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Exchange Rate Volatility Impact on the Earnings of JSE Listed Stock Prices

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Exchange Rate Volatility Impact on the Earnings of JSE Listed Stock Prices

Christopher Kgaje

A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2017

ABSTRACT

This study contributes to a better understanding of the relationship between the impact of exchange rate fluctuation and the earnings of JSE listed firms, using high-frequency weekly data from between January 2006 to December 2016. The study utilises the vector auto-regressive models, *Granger causality,* and *impulse responses* to evaluate the nexus between earnings of the JSE All Share, Resource 10, Financial 15, Industrial 25, and the Top 40 indices and fluctuations of the Rand/US dollar exchange rates. Our findings show unidirectional causality from the JSE All Share and TOP40 returns to the Rand/US dollar fluctuations. The impulse response of the Rand/US dollar fluctuation to the one standard deviation shock from the JSE indices returns is short-lived and different from sector-to-sector. The short-lived impulse response of the Rand/US dollar fluctuation could indicate that foreign investors are after the *hot money* in the relatively attractive JSE stock market thus inducing high volatility as they enter the markets for relatively short periods.

Keywords: Granger causality; impulse response function; vector auto-regressive model

DECLARATION

I, Christopher Kgaje, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Christopher Kgaje

Signed at ……

On the …….. day of …… 20…..

DEDICATION

To my parents, Bra Nick and particularly my mother Mmahuma Kgaje, for teaching me how to persevere in life and how to make the best with whatever little that one has.

To my dearest wife, Thoko, it would not be possible without your love, support and unwavering encouragement throughout my studies. Thank you for endless patience, sacrifices, and most importantly for your strength while I was mostly unavailable.

To my sons, Reabetswe and Oarabile, for giving me a reason to wake up every morning I love you, boys. To Rea, I hope we can learn from this boy. Moreover, to Oarabile thank you for reminding dad every day, to do his homework!

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- To my family and friends for your continued love and support. Now I really miss you like crazy guys,
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CHAPTER 1. INTRODUCTION

The Johannesburg Stock Exchange (JSE) is a financial institution that provides a global trading platform to listed companies and a variety of investors that operate locally and internationally. The stock exchange offers and regulates the Primary Market[1], which includes the primary listing of firms or Initial Public Offerings - IPOs, Secondary Market[2] that encompasses trading of equities, and also post-trade and technology services by selling market data (JSE, 2015).

The JSE was established in 1887 by Benjamin Wollan, a year after the discovery of gold, to assist mining firms and investors in raising capital during the booming of gold mining in Witwatersrand (Phiri, 2017). The JSE has since become the largest stock exchange by market capitalisation and value trade in Africa, the most liquid and ranked in the top 20 globally (JSE, 2017). Moreover, according to the JSE (2015), it was acknowledged for six consecutive years in a row years by the World Economic Forum's Global Competitiveness Report for 2015/2016 as one of the top two best-regulated stock exchanges in the world.

After the inception of a newly elected democratic government and lifting of sanctions against South Africa, the JSE was reformed in terms of the Stock Exchange Control Act in 1995 and allowed foreigners and global investors to trade with some limitations (Phiri, 2017). In 2011, the JSE lifted foreign exchange rules that restricted the amount of foreign firm equity that local investors were permitted to hold. This openness assisted in making the JSE more attractive to foreign-based companies (JSE, 2017). The JSE acquired the South African Futures Exchange – Safex in 2001, and the Bond Exchange of South Africa – BESA in 2009, and presently the JSE offers trading products that include commodities and interest rate future derivatives, bonds, equities, and currency trading (JSE, 2017).

[1] In the Primary Market, privately owned firms open to the public for the first time to raise capital through IPO process by issuing shares to the investors. Thus listing on the JSE offers companies and its shareholders prospects of a free-flowing or liquid market to trade their shares (Neneh, 2013).

[2] Subsequently, buyers and sellers trade these shares in the Secondary Markets known as Equities, Commodity Derivatives, Bonds and Financial Derivatives markets, open to trade globally (JSE, 2015).

Currently, international investors have easy access to the JSE through its technology; thus the JSE enables swift global capital movements. The technology, variety of products and the credibility, places the JSE in a very competitive and attractive position for foreign investors (JSE, 2015). Moreover, lucrative return rates in South African bond markets compared to very low or negative[3] interest rates in developed markets put the JSE in a good position to attract foreign investment and trading. Recent technology improvements and trading platforms have increased the speed that the JSE executes its transactions over 400 times, the establishment of colocation centres[4] enabled high-frequency and algorithmic trading that resulted in the domestic market capitalisation increasing from R8.3 trillion in 2013 to R11.6 trillion in 2016 (Phiri, 2017).

The weak Rand influences listed nett-exporting firms to be more profitable, combined with prospects of high dividend yields, also contributes positively to the South African's stock market (Mlambo, Maredza, & Sibanda, 2013). However, the significant inflow of the forex leads to the strengthening of the Rand that may cause foreign investors to change their market positions leading to significant sell-off and large capital outflows, which may influence the share prices, creating a level of uncertainty (Bonga-Bonga, 2013). It is useful for the investors to know the uncertainty of their future returns, which enables them to make decisions by weighing the risk of holding particular assets. For example, the so-called fear index, South African Volatility Index – SAVI index, was established to measure market sentiment based on the 3-month FTSE/JSE Top40 perceived volatility[5] (Kotzé, Joseph, & Oosthuizen, 2009).

Pricing of financial derivatives relies on the projected future performance of the underlying asset; thus it is critical forecasting the expected volatility accurately (Bartram & Bodnar, 2012). As the case of SAVI, which is one of the financial derivatives launched in 2007 on the JSE, two years later its prediction model

[3] Japan and Germany government bonds have negative interest rates while the USA and UK offer very low interest rate.
[4] Colocation enables JSE clients with the lowest latency connectivity for trading and real time data reception in 150 microseconds (JSE, 2017).
[5] Volatility has been inferred as uncertainty, stock price and exchange rate, fluctuations or movements in this report.

was changed from pooled volatility to an implied volatility model to minimise possibilities of manipulating the volatility index value (Kotzé et al., 2009). According to Kotzé et al. (2009), volatility index value could be influenced by polling volatility contributors, contacting market participants to get information on their bets or at-the-money values to predict the volatility value. However, at the time of writing this report, the Competition Commission of South Africa released a media statement informing the public of the decision to prosecute seventeen banks – currency traders for collusion on price fixing of the Rand/US Dollar pair and market allocation (Competition Commission, 2017). The same concern, of the potential Rand/US Dollar manipulation by currency traders, which the JSE tried to alleviate by changing the model of SAVI seems to have eluded the policy makers and the JSE.

According to the Oxford Dictionary (2014, p. 1723), volatility is a noun derived from volatile which mean “likely to change suddenly, liable to change rapidly and unpredictability, especially for the worst”. However, in the context of finance Brooks (2008, p. 383) describes volatility as a “crude measure of the total risk of financial asset”, and that volatility is determined by the standard deviation or variance of the returns. We have inferred stock price and exchange rate fluctuations or movements as volatility in this report.

Volatility is a significant attribute of the equity markets; hence this study aims to investigate and develop an understanding of what the exchange rate fluctuation influence is on the earnings of the different sectors of the JSE.

1.1 Purpose of the study

The JSE is very attractive for foreign investors due to its liquidity and competitiveness hence it is prone to volatility that characterises stock markets of emerging economies (Phiri, 2017; Yartey, 2008). Exchange rate volatility has an influence on both business and policy decisions (Mlambo et al., 2013). There is a lack of clarity within the literature regarding the relationship between

exchange rate fluctuation and the returns[6] of firms[7] on the stock market. The uncertainty of this relationship, leads to inadequate planning, over-expenditure on international project costs by the enterprises and substandard economic policies by the government (Ali, Abdelnabi, Iqbal, Weni, & Omer, 2016).

The level of ambiguity is in both theory and empirical evidence. For instance, Mlambo et al. (2013) found a weak correlation between the effect of exchange rate volatility to the overall returns of the JSE stock market. On the contrary, Ali et al. (2016) established robust and significant correlations.

The All Share index is widely used as a proxy for the measurement of the overall returns of the JSE (Ali et al., 2016). The practice aggregates the performance of different sectors of the stock market, possibly obstructing the information on how each segment is affected by the underlying variables. Also, Barr, Kantor, and Holdsworth (2007) concluded in their study of the effect of the exchange rate on the JSE Top40 stock returns for the period from 1999 to 2005, that the Rand volatility pulled both the JSE All Share and Top40 indices in different directions, negative and positive. Moreover, the impact of the exchange rate is different to the type of the stock as the effect can be immediate or delayed, depending on whether the stock is Rand-leverage, Rand-hedge or Rand-play, which tend to counteract each other and the overall impact is the nett aggregate effect on the All Share index that will appear to be moderately affected. Muzindutsi and Niyimbanira (2012)'s findings concurred with the prior investigation, after classifying JSE Top40 firms into Tradable, mixed and non-Tradable. The authors identified various opposing associations between the stock market returns within the categories above and the exchange rate volatility.

The purpose of this research is to find out whether periods of high exchange rate fluctuation result in lower earnings for the listed companies. The study covers a period from January 2006 to December 2016 to include periods of significant Rand volatility. The aim is to measure the strength of the correlations

[6] Daily JSE returns or earnings are used interchangeably in this report.
[7] Firm or firms and companies are used interchangeably and they refer to the listed multinational companies

between the Rand fluctuation and the index earnings of the different sectors of the JSE in an attempt to determine the level of impact in each sector.

1.2 Context of the study

Influences of exchange rate movements on micro and macroeconomics have been a concern for a long time especially in the field of development economics after the global financial crisis between 2007 and 2008 (Phiri, 2017). Since the introduction of free floating exchange rate regimes, the effect of the increased exchange rates volatility on trade and stock markets is a serious concern (Mlambo et al., 2013). Exchange rate volatility has a perceived harmful impact to the international trade, especially on the earnings of the listed firms. What motivated this research is that JSE listed firms, together with South African policy makers, have to understand the impact of the exchange rate volatility on the earnings and the competitiveness of companies, as better understanding will assist in developing interventions that will inhibit any negative contribution to the South African economy at large (Ali et al., 2016).

The use of the Gold Standard and the Bretton Woods systems during the 1800's and 1900's respectively, were essential to stabilise exchange rates (Demir, 2013). However, the breakdown of the Bretton Woods system in 1973 followed by the increased financial liberalisation and integration of capital markets globally, exposed both developed and developing economies to exchange rate volatility (Demir, 2013). Moreover, LiPuma and Koelble (2009) argue convincingly that the International Monetary Fund – IMF - has adopted a habit to strongly encourage newly democratised countries to liberalise their exchange rate regimes and open their economies to global trade. The newly formed states are enticed with the promise that liberalisation and the openness of their economy will lead to increased Foreign Direct Investment – FDI, Foreign Portfolio Investment – FPI, access to foreign credit, financing and importation of technology to benefit their developing economies (LiPuma & Koelble, 2009).

South Africa was no exception to the enticement as it followed global trends after its liberation in 1994 and adopted the flexible or free floating exchange rate

regime with inflation rate targeting monetary policy, from February 2000 (Mtonga, 2011). The adoption of inflation targeting[8] was a measure to assist in controlling the volatility of the rand by stabilising interest rates (Mtonga, 2011). However, the Rand suffered prolonged depreciation and volatility in 2001 after implementation of the flexible currency regime, which even led to the Myburgh commission sanctioned to investigate the source of the persistent Rand depreciation (LiPuma & Koelble, 2009; Mtonga, 2011). LiPuma and Koelble (2009) concluded that the negative consequences of adopting free-floating exchange rates by emerging countries are exposure to speculative currency attacks which induce currency volatility and economic instability. Consequently, the South African Reserve Bank – SARB - is holding 47 billion dollars of total gross foreign reserves as ammunition for its defence strategy against speculative currency attacks. The argument is that the opportunity cost of such a defence strategy delays the structural investment in the economy especially in the infrastructure and manufacturing sectors (LiPuma & Koelble, 2009). Moreover, the perception that high exchange rate volatility induces uncertainty in the stock market may result in discouraging trade and the potential expansion capacity (Mlambo et al., 2013).

1.2.1 *Volatility on the JSE*

The FTSE/JSE South African sector index is categorised into the three segments, Financials, Resources and Industrials based on Industry Classification Benchmark – ICB (JSE, 2017). The Resources comprises JSE listed firms that belong to Oil and Gas and Basic Materials. Financials encompass listed insurance, banks, and finance companies. Industrials include any business that is categorised in neither of the two sectors (JSE, 2017). Thus, the RESI20[9], INDI25 and FIN15 indices represent three subdivisions, namely

[8] For example, the South African Reserve Bank has set an inflation target range of 3 – 6% and consequently, the SARB can increase interest rates to slow down rapid depreciation of the rand and offsetting inflation simultaneously by attracting foreign investment (LiPuma & Koelble, 2009).

[9] RESI20 represents resources 10 index. The FTSE/JSE Resources 20 was changed to resources 10 in March 2011 (JSE, 2017). However most of the trading platforms like Bloomberg are still using RESI20 to denote resources 10 index.

Resources 10, Industrial 25 and Financial 15 respectively, based on the largest number of companies by market cap in each respective sector.

South Africa is experiencing a growth in foreign investors since the liberalisation of the Rand, JSE and the economy at large (Bonga-Bonga, 2013). Figure 1 depicts the presence of volatility and the reaction of three indices including the aggregate ALSH[10] and Top40[11], RESI20, FINI15 and INDI25 from January 2006 to December 2016. It is evident from the graph that various sectors responded differently during periods of high volatility. Moreover, delayed response or lags are distinguishable and unique to each segment. In 2008, the global financial crisis was indicated by a significant drop in all the selected sectors of the stock market, including a spike in the Rand/US Dollar exchange rate.

As Bonga-Bonga (2013, p. 1529) explained that it is becoming very important to understand the relationship "between the stock market prices and exchange rates for the pricing of securities, within and across markets, and for the trading and hedging strategies of investors", as the number of foreign traders continues to grow. Thus, it is the intention of this investigation to uncover how the exchange rate fluctuation influences the various sectors.

[10] ALSH represents the All share index which is part of the headline category and it includes about 162 JSE listed firms with the market capitalisation of about R6.4 trillion (JSE, 2017).
[11] Top40 index is a basket of 40 largest JSE listed firms based on their market value in the All share index. The index has a market capitalisation of R5.2 trillion and is constituted from 43 firms (JSE, 2017)

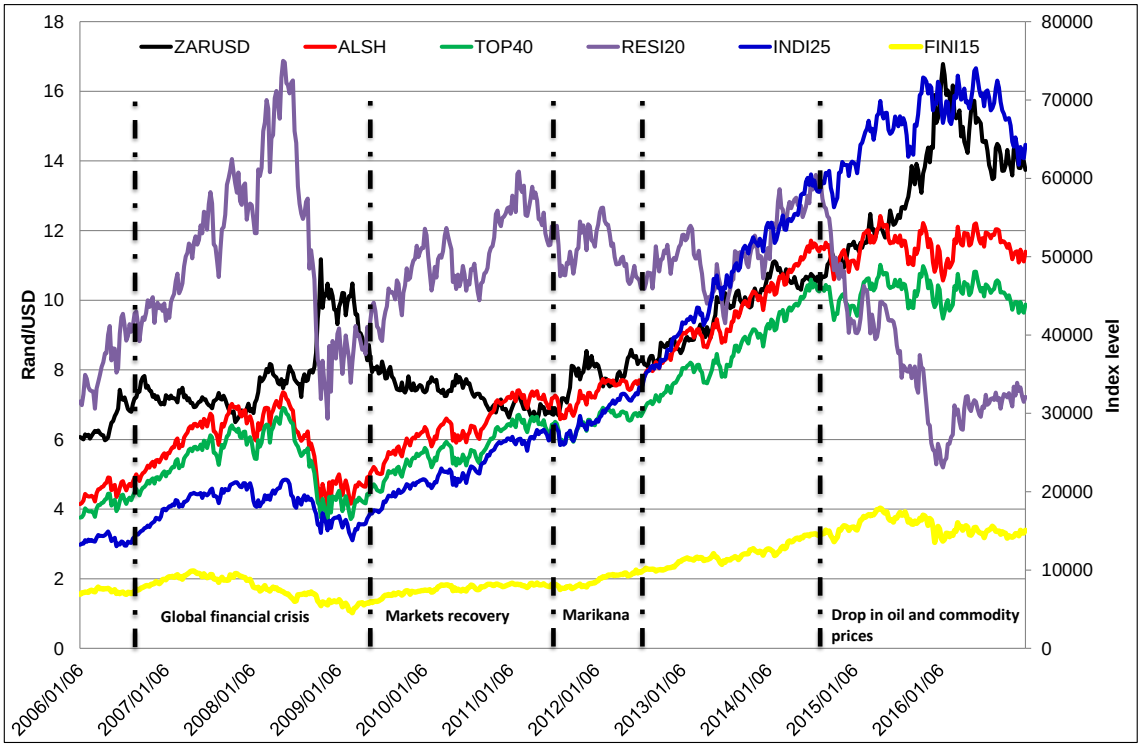


Figure 1: Monthly performance of indices compared to Rand-Dollar exchange

The 'new' SAVI defined as "a measure of the expected volatility calculated using weighted average prices of calls and puts over a wide range of strike prices that expires in 3-month time" (Kotzé et al., 2009, p. 3). The SAVI is compared to the sector performance for a period from April 2008[12] to December 2016 using monthly data. Figure 2 portrays pronounced shocks on the RESI20 index. In 2008 the significant drop in the level of the RESI20 index was due to the global financial crises due to the transmission of volatility from commodity markets to the real effective exchange rate[13] (Arezki et al., 2012). Later, in 2014, a drop in the index level was the consequences of the fall in world oil prices and a decline in commodity prices. Lags are also identifiable and unique to each sector. If a researcher is only focusing on the aggregate ALSH index, then other information peculiar to the industry will be concealed.

[12] April 2008 is the earliest date that the new SAVI was utilised.
[13] Real effective exchange rate is the country's nominal effective exchange rate, defined below, adjusted for consumer price index or inflation (Arezki, Dumitrescu, & Quintyn, 2012).

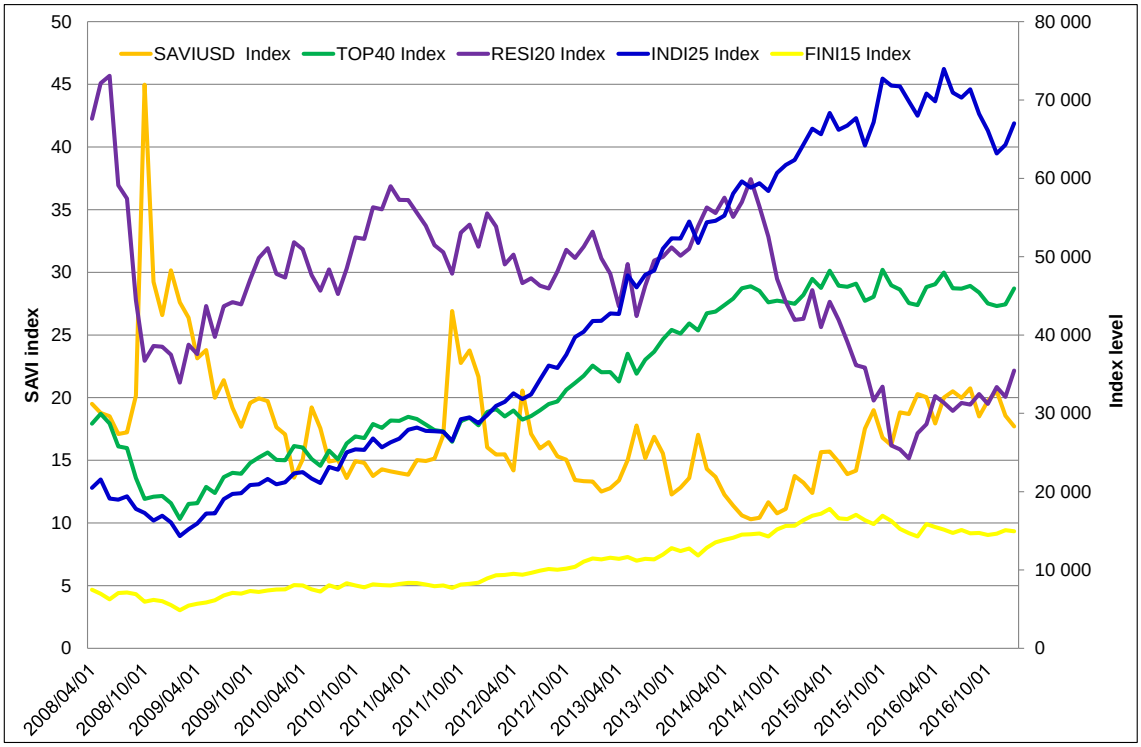


Figure 2: Monthly SAVI compared to the performance of various sectors

Table 1 portrays a bird's-eye view of the interaction of different sector indexes, Rand/US Dollar, nominal[14] effective exchange rate and the volatility index to uncover the nature of their relationships. As observed in Table 1, the interaction of the Rand/US Dollar exchange with various sectors is different. The Rand/US Dollar exchange shows a strong and positive correlation with Top40, FINI15, and INDI25 indices but interacts negatively with the RESI20 index. RESI20 consists of tradable firms, mostly in mining and oil gas sectors exporting most of their output earning foreign currency while their costs are mostly Rand denominated; thus they benefited from the depreciation of Rand.

The nominal effective exchange rate index indications are a positive correlation to the index meaning the stronger the Rand, the higher the RESI20 index will get. The appreciation of the rand led to a rise in the nominal index. As expected,

[14] Nominal effective exchange rate, we refer to it only as "nominal", is the trade-weighted average exchange rate index of the rand calculated against twenty currencies of the leading trading partners of South Africa. Index: 2010 = 100.

the nominal exchange rate interacted strongly in the opposite direction with the INDI25, FINI15, and TOP40 indices. Also, the Rand/US Dollar is almost 1:1 negatively correlated to the nominal exchange rate as normal.

The volatility index also has an adverse impact on the movement of the selected indexes. Interestingly, SAVI shows a weak correlation to both the nominal and Rand/US Dollar exchange rates.

The sector-to-sector correlations were interesting to note in that all the selected indices indicate a negative relationship to the RESI20 and the TOP40 is showing the least correlation.

	Rand/Dollar	SAVI	Nominal	ALSH	TOP40	RESI20	INDI25	FINI15
Rand/Dollar	1.00							
SAVI	0.06	1.00						
Nominal	-0.92	-0.03	1.00					
ALSH	0.83	-0.45	-0.84	1.00				
TOP40	0.83	-0.46	-0.84	1.00	1.00			
RESI20	-0.61	-0.38	0.36	-0.23	-0.21	1.00		
INDI25	0.90	-0.34	-0.87	0.98	0.98	-0.40	1.00	
FINI15	0.83	-0.42	-0.77	0.96	0.96	-0.36	0.96	1.00

Table 1: JSE indices, exchange rate level, and the SAVI correlations

1.3 Problem statement

Companies list on the JSE for different reasons, but direct foreign and local share capital investment are the main motives. The JSE is one of the largest and oldest stock exchanges in Africa and globally, serving as a vehicle to facilitate an injection of Foreign Portfolio Investment of the much-needed capital by corporate firms (Frankel, Smit, & Sturzenegger, 2008). Exposure to the exchange rate risk presents a trade and business management problem. The exchange rate volatility has an impact on the worth of the firms' cash flows used for the valuation of companies' stock value (Mlambo et al., 2013). Thus, exchange rate volatility can affect the performance of the stock market, the stability of the firms' stock market returns and consequently the firms' worth.

Recently, Bartram and Bodnar (2012) explained that one of the key issues in international finance is the extent that exchange rate volatility impacts the firms' stock returns. According to Bartram and Bodnar (2012, p. 1) "changes in exchange rates can affect stock returns either by altering firms' expected cash flows or the cost of capital used to discount these cash flows". Moreover, the authors provide empirical evidence that exposure to exchange rate risk conditionally offers significant stock return premia or loss, depending on the level of currency appreciation or depreciation.

The relationship between the stock market and macroeconomic indicators such as rapid changes income, inflation, real interest rates and exchange rate volatility was reported (Ali et al., 2016; Bartram & Bodnar, 2012; Bonga-Bonga, 2013). Demir (2013) argues that the majority of researchers have found that the exchange rate volatility has an economically and statistically significant impact on the firms' profitability, investment flows and trade activity. The challenge for emerging economies is that research mainly focuses on publicly traded firms in developed countries. Moreover, Demir (2013) acknowledged that lack of studies in the developing countries on the impact of exchange rate volatility is surprising, given that the developing countries face higher exchange rate volatilities with stronger adverse consequences on both macroeconomic and on the earnings of firms at the microeconomic level.

Due to the context of the South African emerging economy, its openness, competitive and well developed financial markets, and the world-class stock exchange that is highly liquid and increasingly attracting foreign trade, listed firm's stocks are bound to exposure to the volatility of capital inflow and outflows; thus the exposure of the JSE to the global markets has increased (Muzindutsi & Niyimbanira, 2012).

On the other hand, the Rand gained the status of being one of the highly traded emerging economy currencies globally and its volatility impacts the sectors of the JSE differently. Some sectors of the JSE instantly react while others have a delayed response to the exchange rate volatility and currency shocks (Barr et al., 2007; Muzindutsi & Niyimbanira, 2012).

In practice, researchers use the All Share index as a proxy for the measurement of overall JSE returns, which aggregate the performance of different sectors of the stock market. The practice could obstruct the information on how each sector is affected differently by the underlying variables. This research seeks to find the nature of the relationship between the JSE stock market and the foreign exchange market and if periods of high exchange rate fluctuations impact on the earnings of the listed companies. The aim is to measure the strength of the correlations between the Rand movement and the different sectors of the JSE to determine the level of impact in each segment.

1.3.1 *Main problem*

The Research Problem is to analyse and evaluate how exchange rate fluctuations impact on the earnings of JSE listed firms.

1.3.2 *Sub-problem 1*

The first sub-problem is to determine the nature of the relationship between the JSE stock market and the Rand/US dollar exchange rate.

1.3.3 *Sub-problem 2*

The second sub-problem is to identify the nature of the relationship between the Rand/US dollar and the different sectors of the JSE to determine the level of impact on each sector.

1.4 Significance of the study

This study is significant as it may contribute to the body of available knowledge and provide guidance about the impact of exchange rate fluctuation on the JSE listed firms. Hence, it is important for the business managers and traders to understand how exchange rate volatility affects the stock market to protect against profit loss using hedging instruments.

Several studies have tried to find a correlation of the stock market to international trade, but ambiguity clouds the empirical findings. Researchers attempted to link South African macroeconomic indicators to the stock exchange but there is still a level of ambiguity in their conclusions. Moreover, attempts are continuously made to correlate the macroeconomic indicators to the corporate profits; the intention is to measure firms' exposure to macroeconomic shocks to devise stratagems of protection. The challenge is to isolate information from aggregated proxies such as the All Share index usually used as a performance measure of the stock market.

However, most importantly, foreign investors in search of emerging equities either for high growth or international diversification are impacted by both the exchange rate volatility and uncertainty of the stock returns. Bonga-Bonga (2013) deliberated that for international investors overall, the rate of return for investing in a foreign equity index is the sum of the percent changes in both the equity index and the foreign exchange rate. Therefore, exchange rate fluctuations are critical to inform the decisions of foreign investors about the expected returns, trading and hedging strategies (Bonga-Bonga, 2013).

With an increased openness of the South African economy, a growing community of international investors in the stock market and the increasing foreign portfolio investment capital flows, volatility in exchange rate markets and equity markets is apparent (Barr et al., 2007). The financial regulators, policy makers, financial institutions and the JSE, cannot afford to ignore the impact of volatility spillovers into the markets. Moreover, these stakeholders need to stay a step ahead and understand how volatility spillovers initiate, their causality, their level of association and impact on various sectors of the markets. Hence, to avoid embarrassing incidents such the current case against 17 foreign and domestic banks colluding on manipulation of forex trade to fix the price of the Rand value. These are some of the negative consequences brought by high levels of economic openness, free-floating currency and less restrictive exchange rate policies as pointed out by LiPuma and Koelble (2009).

There is also a possible policy implication to motivate lawmakers to develop policies that will seek to reduce the volatility of the exchange rate and promote

competitive exchange rates to ensure the export firms remain relatively viable (Khosa, Botha, & Pretorius, 2015). However, Ali et al. (2016) caution policy makers against such decisions as their empirical evidence revealed a firm correlation of macroeconomic variables to the stock market. The ambiguity that surrounds the impact of exchange rate volatility, either at the firm or macroeconomic level, provides sufficient motivation to investigate the subject further and provide empirical evidence that will improve the quality of information available to decision makers and add to the body of available knowledge.

1.5 Delimitations of the study

The scope of the research is limited to four JSE indices, the All Share index, Top40, RESI20, FINI15 and INDI25 indices. Therefore, no attempt was made to include other indices of the JSE on this study.

We only utilise the Rand/US Dollar exchange rate fluctuations for the analysis of currency changes exposure on the JSE over the past 10-year period that includes 2006 to 2016.

Moreover, this study focuses on the exchange rate – share price correlation evaluation and the exchange rate – share price causality analysis that is part of the subset in the research field of exchange rate risk exposure.

The literature available in the area of currency exchange rate exposure is enormous; thus the literature review was based on leading articles regularly utilised by prominent researchers and recent innovative papers.

Other macroeconomic and qualitative factors that may impact significantly on the country's competitiveness such as infrastructure, labour market policies, skills and health quality which may influence the country's macroeconomic stability, productivity and competitiveness, for instance, were also not included in the scope of this study.

1.6 Definition of terms

This report has inferred stock price and exchange rate fluctuations or movements as volatility. According to the Oxford Dictionary (2014, p. 1723), volatility is a noun derived from volatile which mean “likely to change suddenly, liable to change rapidly and unpredictability, especially for the worst”. However, in the context of finance, Brooks (2008, p. 383) describes volatility as a “crude measure of the total risk of financial asset”, and that volatility is determined by the standard deviation or variance of the returns.

A flexible exchange rate is a rate of currency exchange based on global supply or demand of that currency by traders (Frankel, 1999).

Future market is a market where currencies are purchased and sold at current prices but only to be supplied in future at specified dates (Jaffe, Westerfield, & Ross, 2004).

Hedging is a process where buyers and sellers protect themselves against changes in future prices (Brealey, Myers, Allen, & Mohanty, 2012)

1.7 Assumptions

Key assumptions made in this study are:

- Exchange rates from the South African Reserve Bank - SARB are without error.
- The JSE data downloaded from Bloomberg is free of errors.

CHAPTER 2. CONCEPTS AND EMPIRICAL EVIDENCE

This section discusses the conceptual framework that anchors this study. The review includes both theoretical and empirical literature in an attempt to understand the real determinants and connections that link macroeconomic factors, especially the exchange rate fluctuation to the returns of the stock market and its sectors. The objective of the theoretical review is to draw and formulate, from the existing theoretical concepts and empirical evidence, a foundation and research design for this study. Research framework and application by other researchers is explored in detail to design a way forward to synthesise resolution to the research questions discussed in Chapter 1.

2.1 Theoretical review

Unpredictable currency movements may result in unpredictable financial performance at a firm level and the returns to the stock market (Bartram & Bodnar, 2012). This uncertainty on the stock market returns may also be explained within the context of international trade amongst import and export firms, which give rise to three scenarios regarding exchange rate volatility. First, is that the exchange rate volatility has a negative impact on the volume of trade or daily returns (Adjasi, Biekpe, & Osei, 2011; Mlambo et al., 2013). The second view is that it has no impact on the daily earnings or export - import trade. Last, is that exchange rate volatility has a positive impact on the daily returns (Ali et al., 2016; Khosa et al., 2015; Mlambo et al., 2013). The next subsection further discusses the elements of these theories in depth.

Closely related to the response behaviour of investors and traders during periods of uncertainty in the markets is the Flow oriented model, which is essentially how investors and traders view the domestic market competitiveness and attractiveness relative to other international markets (Mlambo et al., 2013). At the firm level, the exchange rate volatility influences the input costs of production and the output prices which impact on the overall profitability (Mlambo et al., 2013). At a stock market perspective, currency volatility influences the risk premia expected by investors as the exchange rate

fluctuation is a source of time-variation in currency risk premia (Bartram & Bodnar, 2012).The risk premia is the difference between the expected stock return and the risk-free interest rate, and the argument is that it must be higher than the risk-free investment for carrying risk (Engle, Lilien, & Robins, 1987). The details of the Flow oriented model and its link to the export market and stock market are discussed in the next subsection.

According to Mlambo et al. (2013), both the Flow orientated models, and the response behaviour of traders' suffer some limitations about the influence of global capital flows on exchange rate volatility. The inward and outward flows of FPI influence the exchange rates determinations thus a stock orientated model also is considered as it influences the stock value of firms (Mlambo et al., 2013). Arbitrage pricing theory links the stock market performance with the macroeconomic indicators such as the volatility of exports, interest rates, money supply and total manufacturing output as described by Mlambo et al. (2013).

Alagidede, Panagiotidis, and Zhang (2011) provide a clear framework or explanation of how the Flow and Stock – orientated models and their subsets, the portfolio balance and monetary models are used to describe the causality link between foreign exchange markets and the equity markets.

The following subsection discusses the theories above in detail about how exchange rate fluctuation influences the stock market returns of listed firms.

2.1.1 *Classic economic theory*

First scenario: negative effect of exchange rate volatility on the market returns and profitability of firms

From views of Adjasi et al. (2011), reforms in African countries that mostly happened in the early 1990's led by the globalisation of emerging economies through democratisation increased the openness of equity markets, liberalisation of capital accounts and free-floating of currency regimes. Moreover, it resulted in increased volatility of the developing economies currencies and stock market prices. High exchange rate volatility creates

uncertainty at the stock exchange and at the firms' level as it leads to uncertainty of the profit or loss to be realised, which will result in the reduction of the benefits of international trade to firms and investors (Ozturk, 2006). According to Khosa et al. (2015), during uncertainty periods, risk averse traders, investors and companies will seek to reduce any exposure to profit losses induced by exchange rates volatility as their main objective is to maximise profit. Khosa et al. (2015) further explained that in the absence of hedging instruments, the traders and firms would adjust their trading activities. Moreover, as Ozturk (2006) noted that businesses and exporters would reduce their output level, reducing their potential profits and domestic companies will be discouraged from expanding into foreign markets. If the cost entry and exit barriers to trade are low and the severity of volatility increases, then corporations and traders will easily stop trading and leave the market (Franke, 1991). Therefore, exchange rate fluctuation will negatively affect the returns in the stock market and profitability at the firm level (Clark, 1973; Khosa et al., 2015).

In addition, Adjasi et al. (2011)'s view on describing the association between the exchange rate fluctuations and stock market returns in the environment of export and import firms is that depreciation of the domestic currency largely benefits the domestic dominant exporting firms. Devaluation of local currency may cause the products of the local exporters to be more competitive in the international markets which will increase the firms' financial performance and its stock price. Conversely, heavily importing firms will suffer from the depreciation of the domestic currency as the imports will get more expensive, reducing the company's financial performance and its stock price (Adjasi et al., 2011).

Second scenario: positive effect of exchange rate volatility on the stock market returns and profitability of firms

The second scenario contravenes the overhead view; primarily it is based on the risk appetite behaviour of the investors and companies that believe in high-risk - high-returns principles, with the assumption that no hedging facilities are available (Khosa et al., 2015). The logic of the principle is anchored on the belief that if the exchange rates are highly unpredictable, firms and investors will

increase their trading volumes to benefit from current profits in the short term to make up for possible losses or reduced profits in future. Thus, the increased trade is assumed to positively influence the cash flows of the firm thus improving its stock price. The other view on the same scenario is that “highly risk adverse firms will increase their output and trade to maximise profits in an attempt to make up for possible profit loss in future should the anticipated future volatility persist” (Khosa et al., 2015, p. 2).

The two scenarios above still do not clarify accurately how the trade will be affected during periods of high exchange rate volatility. However, Bailey, Tavlas, and Ulan (1987, p. 230) proposed that “variability of an exchange rate may either deter bilateral trade or may stimulate it”. Empirical evidence has been provided that shows a positive correlation between exchange rate volatility and international trade that positively influences stock price returns due to the expected improvement of future cash flows at the firm level (Bailey et al., 1987; Franke, 1991).

Third scenario: exchange rate volatility bearing no effect on the market returns and profitability of firms

The third scenario contradicts the diverged, positive and the negative, correlation scenarios. It presents exchange rate volatility having no effect on the stock returns and profitability of trading and firms. According to Khosa et al. (2015), the lack of impact of exchange rate volatility on international trade is dominant in countries with hedging facilities. Contracts are concluded at agreed exchange levels payable on delivery in future; any exchange rate movement should not affect the already fixed price and volume of goods to be delivered (Khosa et al., 2015).

He and Ng (1998) presented empirical evidence of Japanese firms that utilise both operational hedges and financial hedges are less exposed to exchange rate volatility. Furthermore, recently, a comprehensive research at the enterprise level was conducted on Japanese exporting firms. The study indicated a combination of several risk management tools such as both operational and financial hedging, the ratio of foreign sales and the choice of

currency invoicing were used to mitigate the risk posed by exchange rate volatility on the profitability (Ito, Koibuchi, Sato, & Shimizu, 2016).

Also, this is a sector that is largely export driven as the resources are composed of firms that incur their cost locally in Rand's but earn most of their revenue in hard currency – US Dollars and Euro. Thus, this sector benefits from the depreciation of the Rand (Muzindutsi & Niyimbanira, 2012). An increase of listing exporting resources based firms in the stock markets is promoted that these companies can assist developing economies to supplementary hedge against exchange rate exposure (Adjasi et al., 2011). Resource-based stock or index such as RESI20 representing the resources sector can provide a Rand hedge. Therefore it is important to understand how the RESI20 interacts with exchange rate fluctuations (Adjasi et al., 2011; Barr et al., 2007).

2.1.2 *Flow orientated model*

The flow-orientated model is grounded on the principle that there is a causal relationship between the movement of exchange rates and the stock prices. Mlambo et al. (2013) described that exchange rate volatility affects the profitability and competitiveness of firms as it impacts the input costs and output prices. Additionally, Adjasi, Harvey, and Agyapong (2008) explained the appreciation of the domestic currency will cause the export goods and services to be expensive on the international market, thus exporting firms will experience reduced profits and competitiveness. The loss of profitability will lead to the loss of attractiveness on the domestic stock market, which may result in a decrease in trading volumes, resulting in lower market daily returns and lower firm's value. As a result, Mlambo et al. (2013) imply, a negative correlation exists between exchange rate volatility and the company's value as suggested earlier.

Also, Alagidede et al. (2011) adopted both the Flow – and the Stock – orientated frameworks while investigating whether the equity markets and the foreign exchange markets are interrelated and if they are, what would be the status of the direction of their association. The authors used concepts from Dornbusch and Fischer (1980) to describe the Flow – orientated framework as models based on the assumption that both the current account and the trade

balance performance of a country are significant factors that determine exchange rates. Thus the nominal exchange rates and stock prices are directly associated.

2.1.3 *Stock orientated model*

The stock – orientated model emphasises the importance of typically large capital flow into the country's financial account and its effect on exchange rate volatility (Fischer, 2008). These models are also pronounced to be most important to the country's capital account as a significant exchange rate determinant (Alagidede et al., 2011). The impact on the financial account by financial capital inflows and outflows into bonds and stocks, impacts on the movement of the exchange rates (Adjasi et al., 2008). According to Adjasi et al. (2008) for example, if the domestic currency depreciates against a foreign currency, it will increase the returns on the foreign exchange, motivating investors to move funds away from the domestic stock towards the foreign stock. Therefore the movement of share prices may influence or be influenced by the exchange rate volatility and level (Adjasi et al., 2008).

The concept of the significance of risk and variation of the returns has been long established, and it forms the basis for asset pricing model (Fama & French, 1992). Engle et al. (1987, p. 392) investigated the relationship between the required returns for holding risky assets and explained that "the risk is measured by the variance of the returns from holding the asset, and compensation by a rise in the expectation of the return". The authors' investigations led to a design of ARCH-M, termed an autoregressive conditional heteroscedasticity model that allowed a conditional variance to adjust the mean, correlating the forecast of returns with risk premia.

2.1.4 *Arbitrage pricing theory*

Madura (2011) informally defines arbitrage as an act of taking advantage of misaligned quoted prices by making a riskless profit. The arbitrage pricing theory - APT - maintains that the value of the company anchors on the present

value of the company's future discounted cash flows, and it depends on the real interest rates. For example, "an increase in real interest rates will decrease firm's future cash flows and cause the corporation's stock price to fall" (Mlambo et al., 2013, p. 563). As noted by Mlambo et al. (2013), the APT is grounded from macroeconomic and financial indicators such as interest rates, risk premia, yield curve, inflation, productivity, money supply, exchange rate level and exchange rate volatility, to mention a few variables. Therefore, the model is widely employed to determine the effect of macroeconomic indicators such as exchange rate volatility on the stock market (Ali et al., 2016; Mlambo et al., 2013; Phiri, 2017). Humpe and Macmillan (2009) simply describe the APT theory as a combination of risk factors that can explain the asset returns. Using ATP theory, the association between individual or aggregate stock market returns is linked to the position or state of macroeconomic variables. Which is achieved by determining "a short-run relationship between macroeconomic variables and the stock price with regards to the first differences, assuming trend stationarity" (Humpe & Macmillan, 2009, p. 111). The existence of such links has prodded researchers to investigate further to find out "what-causes-what". Thus some investigations seek to uncover and understand the nature of causality between macroeconomic factors and stock market prices.

2.1.5 *Causality relationship between exchange rates and stock prices*

According to Granger, Huangb, and Yang (2000), the causal connection between the stock returns and exchange rate variations anchors on two ideologies known as the traditional or monetary approach and the portfolio balance approach. The portfolio balance and the monetary models are classified as the subsets of the Stock – orientated model (Alagidede et al., 2011).

The traditional approach focuses inwardly from the MNC economic exposure where the uncertainty due to exchange rates influences the competitiveness of the firm leading to alteration of its economic value; thus the exchange rate uncertainty leads the stock price change with a positive correlation (Granger et al., 2000; Kisaka & Mwasaru, 2012). Furthermore, the traditional

macroeconomic frameworks of the foreign exchange rate determination are categorised as a monetarist approach, which puts the main emphasis on the medium to long-run foreign exchange rate determination (Kodongo & Ojah, 2012). Adopted from Gavin (1989) by Alagidede et al. (2011), the monetary models emphasised the absence of an association between the stock prices and the exchange rates but acknowledged that similar macroeconomic factors impact both variables. Nevertheless, this approach has not performed well in providing empirical evidence, according to Kodongo and Ojah (2012).

The second idea anchors on the portfolio balance approach in which the stock prices stimulate the exchange rates variation through portfolio adjustments (Kisaka & Mwasaru, 2012). According to Granger et al. (2000), since the capital markets are highly integrated, a fall of stock prices can lead to a decrease in the capital of local investors that will cause the demand for money to decrease pushing interest rates lower. The result of lower interest rates will likely lead to capital outflow, in search of competitive investments, ceteris paribus, resulting in domestic currency depreciation. Therefore, the portfolio approach is characterised by the negative correlation of the stock price that leads exchange rate changes (Granger et al., 2000).

As supported by Bartram and Bodnar (2012), the firm's exposure to the volatility of exchange rates can alter the economic value of the company by changing its future discounted cash flows used in firm worth valuations. Kisaka and Mwasaru (2012) explain that the freely floating exchange rates convey transactional and economic exposure to firms. The transactional exposure is said to arise from the sensitivity to gains or losses related to the future settlement of investments and contracts expressed in the foreign exchange rate. Economic exposure is due to uncertainty in the discounted cash flows caused by exchange rate volatility, thus the exchange rate uncertainty impact on the risk exposure and the earnings of the firm, affecting the worth of the company (Choi & Prasad, 1995; Kisaka & Mwasaru, 2012). In addition, Choi and Prasad (1995) describe the sensitivity of a firm to translational, transactional and economic exposure brought by the impact of exchange rate volatility on its operating cash flows and

say that this will not affect various firms' value and stock returns in a similar manner.

Also, Alagidede et al. (2011) describe the portfolio balance framework from the concepts of Branson (1981), that suggests a rise in stock market prices leads to an increase in the country's interests rates which will drive the domestic currency to depreciate. Therefore, shocks from the direction of the stock market to the foreign exchange markets will lead to exchange rates and stock markets to move in opposite directions.

Kodongo and Ojah (2012) explain that failures of the traditional approach or the macro-based models in defining exchange rate fluctuations led to the development of the market microstructure theory. In an attempt to develop the empirical evidence and the connection between the foreign currency markets and foreign exchange rate fluctuations, the microstructure approach focuses on the short-run in foreign exchange order flow to estimate the exchange rate fluctuations (Kodongo & Ojah, 2012). The order flow is a measure of buying or selling pressure based on the net of buying and selling-initiated orders (Kodongo & Ojah, 2012). In other words, the stock market prices and exchange rates are influenced concurrently by the perceptions of future macro variables driven through the order flow channel by the available news to the markets (Kodongo & Ojah, 2012). Therefore, the foreign exchange order flow is linked to endogenous portfolio flows hence the exchange rate dynamics are grounded mainly in the financial market structure than on the traditional macroeconomics determinants (Kodongo & Ojah, 2012).

2.2 South African outlook and the external factors affecting JSE returns

The subsections below briefly describe how the macroeconomic factors are related to the exchange rates. We start with a short background of the Rand in paragraph 2.21. The subsequent paragraphs discuss the inflation rate,

economic activity and the money supply which are part of the determinants of stock market prices.

2.2.1 *Background of the Rand*

South Africa has a long history of mitigating against exchange rates volatility as it has used fixed currency regimes and dual exchange rate regimes since 1960's (Mtonga, 2011). South Africa changed its currency in 1961 to commercial rand and cents, after using probably a currency board that is British pound sterling and shillings for many years, subsequent to the Union of South Africa in 1910 as a British colony. From 1961 to 1979, the Rand was fixed against either US dollar or British pound at different intervals. Fixed exchange rates were anchored on a strict foreign exchange control policy that limited capital transactions of both residents and foreigners for stability (Mtonga, 2011).

Mtonga (2011) described the commercial Rand as the prime floating rate with which all residents transacted, and it was under the monetary intervention policy by the South African Reserve Bank, while the financial rand floated freely. After the democratically elected government had taken over, dual exchange regimes were unified to form a single managed float regime in 1995. Swanepoel (2004) affirmed when economic sanctions ended; South Africa re-entered the global economy, thus the need to liberate financial markets, open the economy, remove trade barriers, and to free-float the Rand was a paramount subject. However, the Reserve Bank continued with exchange rate interventions to protect the Rand from depreciating (Swanepoel, 2004).

Eventually, in 2000 the Reserve Bank implemented a free-floating exchange rate regime with inflation targeting monetary policy, thus ending formal direct intervention in the exchange rate market (Mtonga, 2011).

The Rand had since experienced several shocks after the new government took over. In 1996, the Rand lost 20% against the US dollar, further 20 to 25% was lost in 1998 and in 2001 it traded at almost R14 against the dollar (Mtonga, 2011). It then appreciated sharply in 2003 where it traded below R6 against the dollar. Other events or shocks experienced in 2008 were due to the subprime

mortgage crisis in the USA; and in 2012 during the socio-political Marikana crisis (Schaling, Ndlovu, & Alagidede, 2014). It is for this reason; the study period selected stretches from January 2006 to December 2016 in an attempt to cover the recent exchange rate shocks.

Unfortunately, the impact of the well-intended decision to free-float the Rand brought high exchange rate volatility and continued long term devaluation of the rand (Mtonga, 2011). Muzindutsi and Niyimbanira (2012) concurred with that view and explained that the consequences of domestic currency volatility are the exchange rate risk premia payable to investors for holding assets exposed to exchange rate risk, also that the exchange rate volatility has increased because many countries have adapted free-floating exchange rate regimes. Inflation increased as prices of imports and oil drastically increased which may have impacted negatively on the growth of the economy, especially in the manufacturing sector (Frankel et al., 2008).

2.2.2 *Inflation rate*

A rise in the inflation rate is more likely to cause the policy makers to tighten policies by possibly increasing interest rates. The increase in interest rates will lead to an increase in discount rates used in firm valuations. Therefore, the increase in inflation rate leads to a decrease in the stock value of a firm (Ali et al., 2016). Phiri (2017) investigated the impact of inflation on the JSE returns and confirmed a negative correlation between the two variables. Empirical evidence based on the South African context was provided to prove one of the oldest theories that during the economic slowdown firms opt to sell financial stocks thus there is an inverse relationship between inflation and share prices. Earlier, Fama (1981) explained that the inverse stock returns-inflation correlation is the influence of both money demand and quantity of money theories, which describe that inflation will decrease as the real activity in the economy increases.

2.2.3 *Economic activity*

Fama (1981) elaborated how he studied and linked the stock returns to real macroeconomic variables that include inflation, capital expenditure and economic output that is GDP; and he found correlations that led him to propose to combine forecast models. Nevertheless, Estrella and Hardouvelis (1991) commented on how Fama and colleagues used the economic activity term, but that term was never fully defined. The real economic activity of a country is described as a measure of the consumption of both durables and nondurables, services and investments as it is composed of the total market value of aggregated goods and services produced (Estrella & Hardouvelis, 1991). The measure is known as gross national product or gross domestic product GDP in South African context. However, Ali et al. (2016) defended their use of industrial production to measure the real economic activity because the productive capacities of the country relate to its ability to accumulate real assets, which enable firms to generate cash flows. Furthermore, the authors argue that their practice is in line with the parameters used by Humpe and Macmillan (2009). Ali et al. (2016) described the industrial production index as an indicator of real output that is correlated positively to the stock price.

2.2.4 *Money supply*

An increase in the rate of the money supply will cause an increase in liquidity that will result in the upward movement of stock prices. The accepted wisdom supports the theory that excess in the money supply will create growing demand for stock from investors (Ali et al., 2016). Furthermore, Humpe and Macmillan (2009) describe that the influence of money supply may have a positive impact on the share price as a result of increased economic activity, strongly supporting the view above. Moreover, money supply is correlated negatively to the share price, through the law of demand, and changes in the rate of the money supply may be indicative of an unanticipated increase in inflation and future economic uncertainty (Humpe & Macmillan, 2009).

2.3 Empirical studies

In this subsection, we focus on the empirical evidence provided by several researchers. Section 2.3.1 expands on the exchange rate effect at the firm level, where researchers describe how foreign exchange rates impact the decisions of businesses on production, sales, pricing strategy, and financial operations. In section 2.3.2 we discuss finding from other researchers on the relationship of the exchange rate, macroeconomic variables, and the stock market. Lastly, in subsection 2.3.3, we show reports on the causality evidence between various stock market prices and the exchange rates with the main focus on the methods used by researchers.

2.3.1 *Impact of the exchange rate at a firm level*

As Mlambo et al. (2013) explain, the exchange rate risk is crucial to managers of internationally trading enterprises and listed companies as it influences the worth of the organisations and their stock returns. Earlier, Jorion (1990) provided evidence that exchange rate exposure impacted the US MNC's stock prices differently. The movement of the US dollar exchange rate was found to be associated positively with the fluctuation of the US MNC's stock prices. This co-movement, determined by the coefficient between the changes in the firm value and the exchange rate, was measured utilising regression methods (Jorion, 1990). Findings showed a low correlation of the exchange rate exposure to the US oil MNC's with foreign operations, which was contrary to non-oil MNC's. Locally based firms in foreign countries were also affected by the existing exposure between the stock price and the exchange rates (Jorion, 1990).

Gao (2000) studied the effects of exchange rate volatility on the profitability or stock returns of multinational companies and focused on two channels which are affected by the exchange rate news or changes, described as foreign sales and foreign production at a firm level. Some constraints of this framework are the unavailability of microdata from the companies that detail hedging strategies against the exchange rate volatility thus changing currency volatility impact on

the profitability. Gao (2000) remarked that the effect of exchange rate volatility on the profitability of firms could influence macroeconomic theory and policy. Moreover, the exchange rate volatility can also influence the decisions of businesses on production, sales, pricing strategy, and financial operations.

The findings were incongruent with the theory that the impact of unexpected exchange rate volatility on share prices is significant, thus the firms will make a profit from the depreciation of domestic currency (Gao, 2000).

Gao (2000) proposed an empirical theory, which suggests that sudden devaluation of the domestic exchange rate will lead to a profit proportional to the firm's portion of foreign sales, and a loss proportional to the company's portion of production in foreign operations. The overall impact of exchange rate news is the residual effect from the sum of the two opposing effects (Gao, 2000).

2.3.2 *Exchange rate impact on the macroeconomic variables and the JSE*

Ali et al. (2016) showed the association between South African stock market prices and macroeconomic variables such as exchange rate, industrial production, inflation and money supply, empirically. Vector error-correction model – VECM framework was employed to avoid an irrational t-test, and f-tests that assume that variables used are non-stationary, which is fundamental to regression analysis (Ali et al., 2016).

Ali et al. (2016)'s findings from variance decompositions revealed industrial production as a leading indicator as an exogenous variable that can explain 97 percent of its shocks. The second leading indicator was the money supply also with the able to explain 97 percent of its own shocks. The finding on the money supply is believed to be in line with the theory that access to money increases demand for shares thus pushes stock prices up. Surprisingly, the JSE stock market can only explain 91 percent of its own shocks. The exchange rate is 32 percent correlated to the shocks from the stock exchange, and the direction of the association is positive (Ali et al., 2016). A word of caution was made to

policy makers that changes in policy linked to macroeconomic variables will affect the stock market prices (Ali et al., 2016).

On the contrary, Mlambo et al. (2013) used the GARCH model to establish the nature and strength of association between exchange rate volatility and the JSE stock market. Variables included total mining production, United States interest rates, domestic interest rates, money supply, and Rand/USD volatility. The established correlations were feeble between the stock market movement and the macroeconomic variables. The nature of the correlation between exchange rate volatility and the stock market was significant and positive. Furthermore, a one percent point increase in Rand/USD volatility would increase the market capitalisation by 0.004 percent points. However, the established correlation between the rate of money supply and the JSE stock market was negative.

2.3.3 *Causal relationship between the exchange rate and the stock markets*

Alagidede et al. (2011) examined the causal linkage nature in developed economies from 1992 to 2005. Their sample included Japan, Australia, Canada, UK, and Switzerland. The authors utilised three formats of the Granger causality test, the standard Granger causality test using Vector Autoregressive – VAR framework, Granger causality test using unequal lag length, and the Hsiao type Granger causality test. Alagidede et al. (2011) also point out that the empirical evidence is ambiguous which may be due to different methods and datasets used. The other observation was that less causal linkages are more common in emerging economies than in the developed ones. Three tests yielded qualitatively similar findings, as the causal association's path in the UK, Canada, and Switzerland was from the foreign exchange rate to the stock markets prices following the Flow – oriented models. However, the Hsiao type test revealed a causal link for Switzerland from the stock exchange to the exchange rates. Therefore, indeed Alagidede et al. (2011) provided evidence that various methods can provide different causality results, which further fills the empirical evidence with ambiguity.

Bartram and Bodnar (2012) investigated the effect of exchange rate exposure on the stock returns of non-financial firms from 37 emerging and developed economies. They illustrate through conditioning on the exchange rate variation; significant stock return premia directly correlate to the direction of change in the exchange rate at a firm level. They explain that the company's stock returns should increase with depreciating the domestic currency and the opposite should be true for the appreciating local currency, in an enterprise that is positively exposed to exchange rates. The standard regression and time series methodologies were utilised to estimate exposure coefficients that represent the company's value sensitivity to the exchange rate factor and finally the corporation's monthly return premia (Bartram & Bodnar, 2012).

Bartram and Bodnar (2012)'s findings show firms in the emerging markets can benefit up to 8% on annualised returns per unit of exposure to the domestic currency devaluation and companies in developed markets can profit up to 2.3%. Conversely, companies in the emerging markets would lose -5.5% on annualised returns per unit of exposure to the local currency appreciation while the enterprises of the developed countries will experience a small insignificant loss. In short, Bartram and Bodnar (2012) show evidence that exchange rate volatility has a significant and larger impact on the stock returns of emerging markets firms than the developed countries, but yet there is insufficient research carried out in the emerging markets to understand this impact.

Kisaka and Mwasaru (2012) investigated a causal relationship between the stock prices and exchange rates in Kenya. The motivation of their study was to scrutinise the predictability of stock prices and exchange rates on the Nairobi Securities Exchange – NSE. During that period, the government of Kenya was committed to economic openness, to liberalise the monetary regime by freely floating currency to improve trading on the NSE to global standards (Kisaka & Mwasaru, 2012). The authors used the bivariate vector autoregressive model – BVAR for hypothesis testing. Kisaka and Mwasaru (2012) found a unidirectional causality from the exchange rates to stock prices. Implications of the findings mean the sudden movement of exchange rates can cause sharp volatility of stock prices that can lead to a panic, driving portfolio managers to sell stocks in

an attempt to lower losses. High volatility will cause uncertainty in the stock market thus making it difficult for investors to protect their investments on the NSE because the derivative instruments were not available to facilitate hedging, at the time of publication (Kisaka & Mwasaru, 2012). Other stakeholders impacted include investors, financial institutions, financial regulators and listed companies (Kisaka & Mwasaru, 2012).

Kodongo and Ojah (2012) investigated the link between international portfolio flows and the real foreign exchange rates in the African context utilising the Granger causality framework as well. Their study utilises monthly data for the period of 1997 to 2009 on the sample that included South Africa, Nigeria, Egypt, and Morocco. The authors used alternative VAR conditions to demonstrate that the dynamic nexus between the portfolio flows and the foreign exchange rates is time-varying and country dependent. It is important to note that the authors were also interested in uncovering if the international investors were after the "hot money" in African stock markets, thus inducing high volatility as they enter the markets for relatively short periods. Hot money is capital inflows made to benefit from temporary abnormalities from parity disorders (Kodongo & Ojah, 2012).

Kodongo and Ojah (2012)'s findings revealed that high volatility characterised African stock markets and low persistence of international portfolio flows, meaning that a high level of volatility is induced by international or foreign investors most probably after the "hot money". Causality between the exchange rates and the portfolio flows were time varying and country specific, which are attributes due to the openness, accessibility, and attractiveness of specific stock and financial markets to international investors.

Also, Bonga-Bonga (2013) utilised a similar approach using the generalised impulse response function from the bivariate VAR model to evaluate the effect of volatility shocks transmitted between the equity market and the foreign exchange market on the JSE. The investigation uses the Rand-Dollar exchange rate and JSE All Share index weekly data from July 1995 to October. The findings show foreign exchange conditional volatility reacts positively to volatility shocks to All Share returns or equity market and the reaction of the equity

market conditional volatility shocks to the exchange rate is short-lived and thus statistically insignificant (Bonga-Bonga, 2013). As Bonga-Bonga (2013) explains, the finding indicates high volatility in equity stocks signals mounting stock market risk that leads or scares off the foreign investors to wholesale the equity stocks and move their funds to relatively secure and stable markets.

JSE has a significant portion of foreign traders, thus major selloffs of this nature are disruptive to the financial portfolio investment as they may cause significant capital outflow that leads to the volatility of the exchange rate as investors convert their capital back to international currencies to exit the market (Bonga-Bonga, 2013). Furthermore, the author suggests that significant capital outflows due to diffusion of volatility from the stock exchange to the forex market have influenced most emerging economies to adopt exchange rate control policies.

Exchange rate risk premia can be attached to asset prices to compensate for the exchange rate risk exposure (Muzindutsi & Niyimbanira, 2012). Muzindutsi and Niyimbanira (2012) examined the exchange rate impact and the pricing of the incorporated unconditional exchange rate risk premia to compensate for the exchange rate exposure, on the JSE Top40 firms. The study uses a two-factor arbitrage-pricing model for the investigation covering monthly data from 1995 to 2007. Constituents of the JSE Top40 firms were classified based on the location where they earned the majority of revenues to their cost bases, domestic or foreign. Thus, Non-Tradable is companies that earn the majority revenue and incur costs locally. Tradable companies are firms that generate most foreign currency-based income and experience cost locally, or in foreign currency. Lastly, mixed companies are those enterprises that earn revenues in foreign and local currency (Muzindutsi & Niyimbanira, 2012).

Muzindutsi and Niyimbanira (2012)'s findings revealed that Tradable firms were mostly in the mining sector, exporting most of their output and therefore are exposed to exchange rates positively, meaning they benefitted from the depreciation of the Rand. On the contrary, Non-Tradable companies negatively correlate to the exchange rates and tend to be negatively affected by the depreciation of the Rand. The exposure of mixed companies' category was as ambiguous as the exchange rate correlation coefficient was negative behaving

like the non-Tradable class but more than 50% of the firms showed statistically insignificant correlations, meaning this category has a diversity of dual earnings nature of mixed firms, such that the average impact of the exchange rate exposure on the category cancels (Muzindutsi & Niyimbanira, 2012).

Muzindutsi and Niyimbanira (2012) deduced that the JSE Top40 was negatively correlated to exchange rate volatility and acknowledged the level of difficulty brought about by the aggregation of various share volatilities, which was also observed by Barr et al. (2007). The unconditional premia incorporated for the exchange rate risk exposure was found to be significant at 2.2% per month, which is not diversifiable hence investors are advised to earn premia for their exchange rate risk exposure that impacts on discounted future earnings of the firms (Muzindutsi & Niyimbanira, 2012).

To summarise, much ambiguity exists in both theoretical and empirical literature on a subject of the exchange rates and stock markets relationship. The exchange rate dynamics are grounded mainly in the financial market structure rather than on the traditional macroeconomics determinants (Kodongo & Ojah, 2012).

Therefore, given the context in chapter 1 and supported by the theoretical models we have discussed, the JSE is more likely to be attractive to foreign portfolio investors seeking international diversification of financial assets making it inherent to stock price fluctuations (Bonga-Bonga, 2013). Moreover, the South African financial market is more likely to be impacted by the causal relationship than to follow the Portfolio model which defines the causal link of shocks from the stock market prices to the exchange rates markets.

Thus this study seeks to uncover if there are any hidden causality linkages within the sectors of the JSE. Should such linkages be found, their nature and strength will be determined.

2.4 First sub-problem

We have deliberated on the lack of clarity within both the literature and empirical evidence regarding the relationship between exchange rate fluctuations and the returns of companies on the stock market. Ali et al. (2016) acknowledged that there are conflicting and confusing views and results. The authors described the classical economic theory which views the nexus between the exchange rates and stock markets as negative. On the contrary, Ali et al. (2016) reported that the JSE has a positive association with the exchange rates, supporting the theories that claim that appreciation in domestic currency attracts investment and causes the stock prices to rise.

The uncertainty of this relationship may lead to inadequate planning, over expenditure on international project costs by firms and sub-standard economic policies by the government. The purpose of this research is to find out the nature of the relationship between the JSE stock market and the foreign exchange market and if periods of high exchange rate fluctuation impacts on the earnings of the listed companies.

The first sub-problem is to determine the nature of the relationship between the JSE stock market and the Rand/US dollar exchange rate.

2.4.1 *The JSE link to the Rand/US Dollar exchange rate fluctuations*

In previous sections, we discussed the context of the South African developing economy, its openness, competitive and well developed financial markets, and the world-class stock exchange that is highly liquid and increasingly attracting foreign trade. We have also explained how the exposure to the volatility of capital inflow and outflows impact on listed firms' stock prices. Also, Muzindutsi and Niyimbanira (2012) concur that South Africa and the JSE is increasingly vulnerable to the global markets movements experiencing increasing foreign portfolio trades. The Rand is also one of the highly traded emerging economy currencies globally, and its volatility or the currency shocks impact the various

sectors of the JSE differently (Barr et al., 2007; Bonga-Bonga, 2013; Muzindutsi & Niyimbanira, 2012).

Regarding the context above and given the dynamic nature of the exchange rate movements and the stock market price fluctuations, it is often unclear how these variables affect each other. It is important to understand this impact as it influences the decisions of listed firms stock market traders and policy makers. It is then logical to question if the periods of high volatility reduce or increase the returns on the JSE equity markets. Therefore, correlation strength between the Rand/US dollar exchange rate fluctuations or volatility and the earnings of JSE All Share index is measured.

2.4.2 *Hypothesis 1*

H_{01}: There is no significant correlation relationship between the Rand/US dollar exchange rate fluctuations and the returns of JSE Top 40, Industrial 25, Resources 10, and Financial 15 indexes.

2.5 Second sub-problem

Do investors move their capital to some areas of the stock market during periods of high volatility; does the exchange rate fluctuation affect sectors of the JSE differently, and what is the direction of the relationship if it exists? The hypothesis seeks to uncover if sectors of the JSE are affected differently.

It is also a common practice for the researchers to use the JSE All Share index or the Top 40 as the general proxy for the performance of the stock market (Ali et al., 2016; Mlambo et al., 2013). There could be unrevealed sector specific information. The interaction between the exchange rate fluctuation and the index earnings of specific JSE sectors could be different at various volatility periods. Do traders exit certain high risk or exposed JSE sectors and reinvest in risk averse sectors. Thus, does utilising the aggregate JSE All Share index as a proxy for the JSE performance lead different researchers to mixed outcomes?

The second sub-problem is to identify the nature of the relationship between the Rand/US dollar and the various sectors of the JSE to determine the level of impact on each sector.

2.5.1 *Is the impact of currency volatility similar in various JSE sectors*

Bartram and Bodnar (2012) observed that exchange rate fluctuations affected stock returns of few non-financial firms, an observation that motivated them to research the topic whether the cause was systematic and the extent of it. Thus far, the impact of Rand volatility on different sectors of the JSE is also not extensively explored and well researched. The second sub-problem attempts to understand the causal association between Rand volatility and the different sectors of the JSE. This information will assist both risk averse individuals and institutional investors on how best to invest their capital with minimal exposure to currency volatility that could lead to losses. The aim is to determine the causal nature of the Rand volatility and the different sectors of the JSE to ascertain the direction of the relationship in each sector.

2.5.2 *Hypothesis 2*

H_{02}: There is no significant causal relationship between the Rand/US dollar fluctuations and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indexes.

2.6 Conclusion of Literature Review

The literature review and empirical evidence are inconsistent about the relationship between exchange rate fluctuations and its impact on the stock market trade. It is ambiguous whether the equity markets gain returns during volatile periods. Therefore, it is apparent that further empirical studies on this topic need to continue, in an attempt to address the current shortfall and add to the body of available knowledge.

2.6.1 *Hypothesis 1:*

H_{01}: There is no significant correlation relationship between the Rand/US dollar exchange rate fluctuations and the returns of JSE Top 40, Industrial 25, Resources 10, and Financial 15 indexes.

2.6.2 *Hypothesis 2:*

H_{02}: There is no significant causal relationship between the Rand/US dollar fluctuations and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indexes.

CHAPTER 3. RESEARCH METHODOLOGY

In Chapter 3, we discuss research methods used to produce the results of the proposed objectives detailed in Chapter 1 and 2. We also specify the research design, theoretical model, sample population, research instrument, data collection and interpretation, validity, and reliability of the study in the next sections.

3.1 Research methodology

This study aims to determine the nature of the relationship between the exchange rate fluctuations and the returns of the firms listed on the JSE; therefore it involves measuring the level of association between variables to determine causality.

Analytical models used to evaluate the relationship between exchange rate movements and volatility as discussed on empirical studies in the previous chapters follow a quantitative paradigm. Similar to other researchers, this study will utilise quantitative methods (Adjasi et al., 2011; Barr et al., 2007; Bonga-Bonga, 2013; Kisaka & Mwasaru, 2012; Kodongo & Ojah, 2012).

3.2 Research Design

To determine how exchange rate fluctuations impact on the earnings of JSE listed firms by determining the impact in different JSE sectors, we use high-frequency weekly data. This study employs the vector auto-regressive – VAR framework, which overcomes the weakness of traditional regression that assumes that econometric variables are non-stationary thus; the results of t-test and f-test could be invalid (Ali et al., 2016). The method utilises the standard Granger causality test and impulse response function to evaluate causal relationships between earnings of the selected JSE indices and fluctuations of the Rand/US dollar exchange rate. (Adjasi et al., 2011; Barr et al., 2007; Bonga-Bonga, 2013; Kisaka & Mwasaru, 2012; Kodongo & Ojah, 2012). Although the methodology applied by Bonga-Bonga (2013) utilised conditional volatility, our

approach follows that of Adjasi et al. (2011) in that we use the Rand/US dollar fluctuations and the JSE stock exchange indices returns as variables.

3.3 Population and sample

3.3.1 *Population*

The sample population is the JSE listed companies that form All Share, Resource 10, Financial 15, Industrial 25, and the Top 40 indices.

3.3.2 *Sample and sampling method*

The sample population is the weekly JSE indices data mentioned above and the Rand/USD exchange rates. Data period is from January 2006 to December 2016 to cover episodes of the South African Rand shocks of 2008, 2012, and 2015 to include the relative adjustment of the asset prices.

3.4 The research instrument

Readily available data from JSE and South African Reserve Bank was used thus no questionnaire, or additional research instruments were required.

3.5 Procedure for data collection

This study use secondary weekly JSE All Share, Top 40, and Industrial 25, Resources 10, and Financial 15 indices data from Bloomberg.

We also utilised the Rand/US Dollar exchange rate data from the South African Reserve Bank.

3.6 Granger causality test within the VAR model

The variables of the study include the JSE All Share index returns, exchange rate (EXR), and exchange rate fluctuation or movement (EXV). Further, the JSE

Resource 10, Financial 15, Industrial 25, and Top 40 indices are evaluated to disaggregate the sectors of the JSE in an attempt to provide answers to the second sub-problem.

As adapted from Adjasi et al. (2011), the returns of the selected indices are separately analysed as follows:

$$IndR = \left(\frac{Indp_t - Indp_{t-1}}{Indp_{t-1}}\right) \text{ or } IndR = ln\left(\frac{Indp_t}{Indp_{t-1}}\right) \quad (1)$$

Where: $IndR$ - denotes the index returns indicating the Top40, RESI20, INDI25, or FINI15,

$Indp_t$ - denotes the current period index price,

$Indp_{t-1}$ - denotes the previous period index price.

The exchange rate fluctuation - EXV is computed as follows:

$$EXV = \left(\frac{EXR_t - EXR_{t-1}}{EXR_{t-1}}\right) \text{ or } EXV = ln\left(\frac{EXR_t}{EXR_{t-1}}\right) \quad (2)$$

Where: EXV is the exchange rate fluctuation or movement,

EXR_t - denotes the current period exchange rate,

EXR_{t-1} - denotes the previous period exchange rate.

The first step is to perform the unit root test on the variables. The variables are transformed of into log forms and the differences of the log forms were utilised, converting the time series data to be stationary then applied the Augmented Dickey-Fuller – ADF to test each variable at its level and its differenced logarithmic form (Ali et al., 2016).

Based on a model by Jorion (1990), as adapted from Adjasi et al. (2011), the linkage between the indices returns and the exchange rate fluctuations are deduced through the model:

$$R_{it} = \beta_{0i} + \beta_{1i}R_{mt} + \beta_{2i}EXV_t + \epsilon_{it} \quad (3)$$

Where: R_{it} is the return rate on stock of firm i;

R_{mt} - denotes the returns in the market;

EXV_t - denotes the exchange rate movement.

Equation (3) can be approximated as follows at the macro level (Adjasi et al., 2011):

$$IndR = \alpha_1 + \alpha_2 EXV + u_i \quad (4)$$

Where: $IndR$ is the index returns and EXV is the exchange rates movement.

According to Adjasi et al. (2011), Equation (4) was fortified by Granger et al. (2000) to better understand the causality nexus between stock market returns and the exchange rates movement, thus the model illustrated by Equation (5) and (6) was established. Granger causality principle is explained as follows, “if variable X Granger-causes Y if Y can be better predicted using the histories of both X and Y than using the history of Y alone” (Schaling et al., 2014, p. 679). However, it does not mean X absolutely causes Y hence the phrase Granger-cause. As Koop (2006, p. 185) explains that “if past values of X have explanatory power for current values of Y, it at least suggests that X might be causing Y”. Additionally, the notion of Granger causality is only applicable to time-series variables (Koop, 2006). Schaling et al. (2014) elaborated that if variables do not Granger cause each other, then they must be considered independent.

$$EXV_t = \alpha_0 + \sum_{j=1}^{k} \alpha_{1j} EXV_{t-j} + \sum_{j=1}^{k} \alpha_{2j} IndR_{t-j} + \varepsilon_t \quad (5)$$

$$IndR_t = \beta_0 + \sum_{j=1}^{k} \beta_{1j} EXV_{t-j} + \sum_{j=1}^{k} \beta_{2j} IndR_{t-j} + u_t \quad (6)$$

Where: $IndR_t$ is the stock index returns indicating, All Share, Top40, RESI20, INDI25, or FINI15;

EXV_t - denotes the exchange rate return or movement, defined in Equation (2);

k - denotes the number of lagged terms;

ε_t and u_t are error terms.

As adopted from Alagidede et al. (2011), the error terms are assumed to be serially uncorrelated with the zero mean and the restricted covariant matrix. The constant terms are denoted by α_0 and β_0. The null hypothesis to test Granger causality from the stock market returns ($IndR_t$) to the exchange rate movement (EXV_t) is indicated as α_{2j} = 0 (*j = 1, 2,…,k*), the alternative hypothesis requires one of α_{2j} (*j = 1, 2,…,k*) to be significantly different from zero to indicate a causal linkage. Also, the null hypothesis to test Granger causality from the exchange rate movement (EXV_t) to the stock market returns ($IndR_t$) is expressed as β_{2j} = 0 (*j = 1, 2,…,k*), while the alternative entails at least one of β_{2j} (*j = 1, 2,…,k*) to be different from zero to confirm causal linkage (Alagidede et al., 2011).

The second step is to determine the optimal lag length to create a stable VAR model before conducting the Granger causality tests. Several lag length selection criteria are available, which include the Akaike information criterion (AIC), the Hannan – Quinn information criterion, and the Schwarz Bayesian information criterion (SBIC), and the AIC was used in this study. Generally, the

lag length that produces the lowest value of the chosen criterion is selected (Brooks, 2008; Koop, 2006).

We test for the Granger causality relationship between the All Share index, Resource 10, Financial 15, Industrial 25, Top 40, and the exchange rate fluctuation. The Granger causality framework used in this evaluation is within the VAR model where the F-statistics of the Wald test reflects the nature of causality relationship for between two variables (Adjasi et al., 2011; Alagidede et al., 2011; Brooks, 2008; Koop, 2006).

An impulse response analysis was conducted within the VAR model to detect the reaction, and the behaviour of stock returns to shocks prompted by exchange rate movements and vice versa (Adjasi et al., 2011).

3.7 Data analysis and interpretation

The statistical software utilised for data analysis of this study is E-views 8. We executed all the data processing techniques within the E-views environment before tabulating the results on Excel for presentation.

The relationship between the Rand/US Dollar fluctuations and the returns of the JSE indices is assessed firstly by taking an overview of the level data and weekly correlations between the variables. Both the exchange rate and the indices raw or level data are transformed into the natural logarithmic forms to eliminate the fallacious scale issues. Then data is computed into the returns by differencing as described in Equation (1) and (2). The coefficient of variance from the returns data is also assessed to compare the spread of data fluctuations around the means of the variables.

Stationarity of the data is determined through unit root testing utilising ADF to test each variable at both levels and the differenced logarithmic form or the integration of first order. We compare the determined t-statistics to the ADF critical values; thus t-statistics that are more negative or smaller than the critical value at least at 5% significance are the desired precondition that supports the

alternative hypothesis that the transformed time series data is stationary (Brooks, 2008; Koop, 2006).

Unrestricted VAR model using default lag of 2 on the E-views 8 environment was then utilised to develop the estimated model. We determine optimum lag order through the lag length criterion which computes several lag criterions. The best lag is selected based on the smallest AIC criterion number mentioned earlier (Brooks, 2008). The optimal lag length was selected using the AIC criterion. The VAR estimate model was re-run with optimal lag selection as AIC recommendation.

The diagnostic analysis included a lag structure AR roots test to indicate if the estimated VAR is stable. The desired precondition is that the roots must be within or below a unit. The Portmanteau test for residuals is performed to ensure nonexistence of serial correlations in the data. Autocorrelations LM test records undesired residual serial correlations as well. We also execute the normality and the heteroscedasticity white noise residuals tests. The reason we do a diagnostic test is to ensure that the estimated VAR model is stable and suitable containing best, linear and unbiased estimators (Brooks, 2008).

Finally, we performed the Granger causality test and the impulse response function analysis between the Rand/USD, ALSH, TOP40, INDI25, FINI15, and RESI20. The discussion on the significance of Granger causality follows in Chapter 5.

3.8 Limitations of the study

The study excludes the impact of other corporate governance general principles that may affect share performance of the firms within the sector indices.

The significance of other factors, like economic stability and socio-political influence, for instance, that contribute to exchange rate fluctuations were also excluded.

3.9 Reliability and validity

Reliability in quantitative research paradigms involves the repeatability of the findings and observations of the study. Moreover, the validity focuses on the accuracy of the results (Golafshani, 2003). Therefore, reliability test of this study is by comparison of our findings and observations with those achieved by other authors who used similar estimation methods, data frequencies and a South African context.

3.9.1 *External validity*

Leedy and Ormrod (2005) explain that the external validity concerns whether the findings of the study can be generalised and applied to other population samples, areas or periods. For the context of this study, our sample population considers the Rand/US dollar, All Share, TOP40, INDI25, FINI15, and RESI20 indices and it would be erroneous to infer the findings to other indices as the selected indices are made up of specific nature of firms.

3.9.2 *Internal validity*

Internal validity focuses on the accuracy of interpretation of the results to make correct conclusions (Leedy & Ormrod, 2005). However, our study draws its conclusions from the Granger causality notion and impulse response function about the nature of the relationship between the Rand/US dollar and the selected JSE indices. We follow the theories, empirical evidence, and interpretation provided by other authors that investigated Granger causality between the stock prices and exchange rates (Adjasi et al., 2011; Barr et al., 2007; Bonga-Bonga, 2013; Kisaka & Mwasaru, 2012; Kodongo & Ojah, 2012).

3.9.3 *Reliability*

As described earlier, to ensure our results can be replicated we only utilised proven frameworks as described in section 3.9.2. We verify our estimation model using the prescribed method specified in section 3.6 and 3.7. Therefore

diagnostic analysis will ensure that the estimated VAR model is stable and suitable containing best, linear and unbiased estimators.

CHAPTER 4. PRESENTATION OF RESULTS

This chapter presents detailed findings on the relationships that exist between the Rand/US Dollar movements and the returns of the JSE indices. The character of the linkages between the Rand/US Dollar fluctuations and the earnings of the JSE indices are evaluated using the bivariate VAR framework to estimate the direction of the causality between the variables. The results indicate whether the Rand/US Dollar fluctuations are related to the JSE returns. Further, the direction of the causality linkages is determined.

4.1 Hypothesis 1 outcomes

H_{01}: There is no significant relationship between the Rand/US dollar exchange rate fluctuation and the earnings of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices.

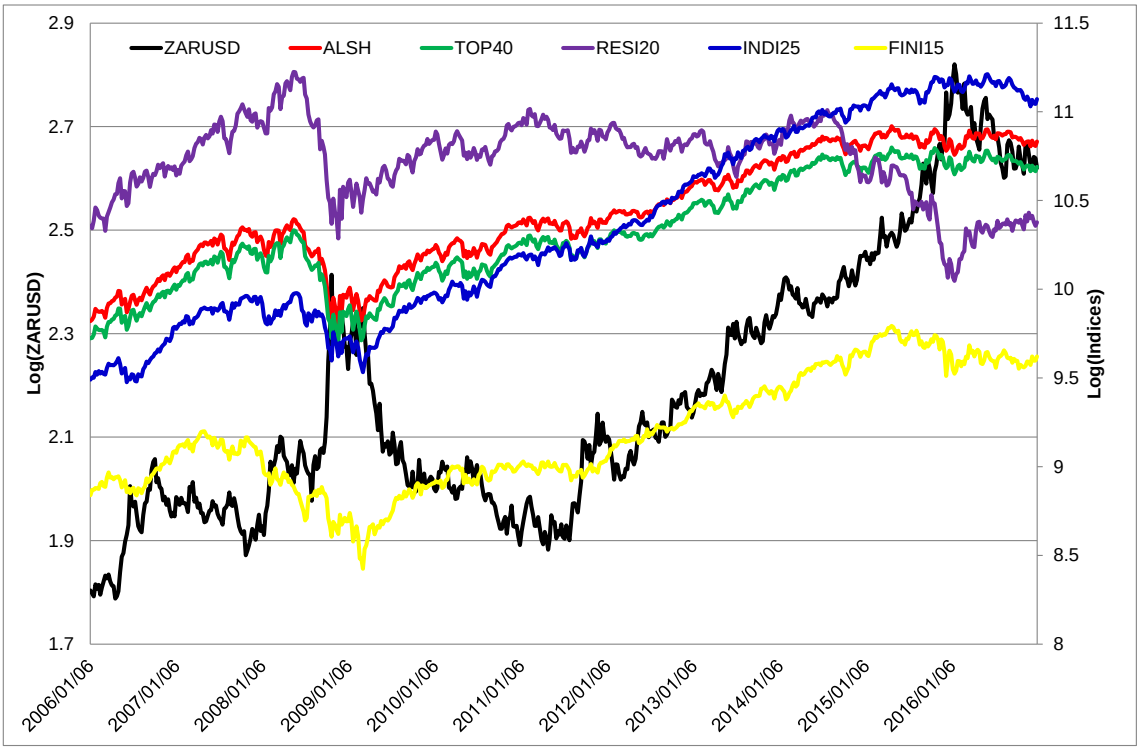


Figure 3: Weekly JSE performance compared to the Rand-Dollar exchange

Figure 3 shows a weekly trend of the JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices and the Rand/US Dollar exchange from January 2006 to December 2016 transformed into the logarithmic format. What is interesting in Figure 3, from 2012 until 2016 is the upward trend of the Rand/US dollar exchange with the JSE All Share, Top40, FINI15 and INDI25 indices. The RESI20 index is moving sideways, and it drops from 2014 until it shows some recovery in 2016.

Correlation [t-Statistic] Probability	**ZARUSD**	**ALSH**	**TOP40**	**INDI25**	**FINI15**	**RESI20**
ZARUSD	1.0000 ----- -----					
ALSH	-0.4052 [-10.590] 0.0000	1.0000 ----- -----				
TOP40	-0.3779 [-9.7544] 0.0000	0.9971 [312.09] 0.0000	1.0000 ----- -----			
INDI25	-0.3285 [-8.311] 0.0000	0.8627 [40.758] 0.0000	0.8511 [38.738] 0.0000	1.0000 ----- -----		
FINI15	-0.4484 [-11.986] 0.0000	0.7448 [26.675] 0.0000	0.7200 [24.795] 0.0000	0.7557 [27.570] 0.0000	1.0000 ----- -----	
RESI20	-0.3259 [-8.2365] 0.0000	0.8758 [43.363] 0.0000	0.8863 [45.741] 0.0000	0.5810 [17.060] 0.0000	0.4582 [12.320] 0.0000	1.0000 ----- -----

Table 2: JSE indices returns and exchange rate fluctuations correlations

In Table 2, the correlations of the JSE indices returns are measured. These returns were calculated as stipulated from Equation (2). The t-test was used to verify the significance of the correlations. The correlations were found to be significant as the p-values of the correlations are zero. The movements or changes in the Rand/US dollar have an adverse influence on the returns of the

selected JSE indices. The Rand/US dollar fluctuations are less correlated to the RESI20 index and relatively highly correlated to the FINI15 index returns. The earnings of the All Share and the Top40 are highly correlated as expected. It is interesting to note that the earnings from the RESI20 and FINI15 indices are the least associated to each other.

	ZARUSD	ALSH	TOP40	INDI25	FINI15	RESI20
Mean	0.0014	0.0018	0.0017	0.0028	0.0014	3.2E-05
Median	-0.0002	0.0026	0.0026	0.0032	0.0022	0.0004
Maximum	0.1098	0.1604	0.1792	0.1586	0.1192	0.2746
Minimum	-0.1333	-0.0963	-0.1101	-0.0846	-0.1329	-0.1693
Std. Dev.	0.0239	0.0263	0.0284	0.0242	0.0285	0.0423
CoV	16.7396	14.8652	16.8257	8.7745	20.8440	1314.8
Skewness	0.2591	0.0624	0.1279	0.0575	-0.3593	0.4099
Kurtosis	6.1995	7.3232	7.5128	6.5314	6.0498	7.5550
Jarque-Bera	250.82	446.61	487.78	298.05	234.39	511.40
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sum	0.8167	1.0119	0.9664	1.5804	0.7821	0.0185
Sum Sq. Dev.	0.3255	0.3942	0.4609	0.3350	0.4630	1.0252
Observations	573	573	573	573	573	573

Table 3: Summary of JSE indices and Rand/US dollar weekly statistics

Table 3 outlines the descriptive statistics where a change in the Rand/US Dollar and the indices returns average values are positive. However, the mean for the RESI20 is the lowest and almost zero. The coefficient of variation, denoted as CoV, is a measure of volatility (Brooks, 2008). Therefore, the returns of the RESI20 are the most volatile at a staggering 1314.8%, followed by FINI15 at 20.844% and INDI25 is the least volatile index within the sample at 8.7745%. The exchange rate is also very volatile at 16.7396%. The Kurtosis for all the variables is higher than 3, indicative of fat tails in data distribution. The Jarque-Bera statistic is also significant at 1%, meaning the data generating process cannot be attributed to a normal distribution (Kodongo & Ojah, 2012).

4.2 Hypothesis 2 outcomes

H_{02}: There is no significant causal relationship between the Rand/US dollar fluctuation and the earnings of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices.

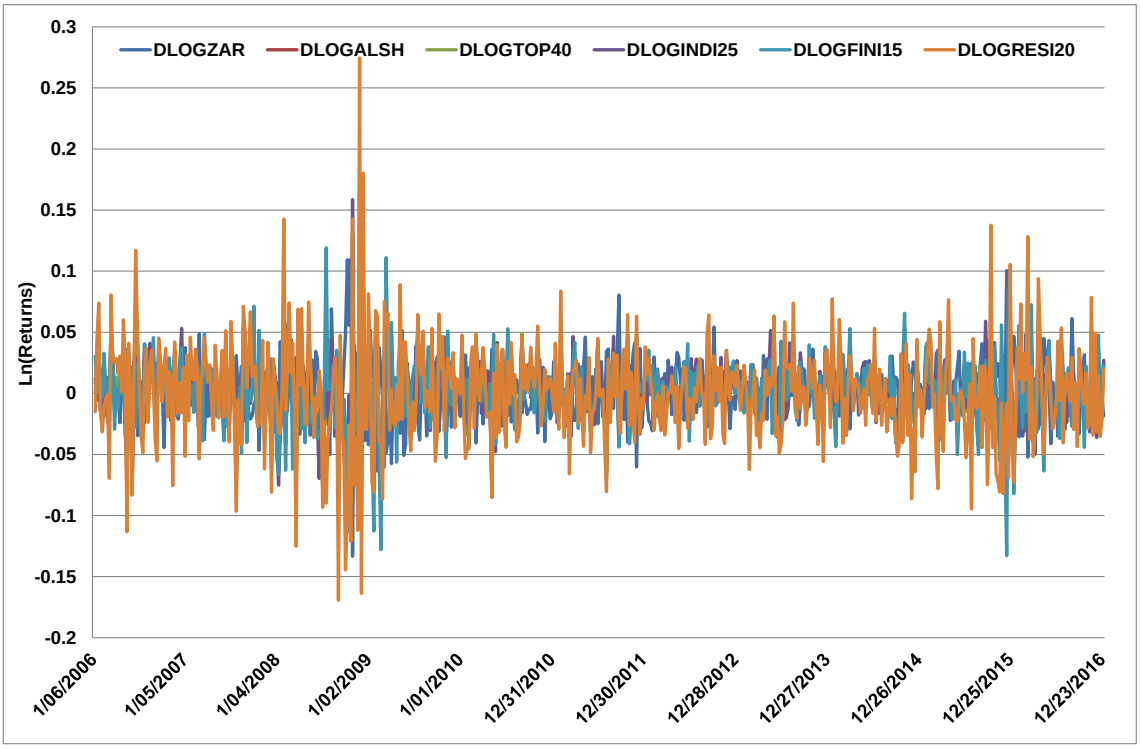


Figure 4: Time series of JSE indices in a format of log returns

Figure 4 depicts the first difference of the logarithmic forms of the selected JSE indices and the Rand/US dollar exchange showing the presence of volatility. The volatility is very pronounced between 2008 and 2009, and also in 2015.

		ADF			
Variables	**Difference**	***Lag**	**t-Statistics**	**Probability**	**Stationarity**
ZARUSD	level	0	-0.9740	0.7638	non-stationaty
ALSH	level	0	-1.4979	0.5342	non-stationaty
TOP40	level	1	-1.5569	0.5041	non-stationaty
INDI25	level	0	-0.8283	0.8099	non-stationaty
FINI15	level	0	-0.8833	0.7934	non-stationaty
RESI20	level	1	-2.1235	0.2356	non-stationaty
ZARUSD	1st difference	0	-25.8568	0.0000	stationary
ALSH	1st difference	0	-26.3667	0.0000	stationary
TOP40	1st difference	0	-26.7976	0.0000	stationary
INDI25	1st difference	0	-26.3663	0.0000	stationary
FINI15	1st difference	0	-25.4482	0.0000	stationary
RESI20	1st difference	0	-26.7630	0.0000	stationary
ADF critical values:		1% level	-3.441533		
		5% level	-2.866365		
		10% level	-2.569399		

Table 4: Summary of the ADF unit root test

The lag length is automatically selected based on Schwarz Information Criterion, with the maximum lag length of 18 used, as shown in Table 4. All the level variables are larger than -2.5694 meaning they are non-stationary at the Augmented Dickey-Fuller – ADF critical values. The index returns and the Rand/US dollar exchange rate movements are stationary thus satisfying the unit roots test requirement to estimate the VAR model.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	10181.45	NA	7.09E-24	-36.27612	-36.22981*	-36.25804*
1	10234.47	104.71580	6.67e-24*	-36.33680*	-36.01265	-36.21023
2	10263.63	56.96942	6.84E-24	-36.31241	-35.71042	-36.07737
3	10289.36	49.70873	7.09E-24	-36.27578	-35.39595	-35.93226
4	10312.96	45.10600	7.42E-24	-36.23159	-35.07392	-35.77959
5	10340.26	51.57220	7.65E-24	-36.20056	-34.76504	-35.64007
6	10388.48	90.08681	7.33E-24	-36.24414	-34.53077	-35.57516
7	10422.75	63.27921*	7.38E-24	-36.23796	-34.24675	-35.46050
8	10446.35	43.09231	7.72E-24	-36.19378	-33.92473	-35.30784
9	10468.70	40.30122	8.11E-24	-36.14508	-33.59819	-35.15066
10	10496.31	49.22802	8.37E-24	-36.11520	-33.29046	-35.01230
11	10519.85	41.45639	8.77E-24	-36.07077	-32.96819	-34.85939
12	10547.55	48.18613	9.05E-24	-36.04117	-32.66075	-34.72131

Table 5: Results indicating optimum lag order selection[15]

Table 5 shows the lag order selection by AIC criterion. The asterisk * designates the optimal lag order selected thus the final predator error, and the Akaike information criterion recommends the optimal lag of one. Both the Schwarz information criterion and the Hannan-Quinn information criterions indicated a zero lag which would be impractical to estimate the VAR. Therefore a lag order of one is selected for the VAR estimation model.

Root	Modulus
0.159008	0.159008
-0.136651 - 0.030864i	0.140093
-0.136651 + 0.030864i	0.140093
-0.110034 - 0.057151i	0.123991
-0.110034 + 0.057151i	0.123991
0.029597	0.029597

Table 6: Summary of the AR roots

[15] * Designates the lag order selection by the following criterion: LR – means sequential modified LR statistic test at 5% level, FPE – is the final predictor error, AIC – is the Akaike information criterion, SC – stands for Schwarz information criterion, and HQ – is the Hannan-Quinn information criterion.

Table 6 shows that the AR roots or the inverse roots of the characteristic polynomials of the applied lag order of one are well below a modulus of one. Therefore the VAR estimate model is stable as no roots lie outside the unit circle.

Lags	LM-Stat	Probability
1	45.4737	0.1339
2	35.7228	0.4817
3	35.8605	0.4752
4	57.2153	0.0137
5	37.7086	0.3910
6	30.0066	0.7486
7	50.4724	0.0553
8	54.8191	0.0231
9	38.4814	0.3579
10	27.3859	0.8484
11	42.0805	0.2244
12	43.8041	0.1741

Table 7: VAR residual serial correlation

Table 7 presents the LM statistics test for residual serial correlations processed to a specific lag order. There are two autocorrelations detected at the lags of order four and eight to 5% significant level; and additional autocorrelation at a lag order of seven significant to 10% level. Therefore, only three out of twelve lags have autocorrelation, and we accept the null hypothesis of no serial autocorrelation exists within the VAR estimate.

Variables			Probability	Granger Causality
Independent		Dependent		
ALSH	→	**ZARUSD**	0.0898	Yes
ZARUSD	→	**ALSH**	0.6974	No
TOP40	→	**ZARUSD**	0.0491	Yes
ZARUSD	→	**TOP40**	0.5756	No
INDI25	→	**ZARUSD**	0.9612	No
ZARUSD	→	**INDI25**	0.9218	No
FINI15	→	**ZARUSD**	0.5540	No
ZARUSD	→	**FINI15**	0.5166	No
RESI20	→	**ZARUSD**	0.3419	No
ZARUSD	→	**RESI20**	0.4152	No

Table 8: Granger causality between Rand/US dollar and the JSE indices

Table 8 presents Granger causality results, and it shows that there are only two causality nexuses. The findings show unidirectional causality from the JSE All Share and TOP40 returns to the Rand/US dollar fluctuations.

A unidirectional causation from the ALSH returns to the Rand/US dollar exchange rate fluctuation was found within 10% significance level. Also, a unidirectional causation at 5% significance level was found from the earnings of the TOP40 index to the Rand/US dollar fluctuation.

There is no feedback causality that runs from the Rand/US dollar fluctuations to the earnings of the JSE stock exchange indices that was significant.

	Dependent variable: **ZARUSD**		
Independent	**Chi-sq**	**df**	**Probability**
ALSH	2.878305	1	0.0898
TOP40	3.871114	1	0.0491
INDI25	0.002365	1	0.9612
FINI15	0.350207	1	0.5540
RESI20	0.903434	1	0.3419
All combined	5.609589	5	0.3461
	Dependent variable: **ALSH**		
ZARUSD	0.151231	1	0.6974
TOP40	0.083032	1	0.7732
INDI25	0.271175	1	0.6025
FINI15	0.839588	1	0.3595
RESI20	0.291932	1	0.5890
All combined	2.310683	5	0.8047
	Dependent variable: **TOP40**		
ZARUSD	0.313432	1	0.5756
ALSH	0.150552	1	0.6980
INDI25	0.265544	1	0.6063
FINI15	0.868093	1	0.3515
RESI20	0.355239	1	0.5512
All combined	2.652761	5	0.7533
	Dependent variable: **INDI25**		
ZARUSD	0.008217	1	0.9278
ALSH	2.189638	1	0.1389
TOP40	3.140635	1	0.0764
FINI15	1.486385	1	0.2228
RESI20	0.840009	1	0.3594
All combined	6.000635	5	0.3062
	Dependent variable: **FINI15**		
ZARUSD	0.420728	1	0.5166
ALSH	0.076297	1	0.7824
TOP40	0.190132	1	0.6628
INDI25	0.082119	1	0.7744
RESI20	0.391593	1	0.5315
All combined	1.094762	5	0.9546
	Dependent variable: **RESI20**		
ZARUSD	0.663862	1	0.4152
ALSH	0.475225	1	0.4906
TOP40	0.987358	1	0.3204
INDI25	0.08943	1	0.7649
FINI15	1.705298	1	0.1916
All combined	3.949522	5	0.5567

Table 9: Wald test

Table 9 presents the Wald test for Granger causality, and it shows the impact of the variables individually against each other and their collective effect. It is interesting to note that all combined indices had no significant impact on the Rand/US dollar fluctuation. Although the earnings of the All Share and the Top40 indices show unidirectional causality to the Rand/US dollar fluctuations, the Rand/US dollar movements seem not to impact on the stock indices returns. There is also a unidirectional Granger causality from the Top40 to the INDI25 index, significant at 10% level.

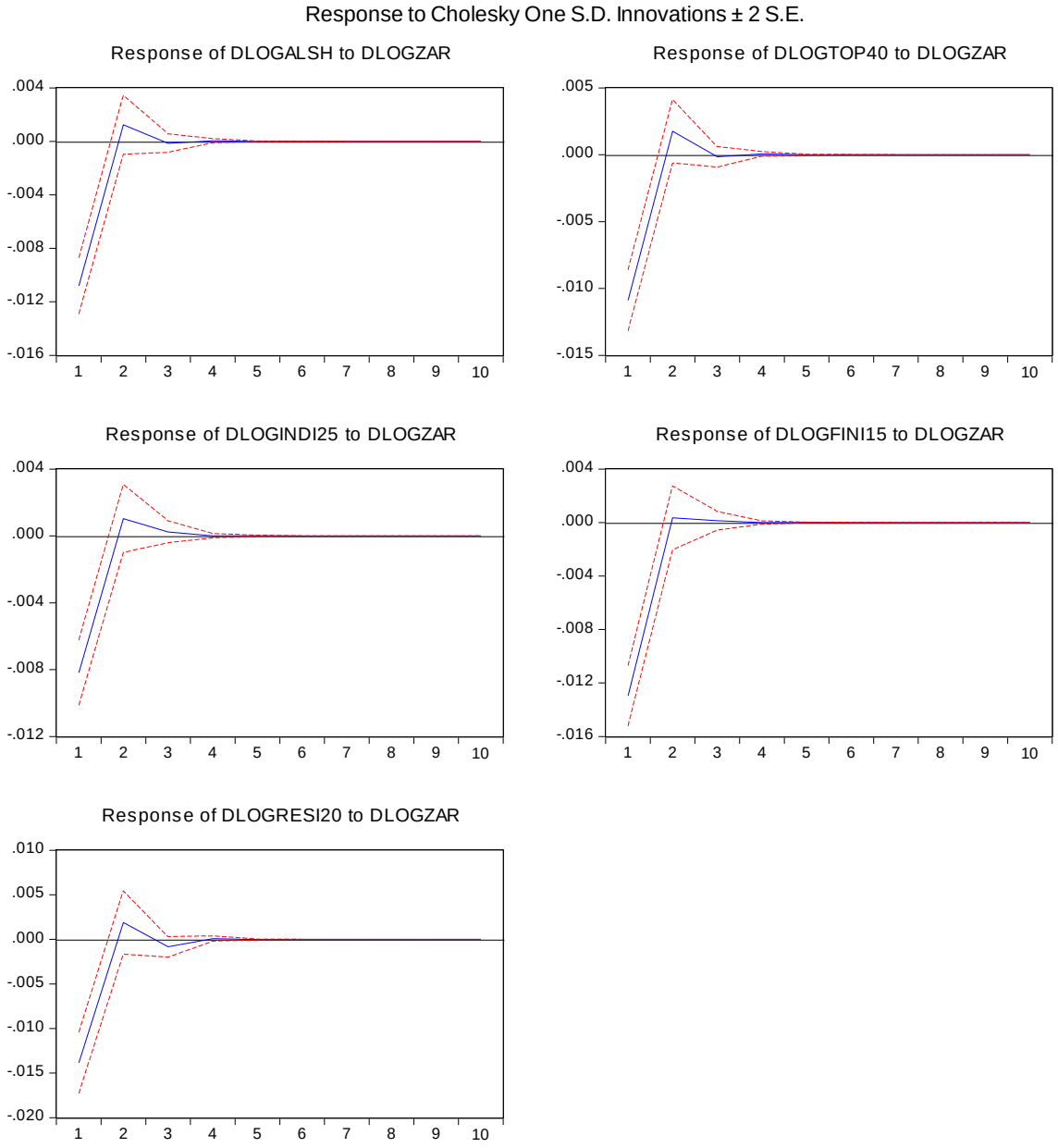


Figure 5: Impulse response of the JSE indices to the Rand/US dollar shocks

The response and impulse response function are interchanged from this part of the report, and they refer to the impulse response function of a variable to one standard deviation shock to the other variable. The impulse response function analysis was conducted to further elucidate the interconnectivity of the earnings of the JSE indices and the Rand/US dollar exchange rates fluctuation. Figure 5 presents the impulse response function of earnings of the JSE indices to one standard deviation shock from the Rand/US dollar fluctuation. It is noteworthy to observe that the selected stock market indices react in a similar manner towards the shock from the Rand/US dollar fluctuation. The reaction of the JSE indices is negative and instantaneous to the change of Rand/US dollar shock. However, the shocks are short-lived as they last for two periods or two weeks in this case, and then remain statistically insignificant for the rest of the period.

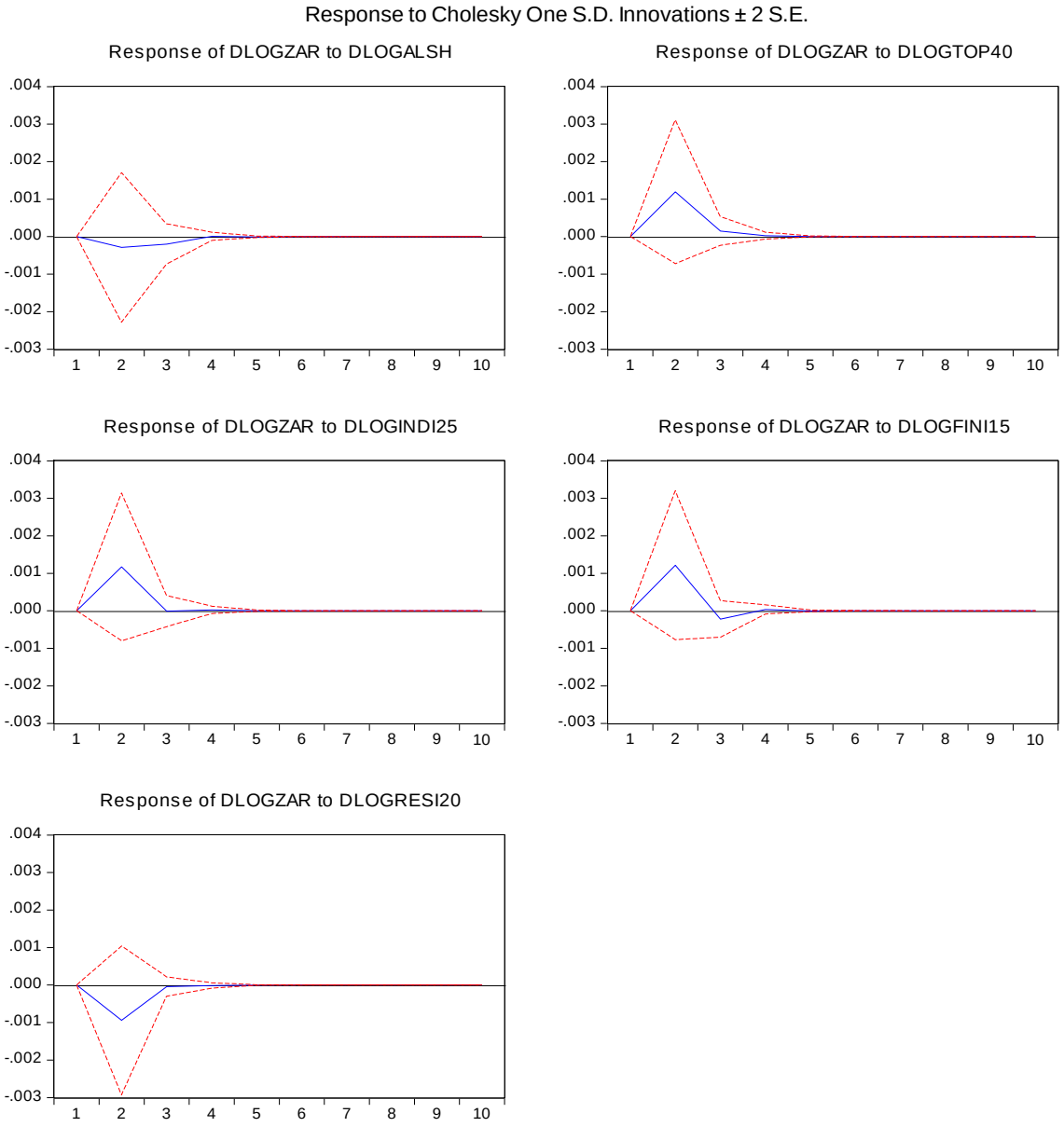


Figure 6: Impulse response of the Rand/US dollar to the JSE indices shocks

Figure 6 illustrates the impulse response function of the Rand/US dollar to shocks from the earnings of the All Share, Top40, INDI25, FINI15, and RESI20 indices. The impulse response function of the Rand/US dollar fluctuation to the one standard deviation shock from the selected JSE indices returns, as mentioned above, is different from sector-to-sector. The only common observation from the Rand/US dollar impulse responses function is that the reactions are delayed or start at zero, are short-lived and then remain insignificant to the horizon after a shock. Rand/US dollar fluctuation responds

very moderately, but in a negative direction to the shock from the All Share index returns. This reaction of the Rand/US dollar is short-lived and lasts for 2 to 3 periods before returning to normal. There is also a second negative impulse response function of the Rand/US dollar fluctuations to the shock of RESI20 index returns, which is also short-lived and lasts for two periods. The impulse response function of the Rand/US dollar fluctuations to the shock from the earnings of the Top40, INDI25, and FINI15 is similar and responds positively to the shocks for two weeks before returning to normal.

4.3 Summary of the results

This chapter presented the results obtained from the research methodology outlined in the previous chapter.

In response to the first hypothesis that there is no significant relationship between the Rand/US dollar exchange rate fluctuation and the returns of the JSE All Share, Top40, INDI25, FINI15, and RESI20 indices, coefficients of correlations between the variables were measured and were found to be significant using the t-test. Descriptive statistics revealed different levels of volatility within the selected JSE indices. The earnings of the RESI20 index are the most volatile while the INDI25 returns are the least volatile, based on the coefficient of variation over the period from January 2006 to December 2016.

To reaffirm the solution provided for the first hypothesis, we probed slightly deeper and developed the second hypothesis. The second null hypothesis seeks to prove whether there is no significant causality relationship between the Rand/US dollar fluctuation and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices.

We established a solution by developing the VAR estimation model that was utilised to confirm Granger causality link between certain variables. Residual and stability tests were completed to ensure the stability and the validity of our VAR model. A significant level of Granger causality was found to be unidirectional from the earnings of the All Share and TOP40 to the Rand/US

dollar exchange rate fluctuation. Also, the impulse response function was utilised to confirm the observations.

CHAPTER 5. DISCUSSION OF THE RESULTS

This chapter discusses the results obtained in Chapter 4. We contrast the results to those achieved by various researchers, for validation and consistency.

Section 5.1 provides a discussion of results with regard to the correlation between the JSE stock returns and the Rand/US dollar fluctuations. Then section 5.2 discusses findings on the Granger causality link between the Rand/US dollar fluctuation and the earnings of the All Share, Top40, INDI25, FINI15, and RESI20. The chapter concludes with the brief summary of our findings in section 5.3.

5.1 Discussion of hypothesis 1

To uncover the nature of the relationship between the JSE stock market and the foreign exchange market as well as how exchange rate fluctuations impact on the earnings of the listed companies. Our first hypothesis is that there is no significant relationship between the Rand/US dollar exchange rate fluctuations and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices.

5.1.1 *Association between the JSE and the Rand/US Dollar exchange rate*

In section 4.1 we have presented the results regarding the nexus between the Rand/US dollar exchange rate fluctuation and the returns of the JSE indices in full. To summarise, we have found significant correlations between the earnings of the JSE All Share, Top40, INDI25, FINI15, and RESI20 indices. Based on the coefficient of variance which was also utilised by Kodongo and Ojah (2012), the returns of the RESI20 index are the most volatile at a staggering 1314.8%, while the INDI25 earnings are the least volatile index at 8.77%. The Rand/US dollar fluctuation correlates negatively with the returns of the selected JSE indices in this study. The strength of the association between the Rand/US

dollar fluctuation and the earnings of the JSE All Share index is about 40.5%, and the correlation is negative.

5.1.2 *Comparison of observed correlations with empirical evidence*

Our findings are in line with the results of Ali et al. (2016) who reported correlation strength of 32.1% between the stock exchange and the exchange rates. However, Ali et al. (2016) used a VECM framework more complex than our approach and the direction of their correlation was positive. Their study focuses on the impact of other macroeconomic variables on the prices of the JSE as discussed in section 2.3.2. Moreover, Ali et al. (2016)'s evidence supported the theory that exchange rates fluctuations are correlated positively with the stock market prices. Our evidence is contrary to that theory.

In conclusion, we have provided evidence that shows the link between the exchange rates and the stock market prices. Therefore, we cannot accept the null hypothesis that there is no significant relationship between the Rand/US dollar exchange rate fluctuations and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices. Rather we accept the alternative that there is a significant association between the exchange rates fluctuations and the stock price returns.

5.2 Discussion of hypothesis 2

The second sub-problem attempts to understand the causal association between the fluctuation of Rand/US dollar exchange rate and the indices earnings of selected sectors of the JSE. Therefore our second hypothesis is that there is no significant causality relationship between the Rand/US dollar exchange rate movements and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices.

5.2.1 *Causal link between Rand/US dollar fluctuations and the JSE earnings*

In chapter 1 we expressed how researchers use the stock prices in general as a proxy for determining the performance of the stock exchange. We attempted to build a case that the practice could be obstructing the information on how each sector is affected differently by the underlying variables and provided evidence from Barr et al. (2007).

We also deliberated in section 1.3, about the context of the South African emerging economy and how it is increasingly attracting foreign trade because of its openness, competitive and well-developed financial markets, and the world-class stock exchange.

The results in section 4.2 revealed a unidirectional Granger causality within the significance level of 10% from the All Share index returns to the Rand/US dollar exchange rate fluctuation. There is also a significant unidirectional Granger causality within 5% significance from the earnings of the TOP40 to the fluctuations of the Rand/US dollar exchange rates. Within the JSE sectors, the TOP40 index earnings show a unidirectional Granger causality to the INDI25 index returns within 10% significance level. No other Granger causality was significant between the variables. Moreover, there was no significant feedback causality found from the exchange rate fluctuation to the stock returns.

As we suspected that various sectors of the JSE are influenced differently by exchange rate movements, we have also learned that the opposite could be true, meaning, significant capital outflows from the different JSE sectors could affect the exchange rate movements (Bonga-Bonga, 2013).

The impulse response function results presented in section 4.2 provide evidence that indeed the impulse response function of the Rand/US dollar exchange rate fluctuation to the one standard deviation shock from the JSE indices returns is different from sector-to-sector. The impulse response function of the JSE All Share index is negative and instantaneous to the shock from fluctuations of the Rand/US dollar exchange rate. Moreover, the Rand/US dollar fluctuation reacts very moderately, but in a negative direction to the one

standard deviation shock from the All Share index returns. There is also a second negative impulse response function of the Rand/US dollar fluctuations to the shock of RESI20 index returns. The impulse response function of the Rand/US dollar fluctuations to the shocks from of the Top40, INDI25 and FINI15 indices earnings is similar.

This finding further strengthens our argument that by only focusing on the All Share as a market proxy for the stock market performance, researchers, policymakers and relevant stakeholders can lose some significant information.

5.2.2 *Causality results contrasted with concepts and empirical evidence*

Our Granger causality and the impulse response function results between the JSE All Share earnings and the Rand/US dollar fluctuations are similar to the findings of Adjasi et al. (2011) as well as Bonga-Bonga (2013), which confirm that shocks from the JSE fluctuations spill over to the Rand/US dollar exchange market. High volatility in the JSE indicates increased market risk levels which drive major selloff of capital assets leading to substantial capital outflow which impacts on the country's balance of payment and reflects on currency fluctuations, as explained by Bonga-Bonga (2013).

However, Bonga-Bonga (2013)'s findings show the impulse response function of exchange rate fluctuations to shocks from the All Share is persistently significant for almost 22 weeks. That finding is somehow different to ours as the impulse response function of the Rand/US dollar fluctuation to the shocks from the earnings of the All Share, Top40, INDI25, FINI15 and RESI20 is similar, and the shocks effect is short-lived and last for two weeks before returning to normal. The impact of the period that the shocks last before returning to normal is important to understand as well as its links to the subject of "hot money" which was mentioned earlier in section 2.3.3.

Given the context of the South African economy and the JSE status, also discussed in Chapter 1 and 2, our impulse response function observations on the short-lived market shocks could mean the foreign investors are after the "hot

money" in the JSE stock market as explained by Kodongo and Ojah (2012), thus inducing high volatility as foreign capital enter the markets for relatively short periods.

The South African financial market is more likely to be impacted by the causality relationship that follows the Portfolio model, which defines the causality link of shocks from the stock market prices to the exchange rates markets in accordance with the context and theories discussed in Chapters 1 and 2 respectively (Bonga-Bonga, 2013; Kodongo & Ojah, 2012; Muzindutsi & Niyimbanira, 2012). Thus, our findings of Granger causality running unidirectional from the changes in the earnings of the ALSH and Top40 to the Rand/US dollar fluctuations are in line with the theoretical views of authors above.

These findings link to the dynamic macroeconomic factors that characterise South African financial markets to attract foreign investments which we have discussed. Situations where foreign investors change their investment positions lead to significant capital outflows that transmit volatility from the stock exchange to the foreign exchange market as the JSE has significant international investors (Bonga-Bonga, 2013).

The question is, what initiates or motivates those situations for the foreign investors to unwind positions and sell a large proportion of stocks to exit the market. Bonga-Bonga (2013) cites increased volatility pressure in the emerging equity markets often starts from uncertainties in the developed markets but does not deliberate how this volatility starts. On the other hand, Kodongo and Ojah (2012) describe the transmission of volatility from African stock markets to the foreign exchange markets is induced by international investors after hot money; as they enter the financial markets for relatively short periods to benefit from temporary abnormalities from parity disorders. Both inferences above do not have to be mutually exclusive, as they may both exist simultaneously in the South African context.

The other question is what could be the impact of currency manipulation on the volatility or movement of the stock markets and the foreign exchange rate. The

motivation of this issue comes from the incident discussed in Chapter 1 in which the South African Competition Commission prosecuted 17 local and international banks for colluding on manipulation of the exchange rate of the Rand (Competition Commission, 2017). These questions could be potential research topics for further investigation in future.

5.3 Conclusion

Our Research Problem is to analyse and evaluate how exchange rate fluctuations impact on the earnings of JSE listed firms.

We developed the first hypothesis to respond to the research problem that there is no significant relationship between the Rand/US dollar exchange rate fluctuations and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices.

In summary, we have utilised methods from other researchers that investigated the causal link between the exchange rates and stock markets. The methodologies involve the use of Granger causality and impulse response function within the VAR framework.

In response to the first hypothesis, we have provided evidence that shows the connection between the exchange rates fluctuations and the stock market prices are significant. We have established correlations from the coefficient of variance analysis between the returns of the JSE All Share, Top40, INDI25, FINI15, and RESI20 indices. The RESI20 index is the most volatile while the INDI25 is the least volatile index. The Rand/US dollar fluctuation is correlated negatively with the returns of all selected JSE indices. The strength of the association between the Rand/US dollar fluctuation and the earnings of the All Share index is 40.5%, and the correlation is negative.

Therefore, we rejected the first null hypothesis and accepted the alternative that there is a significant relationship between the Rand/US dollar exchange rate

fluctuations and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices.

The second sub-problem was to understand the causal association between Rand/US dollar fluctuation and the different sectors of the JSE. Therefore our second hypothesis is that there is no significant causal relationship between the Rand/US dollar movement and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices. Moreover, we used VAR approach to determine Granger causality and impulse response function.

Our findings show unidirectional causality from the JSE All Share index returns to the Rand/US dollar fluctuations within the significance level of 10%.

A unidirectional causation from the Top40 returns to the Rand/US dollar exchange rate fluctuations was also found at 5% significant level.

Also, the impulse response function within the VAR framework confirmed Granger causality observations. The impulse response function of the Rand/US dollar fluctuation to the one standard deviation shock from the JSE indices returns is different from sector-to-sector.

The impulse response function of the Rand/US dollar fluctuation reacts very moderately but in a negative direction to the shocks from the All Share index returns. Also, there is a negative response to the Rand/US dollar fluctuations from the shocks to the RESI20 index returns. The impact of shocks in all our tested variables is short-lived and lasted for two weeks before returning to normal.

Therefore, we also rejected the second null hypothesis and accepted the alternative that there is a significant causal relationship between the Rand/US dollar exchange rate fluctuations and the returns of the JSE All Share and Top40.

CHAPTER 6. CONCLUSIONS & RECOMMENDATIONS

In this chapter, we summarise the findings from Chapter 5 and provide suggestions for further investigations. We developed recommendations for additional questions from this study.

6.1 Findings of the study

We conclude this study by proving overall highlights from each chapter. Section 6.1.1 provides the research objectives; Section 6.1.2 briefly discusses outcomes from literature review, Section 6.1.3 outlines the methodology and Section 6.1.4 summarises the findings of this study.

6.1.1 *Objectives of this study*

The research objectives of this study were to analyse and evaluate how exchange rate fluctuations impact on the earnings of JSE listed firms.

The first sub-problem was to determine the nature of the relationship between the JSE stock market and the Rand/US dollar exchange rate. To respond to the sub-problem, we then developed the first hypothesis that there is no significant relationship between the Rand/US dollar exchange rate fluctuation and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices.

The second sub-problem was to identify the nature of the relationship between the Rand/US dollar and the different sectors of the JSE to determine the level of impact on each sector. Likewise, we formulated a second hypothesis that there is no significant causal relationship between the Rand/US dollar movements and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices.

6.1.2 *Summary of the context*

The foreign portfolio investments are on the rise in South Africa due to the reasons discussed in Chapter 1 and 2. These factors include freely floating Rand, the economy openness, competitive and well-developed financial markets, and the world-class stock market that is highly liquid and competent legal systems, to mention few factors.

All ideal improvements that South Africa does to attract more foreign capital have adverse consequences on the contrary. These consequences include increased volatility of the stock market prices due to large investment portfolio flows (Bonga-Bonga, 2013). Another negative consequence of free-floating currency is the increasing exposure to speculative currency attacks which induce currency volatility and economic instability (LiPuma & Koelble, 2009). Moreover, recently the Rand value manipulation by currency traders, which seems to have eluded the policy makers and the JSE are some of the negative consequences brought by high levels of economic openness, free-floating currency and less restrictive exchange rate policies discussed in Chapter 1 (LiPuma & Koelble, 2009).

Therefore, stakeholders including financial regulators, policy makers, financial institutions, listed firms, traders and the JSE, need to stay a step ahead and understand how volatility spillovers initiate, their causality and their level of association as well as their impact on various sectors of the markets. Hence, it is important for the relevant stakeholders to understand these factors to enable them to plan ahead and avoid adverse incidents.

6.1.3 *Summary of the concepts and empirical evidence*

Much ambiguity exists in both theoretical and empirical literature on a subject of the exchange rates and stock markets relationship. The exchange rate and stock prices dynamics are grounded mainly in the financial market structure

rather than on the traditional macroeconomics determinants (Kodongo & Ojah, 2012).

The causal relationship of shocks from exchange rates to the stock exchange prices anchor on the Flow – orientated models. The Portfolio model which is a subset of the Stock – orientated framework defines the causal link of shocks from the stock market prices to the exchange rates markets (Alagidede et al., 2011; Granger et al., 2000).

According to Kodongo and Ojah (2012), foreign investors induce high levels of volatility as they chase after the “hot money”, especially in emerging capital and equity markets. Exchange rate volatility and the portfolio flows fluctuations are the attributes of the countries’ economy openness, accessibility, and attractiveness of the stock and financial markets to international investors.

A significant portion of JSE traders are international investors thus major selloffs of equities are disruptive to the financial portfolio investment as they may cause significant capital outflow that leads to the fluctuation of the exchange rate as investors convert their capital back to international currencies to exit the market (Bonga-Bonga, 2013).

Also, the free float nature of South African currency regimen exposes the Rand to the flow of international money influence, making it volatile (Mtonga, 2011; Muzindutsi & Niyimbanira, 2012). South Africa with its increasing economic openness, competitive and well-developed financial markets, as well as its competent legal structures, will continue enabling the country to be an attractive destination to international capital flows (Kodongo & Ojah, 2012)

Therefore, given the context above and supported by the theoretical models we have discussed, the JSE is more likely to be attractive to foreign portfolio investors seeking international diversification of financial assets, making it inherent to stock price fluctuations (Bonga-Bonga, 2013). Moreover, the South African financial market is more likely to be impacted by the causal relationship that follows the Portfolio model which defines the causal nexus of shocks from the stock market prices to the exchange rates markets.

Consequently, the study tried to uncover if there are any hidden causality linkages within the sectors of the JSE.

6.1.4 *Summary of the methodology*

We used high-frequency weekly data for the period between January 2006 and December 2016. This study employed the vector auto-regressive – VAR framework to determine Granger causality and impulse response function; to evaluate causal nexus between earnings of the selected JSE indices and fluctuations of the Rand/US dollar exchange rates (Adjasi et al., 2011; Barr et al., 2007; Bonga-Bonga, 2013; Kisaka & Mwasaru, 2012; Kodongo & Ojah, 2012).

Following the approach of Kodongo and Ojah (2012), we have established correlations and the coefficient of variance analysis between the returns of the JSE All Share, Top40, INDI25, FINI15, and RESI20 indices.

6.1.5 *Overview of the findings*

Our Research Problem is to analyse and evaluate how exchange rate fluctuation impact on the earnings of JSE listed firms.

We developed two hypotheses to respond to the research problem as summarised above and detailed in Chapter 1 and 2. Also, we have utilised methods from other researchers that investigated the causality link between the exchange rates and stock markets as discussed in section 6.1.4.

In response to the first hypothesis, we have provided evidence that shows the connection between the Rand/US dollar exchange rate fluctuation and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indices are significant. We have established correlations from the coefficient of variance analysis between the returns of the JSE All Share, Top40, INDI25, FINI15, and RESI20 indices. The RESI20 index is the most volatile while the INDI25 is the least volatile index. The Rand/US dollar fluctuation is correlated

negatively with the returns of all selected JSE indices in this study. The strength of the association between the Rand/US dollar fluctuation and the earnings of the All Share index is 40.5%, and the correlation is negative.

In response to the second hypothesis, we used VAR approach to determine Granger causality nexus, and we applied the impulse response function to confirm observations made from Granger causality within the VAR framework.

Our findings show a unidirectional Granger causality from the JSE All Share returns to the Rand/US dollar fluctuations within a significant level of 10%. The Top40 returns show a unidirectional Granger causality relationship to the Rand/US dollar exchange rate fluctuations at 5% significant level. The impulse response function confirmed the reaction of Rand/US dollar fluctuation to the one standard deviation shock from the JSE indices returns is different from sector-to-sector. Moreover, the response to shocks in all our tested variables is short-lived and lasted for two weeks before returning to normal. Impulse response function observations that are short-lived to the stock market shocks could indicate that foreign investors are after the “hot money” in the JSE stock market thus inducing high volatility as they enter the markets for relatively short periods as explained by Kodongo and Ojah (2012).

Moreover, the results are consistent with portfolio model theory and in line with the findings of other authors. We attribute the findings to the significant foreign investment flows in the JSE due to dynamic macroeconomic factors that characterise South African financial markets as attractive to international investors.

6.2 Recommendations

It is important for the business managers and traders to understand how exchange rate fluctuation affects the stock exchange and to learn how to protect against the stock market and the exchange rate volatility using available hedging instruments.

Exchange rate fluctuations are paramount to inform the decisions of foreign investors about the expected returns, trading and hedging strategies. Therefore it is critical to understand how sectors of the JSE are related to the Rand/US dollar fluctuations.

An opportunity exists for the lawmakers and regulatory institutions to develop monetary policies that could seek to reduce the volatility of the exchange rate and promote competitive exchange rates to ensure the domestic export firms remain relatively viable. Also, to alleviate the disruptive impact on the capital flow in the balance of payment and manipulation exchange rate (Bonga-Bonga, 2013; Khosa et al., 2015; Kodongo & Ojah, 2012). However, policy amendments should be executed with cautious decisions as empirical evidence revealed a strong correlation of between macroeconomic variables and the stock market (Ali et al., 2016).

6.3 Suggestions for further research

This study focused on the JSE and South African context. Further studies can be extended to other African stock markets to understand causality nexus of exchange rates and the stock prices in various sectors.

Future work to extend the scope of this investigation may include utilising exchange rate conditional volatility to evaluate how it influences the returns of different sectors in the JSE.

Also, what could be the impact of currency manipulation on instability in the equity markets and foreign exchange markets? The motivation of this question comes from the incident discussed in Chapter 1 in which the South African Competition Commission prosecuted 17 local and international banks for colluding on manipulation of the exchange rate of the Rand (Competition Commission, 2017).

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APPENDIX A

Consistency matrix

Consistency matrix

The Research Problem is to analyse and evaluate how exchange rate fluctuation impact on the earnings of JSE listed firms in an attempt to uncover the prevailing ambiguity by measuring the impact in different JSE sectors.					
Sub-problem	**Literature Review**	**Hypotheses or Propositions or Research Questions**	**Source of data**	**Type of data**	**Analysis**
The first sub-problem is to determine the nature of the relationship between the JSE stock market and the Rand/US dollar exchange rate.	(Granger et al., 2000) (Kisaka & Mwasaru, 2012; Kodongo & Ojah, 2012) (Bonga-Bonga, 2013) (Adjasi et al., 2011) (Ali et al., 2016)	H_{01}: There is no significant relationship between the nature of the Rand/US dollar exchange rate fluctuation and the daily returns of JSE All Share index.	Johannesburg stock exchange – share prices South African Reserve Bank – Exchange rates	Quantitative time-series data	VAR model granger causality

The Research Problem is to analyse and evaluate how exchange rate fluctuation impact on the earnings of JSE listed firms in an attempt to uncover the prevailing ambiguity by measuring the impact in different JSE sectors.					
Sub-problem	**Literature Review**	**Hypotheses or Propositions or Research Questions**	**Source of data**	**Type of data**	**Analysis**
The second sub-problem is to identify the nature of the relationship between the Rand/US dollar and the different sectors of the JSE to determine the level of impact on each sector.	(Gao, 2000) (Granger et al., 2000) (Kodongo & Ojah, 2012) (Bonga-Bonga, 2013) (Alagidede et al., 2011) (Adjasi et al., 2011) (Ali et al., 2016)	H_{02}: There is no significant causal relationship between the Rand/US dollar fluctuation and the returns of JSE All Share, Top 40, Industrial 25, Resources 10, and Financial 15 indexes.	Johannesburg stock exchange – share prices South African Reserve Bank – Exchange rates	Quantitative time-series	VAR Model granger causality and impulse response function