tr>
<td>2002M04</td>
<td>11.08</td>
<td>4.75</td>
<td>90.3</td>
<td>654181</td>
<td>145785</td>
<td>15</td>
</tr>
<tr>
<td>2002M05</td>
<td>10.16</td>
<td>4.75</td>
<td>89.7</td>
<td>679500</td>
<td>148730</td>
<td>15</td>
</tr>
<tr>
<td>2002M06</td>
<td>10.18</td>
<td>4.75</td>
<td>92.5</td>
<td>664968</td>
<td>141276</td>
<td>16</td>
</tr>
<tr>
<td>2002M07</td>
<td>10.1</td>
<td>4.75</td>
<td>88.9</td>
<td>675686</td>
<td>123691</td>
<td>16</td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Value1</td>
<td>Value2</td>
<td>Value3</td>
<td>Value4</td>
<td>Value5</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>2002</td>
<td>M08</td>
<td>10.59</td>
<td>4.75</td>
<td>93</td>
<td>685178</td>
<td>129559</td>
</tr>
<tr>
<td>2002</td>
<td>M09</td>
<td>10.6</td>
<td>4.75</td>
<td>94.3</td>
<td>682704</td>
<td>127301</td>
</tr>
<tr>
<td>2002</td>
<td>M10</td>
<td>10.31</td>
<td>4.75</td>
<td>93.2</td>
<td>699441</td>
<td>125546</td>
</tr>
<tr>
<td>2002</td>
<td>M11</td>
<td>9.65</td>
<td>4.35</td>
<td>93.6</td>
<td>703217</td>
<td>128410</td>
</tr>
<tr>
<td>2002</td>
<td>M12</td>
<td>8.95</td>
<td>4.25</td>
<td>94.8</td>
<td>701634</td>
<td>124972</td>
</tr>
<tr>
<td>2003</td>
<td>M01</td>
<td>8.69</td>
<td>4.25</td>
<td>85.7</td>
<td>721267</td>
<td>118349</td>
</tr>
<tr>
<td>2003</td>
<td>M02</td>
<td>8.29</td>
<td>4.25</td>
<td>98.8</td>
<td>725927</td>
<td>112868</td>
</tr>
<tr>
<td>2003</td>
<td>M03</td>
<td>8.05</td>
<td>4.25</td>
<td>93.5</td>
<td>730859</td>
<td>103432</td>
</tr>
<tr>
<td>2003</td>
<td>M04</td>
<td>7.66</td>
<td>4.25</td>
<td>95.1</td>
<td>753303</td>
<td>101089</td>
</tr>
<tr>
<td>2003</td>
<td>M05</td>
<td>7.66</td>
<td>4.25</td>
<td>94.1</td>
<td>763619</td>
<td>116075</td>
</tr>
<tr>
<td>2003</td>
<td>M06</td>
<td>7.86</td>
<td>4.22</td>
<td>92.5</td>
<td>771290</td>
<td>112860</td>
</tr>
<tr>
<td>2003</td>
<td>M07</td>
<td>7.55</td>
<td>4</td>
<td>98.3</td>
<td>777749</td>
<td>119045</td>
</tr>
<tr>
<td>2003</td>
<td>M08</td>
<td>7.39</td>
<td>4</td>
<td>95.3</td>
<td>771908</td>
<td>124694</td>
</tr>
<tr>
<td>2003</td>
<td>M09</td>
<td>7.31</td>
<td>4</td>
<td>97</td>
<td>785588</td>
<td>121286</td>
</tr>
<tr>
<td>2003</td>
<td>M10</td>
<td>6.96</td>
<td>4</td>
<td>98</td>
<td>792390</td>
<td>132557</td>
</tr>
<tr>
<td>2003</td>
<td>M11</td>
<td>6.72</td>
<td>4</td>
<td>97</td>
<td>800724</td>
<td>132065</td>
</tr>
<tr>
<td>2003</td>
<td>M12</td>
<td>6.54</td>
<td>4</td>
<td>97.6</td>
<td>800031</td>
<td>141155</td>
</tr>
<tr>
<td>2004</td>
<td>M01</td>
<td>6.94</td>
<td>4</td>
<td>100.5</td>
<td>810694</td>
<td>147520</td>
</tr>
<tr>
<td>2004</td>
<td>M02</td>
<td>6.75</td>
<td>4</td>
<td>98.4</td>
<td>835966</td>
<td>147971</td>
</tr>
<tr>
<td>2004</td>
<td>M03</td>
<td>6.61</td>
<td>4</td>
<td>100</td>
<td>834779</td>
<td>145084</td>
</tr>
<tr>
<td>2004</td>
<td>M04</td>
<td>6.57</td>
<td>4</td>
<td>95.9</td>
<td>844659</td>
<td>141317</td>
</tr>
<tr>
<td>2004</td>
<td>M05</td>
<td>6.8</td>
<td>4</td>
<td>101.1</td>
<td>843196</td>
<td>142849</td>
</tr>
<tr>
<td>2004</td>
<td>M06</td>
<td>6.42</td>
<td>4.01</td>
<td>96.5</td>
<td>854675</td>
<td>139913</td>
</tr>
<tr>
<td>2004</td>
<td>M07</td>
<td>6.14</td>
<td>4.25</td>
<td>104.2</td>
<td>859927</td>
<td>142845</td>
</tr>
<tr>
<td>2004</td>
<td>M08</td>
<td>6.47</td>
<td>4.43</td>
<td>99.8</td>
<td>886070</td>
<td>154575</td>
</tr>
<tr>
<td>2004</td>
<td>M09</td>
<td>6.53</td>
<td>4.58</td>
<td>98.9</td>
<td>903615</td>
<td>164306</td>
</tr>
<tr>
<td>2004</td>
<td>M10</td>
<td>6.38</td>
<td>4.75</td>
<td>96.2</td>
<td>917273</td>
<td>163066</td>
</tr>
<tr>
<td>2004</td>
<td>M11</td>
<td>6.03</td>
<td>4.93</td>
<td>96.1</td>
<td>915252</td>
<td>174729</td>
</tr>
<tr>
<td>2004</td>
<td>M12</td>
<td>5.72</td>
<td>5.15</td>
<td>97.4</td>
<td>910382</td>
<td>177755</td>
</tr>
<tr>
<td>2005</td>
<td>M01</td>
<td>5.96</td>
<td>5.25</td>
<td>109.9</td>
<td>916687</td>
<td>179533</td>
</tr>
<tr>
<td>2005</td>
<td>M02</td>
<td>6.49</td>
<td>5.49</td>
<td>99.4</td>
<td>939943</td>
<td>188993</td>
</tr>
<tr>
<td>2005</td>
<td>M03</td>
<td>6.03</td>
<td>5.58</td>
<td>106.2</td>
<td>938754</td>
<td>186861</td>
</tr>
<tr>
<td>2005</td>
<td>M04</td>
<td>6.15</td>
<td>5.75</td>
<td>100.5</td>
<td>969182</td>
<td>175647</td>
</tr>
<tr>
<td>2005</td>
<td>M05</td>
<td>6.33</td>
<td>5.98</td>
<td>102.8</td>
<td>979210</td>
<td>192836</td>
</tr>
<tr>
<td>2005</td>
<td>M06</td>
<td>6.74</td>
<td>6.01</td>
<td>98.5</td>
<td>998508</td>
<td>198854</td>
</tr>
<tr>
<td>Date</td>
<td>Company 1</td>
<td>Company 2</td>
<td>Company 3</td>
<td>Company 4</td>
<td>Company 5</td>
<td>Company 6</td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>2005M07</td>
<td>6.7</td>
<td>6.25</td>
<td>101.8</td>
<td>1031910</td>
<td>212729</td>
<td>10.5</td>
</tr>
<tr>
<td>2005M08</td>
<td>6.46</td>
<td>6.44</td>
<td>97.4</td>
<td>1050780</td>
<td>214784</td>
<td>10.5</td>
</tr>
<tr>
<td>2005M09</td>
<td>6.37</td>
<td>6.59</td>
<td>95.5</td>
<td>1062469</td>
<td>235643</td>
<td>10.5</td>
</tr>
<tr>
<td>2005M10</td>
<td>6.59</td>
<td>6.75</td>
<td>96.7</td>
<td>1065764</td>
<td>229684</td>
<td>10.5</td>
</tr>
<tr>
<td>2005M11</td>
<td>6.66</td>
<td>7</td>
<td>97.8</td>
<td>1069392</td>
<td>234172</td>
<td>10.5</td>
</tr>
<tr>
<td>2005M12</td>
<td>6.35</td>
<td>7.15</td>
<td>93.6</td>
<td>1103406</td>
<td>253454</td>
<td>10.5</td>
</tr>
<tr>
<td>2006M01</td>
<td>6.08</td>
<td>7.26</td>
<td>99.8</td>
<td>1110562</td>
<td>276478</td>
<td>10.5</td>
</tr>
<tr>
<td>2006M02</td>
<td>6.12</td>
<td>7.5</td>
<td>94.3</td>
<td>1140632</td>
<td>267507</td>
<td>10.5</td>
</tr>
<tr>
<td>2006M03</td>
<td>6.24</td>
<td>7.53</td>
<td>99.3</td>
<td>1202128</td>
<td>285088</td>
<td>10.5</td>
</tr>
<tr>
<td>2006M04</td>
<td>6.08</td>
<td>7.75</td>
<td>100.7</td>
<td>1196883</td>
<td>296021</td>
<td>10.5</td>
</tr>
<tr>
<td>2006M05</td>
<td>6.31</td>
<td>7.93</td>
<td>97.6</td>
<td>1225453</td>
<td>288218</td>
<td>10.5</td>
</tr>
<tr>
<td>2006M06</td>
<td>6.97</td>
<td>8.02</td>
<td>98.3</td>
<td>1237184</td>
<td>300309</td>
<td>11</td>
</tr>
<tr>
<td>2006M07</td>
<td>7.07</td>
<td>8.25</td>
<td>99.9</td>
<td>1252299</td>
<td>296436</td>
<td>11</td>
</tr>
<tr>
<td>2006M08</td>
<td>6.95</td>
<td>8.25</td>
<td>98.6</td>
<td>1271414</td>
<td>310660</td>
<td>11.5</td>
</tr>
<tr>
<td>2006M09</td>
<td>7.45</td>
<td>8.25</td>
<td>98.9</td>
<td>1283600</td>
<td>317053</td>
<td>11.5</td>
</tr>
<tr>
<td>2006M10</td>
<td>7.63</td>
<td>8.25</td>
<td>98.5</td>
<td>1315292</td>
<td>330672</td>
<td>12</td>
</tr>
<tr>
<td>2006M11</td>
<td>7.25</td>
<td>8.25</td>
<td>100.6</td>
<td>1341556</td>
<td>339611</td>
<td>12</td>
</tr>
<tr>
<td>2006M12</td>
<td>7.03</td>
<td>8.25</td>
<td>97.9</td>
<td>1350994</td>
<td>353788</td>
<td>12.5</td>
</tr>
<tr>
<td>2007M01</td>
<td>7.19</td>
<td>8.25</td>
<td>101.1</td>
<td>1360446</td>
<td>361082</td>
<td>12.5</td>
</tr>
<tr>
<td>2007M02</td>
<td>7.18</td>
<td>8.25</td>
<td>101.4</td>
<td>1404453</td>
<td>367191</td>
<td>12.5</td>
</tr>
<tr>
<td>2007M03</td>
<td>7.35</td>
<td>8.25</td>
<td>101.7</td>
<td>1443477</td>
<td>388740</td>
<td>12.5</td>
</tr>
<tr>
<td>2007M04</td>
<td>7.1</td>
<td>8.25</td>
<td>98.2</td>
<td>1462251</td>
<td>404193</td>
<td>12.5</td>
</tr>
<tr>
<td>2007M05</td>
<td>7.01</td>
<td>8.25</td>
<td>98.4</td>
<td>1499900</td>
<td>408466</td>
<td>12.5</td>
</tr>
<tr>
<td>2007M06</td>
<td>7.15</td>
<td>8.25</td>
<td>97.4</td>
<td>1523351</td>
<td>404486</td>
<td>13</td>
</tr>
<tr>
<td>2007M07</td>
<td>6.97</td>
<td>8.25</td>
<td>96</td>
<td>1552402</td>
<td>403754</td>
<td>13</td>
</tr>
<tr>
<td>2007M08</td>
<td>7.22</td>
<td>8.25</td>
<td>94.4</td>
<td>1593000</td>
<td>404951</td>
<td>13.5</td>
</tr>
<tr>
<td>2007M09</td>
<td>7.1</td>
<td>8.03</td>
<td>100.7</td>
<td>1603241</td>
<td>421185</td>
<td>13.5</td>
</tr>
<tr>
<td>2007M10</td>
<td>6.76</td>
<td>7.74</td>
<td>94.3</td>
<td>1620388</td>
<td>442549</td>
<td>14</td>
</tr>
<tr>
<td>2007M11</td>
<td>6.7</td>
<td>7.5</td>
<td>93.6</td>
<td>1655918</td>
<td>427520</td>
<td>14</td>
</tr>
<tr>
<td>2007M12</td>
<td>6.84</td>
<td>7.33</td>
<td>96.6</td>
<td>1681099</td>
<td>410070</td>
<td>14.5</td>
</tr>
<tr>
<td>2008M01</td>
<td>7</td>
<td>6.98</td>
<td>89.7</td>
<td>1703823</td>
<td>386643</td>
<td>14.5</td>
</tr>
<tr>
<td>2008M02</td>
<td>7.66</td>
<td>6</td>
<td>91.9</td>
<td>1695585</td>
<td>427483</td>
<td>14.5</td>
</tr>
<tr>
<td>2008M03</td>
<td>7.99</td>
<td>5.66</td>
<td>88</td>
<td>1732733</td>
<td>415046</td>
<td>14.5</td>
</tr>
<tr>
<td>2008M04</td>
<td>7.76</td>
<td>5.24</td>
<td>94.5</td>
<td>1764893</td>
<td>431258</td>
<td>15</td>
</tr>
<tr>
<td>2008M05</td>
<td>7.61</td>
<td>5</td>
<td>97.5</td>
<td>1804427</td>
<td>446649</td>
<td>15</td>
</tr>
<tr>
<td>Month</td>
<td>Year</td>
<td>ID</td>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td>Value 4</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
<td>------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>2008M06</td>
<td></td>
<td>7.94</td>
<td>5</td>
<td>94.1</td>
<td>1824858</td>
<td>428600</td>
</tr>
<tr>
<td>2008M07</td>
<td></td>
<td>7.61</td>
<td>5</td>
<td>88</td>
<td>1847784</td>
<td>390582</td>
</tr>
<tr>
<td>2008M08</td>
<td></td>
<td>7.67</td>
<td>5</td>
<td>93.2</td>
<td>1847945</td>
<td>390195</td>
</tr>
<tr>
<td>2008M09</td>
<td></td>
<td>8.08</td>
<td>5</td>
<td>95.7</td>
<td>1867971</td>
<td>337035</td>
</tr>
<tr>
<td>2008M10</td>
<td></td>
<td>9.78</td>
<td>4.56</td>
<td>95.2</td>
<td>1897901</td>
<td>296684</td>
</tr>
<tr>
<td>2008M11</td>
<td></td>
<td>10.11</td>
<td>4</td>
<td>91.3</td>
<td>1944378</td>
<td>287100</td>
</tr>
<tr>
<td>2008M12</td>
<td></td>
<td>9.92</td>
<td>3.61</td>
<td>88.5</td>
<td>1927620</td>
<td>291552</td>
</tr>
<tr>
<td>2009M01</td>
<td></td>
<td>9.91</td>
<td>3.25</td>
<td>80</td>
<td>1941750</td>
<td>278803</td>
</tr>
<tr>
<td>2009M02</td>
<td></td>
<td>9.98</td>
<td>3.25</td>
<td>84.7</td>
<td>1924156</td>
<td>250333</td>
</tr>
<tr>
<td>2009M03</td>
<td></td>
<td>9.95</td>
<td>3.25</td>
<td>83.8</td>
<td>1920081</td>
<td>276410</td>
</tr>
<tr>
<td>2009M04</td>
<td></td>
<td>8.96</td>
<td>3.25</td>
<td>85.3</td>
<td>1915123</td>
<td>280242</td>
</tr>
<tr>
<td>2009M05</td>
<td></td>
<td>8.37</td>
<td>3.25</td>
<td>89</td>
<td>1936451</td>
<td>309731</td>
</tr>
<tr>
<td>2009M06</td>
<td></td>
<td>8.03</td>
<td>3.25</td>
<td>88.4</td>
<td>1928813</td>
<td>302695</td>
</tr>
<tr>
<td>2009M07</td>
<td></td>
<td>7.94</td>
<td>3.25</td>
<td>89.5</td>
<td>1948071</td>
<td>332863</td>
</tr>
<tr>
<td>2009M08</td>
<td></td>
<td>7.94</td>
<td>3.25</td>
<td>85.9</td>
<td>1947873</td>
<td>342828</td>
</tr>
<tr>
<td>2009M09</td>
<td></td>
<td>7.5</td>
<td>3.25</td>
<td>85.3</td>
<td>1946670</td>
<td>344186</td>
</tr>
<tr>
<td>2009M10</td>
<td></td>
<td>7.49</td>
<td>3.25</td>
<td>86.8</td>
<td>1949843</td>
<td>364158</td>
</tr>
<tr>
<td>2009M11</td>
<td></td>
<td>7.51</td>
<td>3.25</td>
<td>88</td>
<td>1952363</td>
<td>371155</td>
</tr>
<tr>
<td>2009M12</td>
<td></td>
<td>7.48</td>
<td>3.25</td>
<td>87.3</td>
<td>1964977</td>
<td>383526</td>
</tr>
<tr>
<td>2010M01</td>
<td></td>
<td>7.46</td>
<td>3.25</td>
<td>89.8</td>
<td>1945313</td>
<td>369687</td>
</tr>
<tr>
<td>2010M02</td>
<td></td>
<td>7.67</td>
<td>3.25</td>
<td>90.3</td>
<td>1935409</td>
<td>370960</td>
</tr>
<tr>
<td>2010M03</td>
<td></td>
<td>7.41</td>
<td>3.25</td>
<td>94.6</td>
<td>1955462</td>
<td>398450</td>
</tr>
<tr>
<td>2010M04</td>
<td></td>
<td>7.34</td>
<td>3.25</td>
<td>84.7</td>
<td>1956546</td>
<td>396893</td>
</tr>
<tr>
<td>2010M05</td>
<td></td>
<td>7.65</td>
<td>3.25</td>
<td>82.7</td>
<td>1964733</td>
<td>375521</td>
</tr>
<tr>
<td>2010M06</td>
<td></td>
<td>7.64</td>
<td>3.25</td>
<td>90.4</td>
<td>1981031</td>
<td>363978</td>
</tr>
<tr>
<td>2010M07</td>
<td></td>
<td>7.52</td>
<td>3.25</td>
<td>91.9</td>
<td>2020529</td>
<td>392972</td>
</tr>
<tr>
<td>2010M08</td>
<td></td>
<td>7.29</td>
<td>3.25</td>
<td>94.8</td>
<td>2037441</td>
<td>377790</td>
</tr>
<tr>
<td>2010M09</td>
<td></td>
<td>7.11</td>
<td>3.25</td>
<td>94.9</td>
<td>2045374</td>
<td>410333</td>
</tr>
<tr>
<td>2010M10</td>
<td></td>
<td>6.91</td>
<td>3.25</td>
<td>94.6</td>
<td>2069857</td>
<td>421764</td>
</tr>
<tr>
<td>2010M11</td>
<td></td>
<td>6.97</td>
<td>3.25</td>
<td>95.7</td>
<td>2087685</td>
<td>419554</td>
</tr>
<tr>
<td>2010M12</td>
<td></td>
<td>6.82</td>
<td>3.25</td>
<td>93.1</td>
<td>2090474</td>
<td>447053</td>
</tr>
</tbody>
</table>