THE EFFECT OF GOLD PRICE VOLATILITY ON STOCK MARKET RETURNS IN SOUTH AFRICA

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ABSTRACT

The South African stock market has become a major player in the African Securities Exchanges Association through its performance. Gold is one of the commodities that are traded at Johannesburg Stock Exchange, hence gold price fluctuations are the crucial factor that JSE needs to keep its eye on. The demand for gold in South Africa is continuously rising because gold has full security, less credit risk and is a highly liquid instrument. Based on the given background, the study examines the effect of gold price volatility on stock market returns in South Africa, employing the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) (1.1) model. The study used monthly data covering the period from 2005 to 2017. The Storage model and discounted cash flows model which are the theories that connect gold price and stock market were specified. The research findings are supported by previous studies. The gold price volatility was found to have a negative effect on stock market returns, and the proxy of stock market returns is the All Share Index. The study will help to provide an understanding of how gold price volatility affects the stock market that will help policymakers to come up with policies that are relevant to volatility of gold price towards stock market.

Keywords: Stock Market Returns, All Share Index, Gold Price Volatility

DECLARATIONS

ON ORIGINALITY OF WORK

I, the undersigned, Gcadana Nqabisa Mary student number 201211182, hereby declare that the dissertation is my own original work, and that it has not been submitted, and will not be presented at any other University for similar or any other degree award.

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DEDICATION

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ACRONYMS AND ABBREVIATIONS

ADF	Augmented Dickey-Fuller
ALSI	JSE All Share Index
API	Application Programme Interface
APT	Arbitrage Pricing Theory
ARCH	Autoregressive Conditional Heteroscedasticity
ARDL	Autoregressive Distributed Lag
ASEA	African Securities Exchanges Association
BESA	Bond Exchange of South Africa
CAPM	Capital Asset Pricing Model
CSDs	Central Securities Depositories
DCF	Discounted Cash Flows
DMA	Directorate of Market Abuse
DTI	Department of Trade and Industry
EMH	Efficient Market Hypothesis
ETFs	Exchange Traded Funds
ETNs	Exchange Traded Notes
FBMES	FTSE Bursa Malaysia Emas Shariah Index
FIBV	Federation International Bourses de Valeurs
FMAB	Financial Markets Advisory Board
FMCA	Financial Markets Control Act 5 of 1989
FSB	Financial Services Board
GARCH	Generalised Autoregressive Conditional Heteroscedasticity
GDP	Gross Domestic Product
JET	Johannesburg Equities Trading
JSE	Johannesburg Stock Exchange
KLC	Kuala Lumpur Composite Index
LSE	List of Stock Exchange
LSE'S SETS	London Stock Exchange Electronic Trading System
MGARCH	Multivariate Generalised Autoregressive Conditional Heteroscedasticity
NIFTY	National Stock Exchange of India's stock market index
OLS	Ordinary Least Squares

OTC	Over the Counter
SAFEX	South African Futures Exchange
SARB	South African Reserve Bank
SECA	Stock Exchange Control Act 1 of 1985
SENS	Stock Exchange News Service
SENSEX	S&P Bombay Stock Exchange Sensitive Index
SROs	Self-Regulatory Organisations
SSE	Shanghai Stock Exchange
STRATE	Share Trading Transactions Totally Electronic
UK	United Kingdom
USA	United States of America
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
WFE	World Federation Exchanges

CHAPTER: 1

1.1 INTRODUCTION AND BACKGROUND OF THE STUDY

Gold is extracted in limited quantities since it is a precious mineral that is difficult to find in nature and this leads to the limited supply (Contuk, Burucu and Gungor, 2013). Thus, some South Africans have utilised gold as an investment for centuries. Moreover, investors considered gold as a trustworthy investment for either long-term saving or an investment portfolio (Srinivasan and Prakasam, 2015). On the other hand, Jaiswal and Voronina (2012) stated that gold has been utilised as money and is the most popular metal to invest in for the past few decades. Jaiswal and Voronina (2012) also considered gold as an extremely liquid security that has both the features of currency and a commodity. On other hand, Tully and Lucey (2007) postulated that gold serves as a platform of wealth, and is a basic measure of exchange and standard value.

The largest countries that produce gold include USA, Australia, China and South Africa, and the top countries in consuming gold in the world are USA, China and India (Khan, Aziz and Herani, 2016). However, Do, Mcaleer and Sriboonchitta (2009) observed a dramatic rise in the demand for gold due to a depreciated US dollar, increased inflation rate and eventually, recession in the world economy. In this manner, Contuk, Burucu and Gungor (2013) also proved that gold demand has risen because of the increased risk factors and uncertainties that take place in the financial markets. The assumption was that the supply and demand along with speculation affects gold price volatility (Contuk, Burucu and Gungor, 2013).

Nurudeen (2009) stated that a country's dependence on foreign aid could be reduced by an efficiently operating domestic stock market placing the country in a better position for competitiveness in the market for global capital. Furthermore, the author expressed that the South African stock market has become a major player in the African stock exchanges through its performance. The South African stock market was ranked 12th in the World Bank in 2017 according to market capitalisation and the JSE market capitalisation increased to US$1 230.98 (Nurudeen, 2017).

There were studies done on the sensitivity of stock market returns on gold price volatility, such as Khan, Aziz and Herani (2016) who assumed that gold was the leading indicator of economic development. Mishra, Das and Mishra (2010) also

found that the stock market of a country was highly dependent on local and international factors such as gold price volatility, when financial deregulation took place. Gaur and Bansal (2010) noticed that the stock market could crash when the currency weakens such as the US Dollar but gold was considered to be a safe instrument to invest in. Since investment on gold opens the opportunity to hedge against stock market exposure in developing countries.

When the stock market returns fall due to economic slowdown, the investors will pull out their investment in stocks and invest in gold up until the economy improves (Srinivasan and Prakasam, 2015). Since, South Africa is a net gold exporting there is no doubt that the country may be exposed to shocks in gold prices according to (Morem and Bonga-Bonga, 2018). However, Ewing and Malik (2013) explained the relation between stock market returns and gold prices as it provides the insight into how investors' positions can be combines when making hedging decisions.

1.2 STATEMENT OF RESEARCH PROBLEM

The demand for gold in South Africa continues to increase owing to full security fond of gold, to mention less credit-risk and liquidity. In this regard, Bhunia and Das (2012) contend that high levels of global inflation and political turbulence do not influence the liquidity of gold.

In South Africa, the domestic gold price was strongly associated with import parity which is determined by Dollar-Rupee rates, global spot prices and dollar local taxes and levies stated by Mishra, Das and Mishra (2010). For this reason, South Africa was a gold price taker subject to global gold price. Furthermore, Mishra, Das and Mishra (2010) stated that gold commodity turned out to be attractive to the individuals who were searching for a safe haven during the economic crisis, thereby increasing global spot gold prices. Given that the commodity prices were highly volatile it was vital for rich countries with resources to better understand the association that took place between commodity price volatility and fluctuations in stock market and volatility in commodity prices.

Gold is one of the minerals that contributes to economic growth in South Africa. The stock market was among the top essential markets in the financial sector and on economic growth, as proven by DTI in 2008. Therefore, it is essential to see what the important factors that affect stock market returns are.

Mishra, Das and Mishra (2010) revealed that a country's stock market became more dependent on internal and international factors including the gold price, once financial deregulation took place. Hence, this study aims to investigate the effect of gold price volatility on stock market returns in South Africa.

1.3 OBJECTIVES

The main objective of the study is to examine the effect of gold price volatility on stock market returns in South Africa.

SPECIFIC OBJECTIVES

- To examine the trends of gold price volatility and stock market returns in South Africa.
- To empirically establish the effect of gold price volatility on stock market returns in South Africa.
- To make conclusions and policy recommendations based on the outcomes of this study.

1.4 HYPOTHESES OF THE STUDY

- H_0: Gold price volatility does have an effect on stock market returns
- H_1: Gold price volatility does not have an effect on stock market returns

1.5 JUSTIFICATION FOR THE STUDY

Many academic analysts and researchers have noticed the issue of gold price volatility. However, there are few studies that were conducted on the effect of gold price volatility on stock market returns such as Contuk, Burucu and Gungor (2013) which focused on the effect of gold price volatility on stock returns. In South Africa, there is limited research in this area and this study is conducted with the aim of filling the gap in empirical literature. The few available researchers of the subject matter such as Mishra, Das and Mishra (2010); Bhunia and Das (2012) focused on Granger-causality of gold price volatility on stock market returns. Therefore, the study seeks to contribute to the literature on the effect of gold price volatility on stock market returns in South Africa.

This study will provide an understanding of how gold price volatility affects stock market returns which will help policymakers to come up with policies that are relevant to the volatility of gold price towards stock market.

1.6 OUTLINE OF THE STUDY

The introduction of the study and background is shown in Chapter 1, while Chapter 2 provides an overview of gold price volatility and the stock market over the periods of 2005 January to 2017 January. Chapter 3 provides a literature review that consists of three parts, theoretical framework, empirical literature and assessment of literature. Research methodology is provided in Chapter 4, and research findings are provided in Chapter 5. The last chapter, Chapter 6, provides a summary and recommendations.

CHAPTER 2: OVERVIEW OF GOLD PRICE VOLATILITY AND THE STOCK MARKET IN SOUTH AFRICA

2.1 INTRODUCTION

This chapter will provide an overview of gold price volatility and some factors that affect the stock market in South Africa. This chapter is divided into four sections. Section 2.2 provides the background and analysis of the gold price and the factors that affect the Johannesburg Stock exchange (JSE) as it is the market in which the prices of stocks and commodities are determined. The changes and general assessment of gold price volatility and the proxy of stock market returns which is the JSE All Share Index (ALSI) will be illustrated in Section 2.3. This section is important to understand whether a relationship exists between gold price volatility and the proxy of stock market returns. The last sections will provide some concluding remarks to serve as a summary of the whole chapter.

2.2 OVERVIEW OF FINANCIAL MARKETS

Financial Market is defined as a market where exchange or trade of financial instruments takes place and the flow of finds are facilitated in this market to finance investment by individuals, government and corporations stated by Darskuviene (2010). The markets can be divided through various ways where the trading of financial instrument takes place, that is, at an exchange-regulated market and over the counter market (OTC) is where the trading of financial instruments takes place. Hence, Brummer (2008) defines an exchange-regulated market as a formal market, where trade can either take place on the floor or otherwise via electronic networks of dealers by trading with one another wherever they are seated. Furthermore, the author defines the OTC markets as a market that takes place trading over telephone or by computer and is regarded as an informal market. Each of these markets can be categorised into two namely: primary and secondary markets.

In both markets (primary and secondary) the trading of financial instruments can be done, but that depends on the kind of the instruments traded. A primary market can be defined as a market where new instruments are issued for the first time such as local authority bonds, government bonds and shares in new public corporations. Thus, this type of market is considered as a place to raise new funds for the borrowers in the market according to Pilbean (2010). Secondary market is a market

that deals with the buying and selling of financial instruments which have been already issued. In addition, Pilbean (2010) explains this market as important to investors because it provides liquidity as it brings together the buyers and sellers of securities, reducing searching costs, and it reduces the transaction costs that are included in the deal that takes place. However, without this efficient market for shares there will be a limited number of markets that accept new issues. The Johannesburg Stock Exchange is regarded as a secondary market.

2.3 BACKGROUND TO THE JOHANNESBURG STOCK EXCHANGE (JSE)

Johannesburg Stock Exchange (JSE) was founded in 1887 by Benjamin Woolan, after the discovery of gold fields in Witwatersrand and the subsequent formation of the mining and investment companies mainly to provide a facility where investors would be able to buy and sell shares, as stated by (Kwon and Shin, 1999). The JSE has become the participant of the Federation International Bourses de Valeurs (FIBV) in 1963, and JSE was an active participant of the African Securities Exchange in 1993. All the stockbrokers were obliged to be the citizen of South African, on 8 November 1993 since this was the commencement. The screen-based system replaced the open outcry market on the 7 of June 1996, and the screen-based system was called Johannesburg Equities Trading (JET).

Muradoglu and Metin (1996) stated that the JSE has made the Stock Exchange News Service (SENS) to be known in 1997, a real-time news service for the dissemination of company information and price sensitive information. Listed companies are required to submit price-sensitive information to SENS before it is affected, to ensure transparency and efficiency in the market. However, in November 1999, the Share Trading Transactions Totally Electronic (STRATE) was recognized as the electronic trading system, and in that year, there was promulgated of the new insider trading act. The name of the Johannesburg Stock Exchanges has been officially changed to JSE Securities Exchange in September 2000, recently moved to the Gauteng Province and is situated in a city called Sandton.

In May 2000, there was an official launch of the JET API and four companies moved across to STRATE in a month later. However, Khil and Lee (2000) confirms that the largest stock exchange in Africa is the JSE Securities Exchange, and was ranked the 16th largest stock exchange worldwide. The international exchange programme was

established by JSE and American State of Illinois on a corporate agreement in 2001, this was primarily done for young people in the industry of stock broking. It merged or acquired with the South African Futures Exchange (SAFEX) (Lee and Gan, 2006).

Since 2002, the London Stock exchange (LSE)'s system replaced the STRATE electronic settlement environment and the JET system, after all listed securities was dematerialised and transferred to STRATE and JET. And the London Stock exchange (LSE)'s operates in London. To replace the SENS, the JSE introduced Info Wiz as a new information dissemination system in 2002, which is equivalent to the LSE's London Market Information Link. This provides a world-class information dissemination system and improves distribution of the price-sensitive information in the market. The ability of the JSE to employ efficient information systems has played a big role in attracting investors to the market (Muradoglu and Metin, 1996).

Mbeki (2002) highlighted that by making a strong relationship across the continent and easing admittance to world-class systems, then the JSE will be able in a competition for that capital. The contributions will be real to the African Renaissance and the goals of the NEW Partnership for Africa's Development (NEPAD). This will enhance its contribution to the Southern African region, as it brings transformation to African exchanges. As highlighted (JSE, 2005) stated that the technological innovation is still an ongoing process and the JSE is committed to ensuring that it sources the best available technologies to ensure efficiency in the market. There was a partnership with the Department of Trade and Industry when the Alternative Exchange (ALTX) was launched in 2003, also there was launch of interest rate exchange after a year later that was known as the yield-X. The Bond Exchange of South Africa (BESA) merged with the JSE in 2009, as stated on (JSE, 2012).

The Johannesburg Stock Exchange has achieved a lot since its establishment. Until the current day, the JSE has experienced remarkable developments to the extent that it has managed to be amongst the top five emerging markets and was an efficient and world class trading exchange in terms of regulation, settlement, risk management and clearing assurance. This makes it possible for investors to get returns from investments that had made them and it also channels funds into the economy. The core function was to increase primary capital and to ensure that cash resources were rechannelled into the economy. This builds the economy and

enhances wealth creation (JSE, 2013). If the stock market can mobilise and enhance the domestic savings and enhance the quality and quantity of investment that way can be able to fast-track the economic growth (El Wassal, 2013). The rate of saving can increase if there was better savings mobilisation and if stock markets assign savings to investment projects to have higher returns, thus that to make savings more attractive to savers the rate of return must be cumulative (El Wassal 2013). Consequently, more savings will be channelled into the corporate sector. Furthermore, the corporations are made competitive on an equal basis for funds by an efficient stock markets and it helps the investments to become more efficient.

The Johannesburg Stock Exchange (JSE) consists of three markets, namely: Equity Market, South African Bond Market and Derivatives Market. In addition, JSE (2013) also provides the Bond-based Derivatives, including Forward Rate Agreements, Bond futures, standard bond options and Vanilla Swaps.

2.3.1 EQUITY MARKET

This is a market that permits buyers and sellers to interact with one another as both seek exposure to the listed companies in South Africa. Across the world the listed companies connect buyers and sellers that are looking for exposure in the listed companies of South Africa, due to the variety of listed financial products and the listed companies which have been in operation for more than 120 years across the world (JSE, 2013). According to (JSE, 2013) the equity market in JSE comprises the AltX and the Main Board, meaning that investors are permitted to trade in the variety of the financial instruments that are involved but not limited to Exchange Traded Funds (ETFs), warrants, Exchange Traded Notes (ETNs), and Shares and specialised products. JSE (2013) states that the fast and efficient trading was provided by the equity market through its high-performance market data system and its world class Millennium IT trading system.

2.3.2 SOUTH AFRICAN DEBT MARKET

The debt market permits firms and companies to raise funds by issuing debt instruments to investors (Van Wyk, *et al*., 2014). In this type of contract, the borrower (company) has a contractual obligation to repay the holder of a debt instrument on a specific date or at regular intervals a fixed value of funds until an agreed time. The debt instrument has a guaranteed return to investors; hence the firm must repay the

holder of the debt instrument whether it has generated a profit or not. In this market, the securities are traded or issued on the maturity dates which can be more than a year and this market comprises of two types of market which are money and capital market that are differentiated by their maturity term. In the money market the trading, and issuing of securities takes place on the maturity dates that are less than a year (Van Wyk, *et al*., 2014).

2.3.3 DERIVATIVES MARKET

This market permits businesses to hedge risks that come from factors that are beyond their control like foreign currencies, volatility commodity prices, interest rate and equity prices. Derivatives derive their value from the values of the underlying securities and other variables. The types of these variables can be an index such as underlying instrument and JSE financial 15 Index, maybe equity, foreign exchange or commodity, money and bond. The derivatives are settled at future date. At some point the final settlement date can be extended to many years in the future. The firms that seek profits can use the derivatives by betting on which way prices will move; such speculators provide liquidity to the derivatives market and presume the risks that hedgers wish to avoid (Van Wyk, *et al*., 2014).

2.3.4 TRADING SYSTEMS

In 1996, the JSE limited closed the open outcry trading floor and adopted the automated trading system called the Johannesburg Equities Trading system (JET). This is a centralised and order-driven trading system; where buyers and sellers submit bid and ask prices of a particular share to a central location where orders are matched by a broker (Wassink, 2012). This improved investor protection and positively influenced the value of shares traded from US$78,391.8 million in year 2002 to US$423,384 million in year 2007 because of improved transparency, security and audit trials.

It is believed that a new system brings about more improvements and efficiency. Hence, the JSE Limited replaced the JET trading system with the London Stock Exchange Electronic Trading System (LSE'S SETS), adopted from the London Stock Exchange in 2002. One advantage of using LSE trading platform is that South African share prices could be disseminated around the world to over 100 000 terminals by LSE, thus the South African shares will have an increasing exposure to

the world investment markets (Mabhunu, 2004). This significantly influenced liquidity in the JSE as it made trading quicker and easier. Based on the data from World Federation Exchanges (WFE, 2011), the rate at which the value of share trading was increasing improved from 13.15% in year 2002 to 59, 28% in 2004, and this may be attributed to this transformation.

2.3.5 CLEARING AND SETTLEMENT SYSTEMS

In 1999, the JSE in collaboration with the largest commercial banks in South Africa established an electronic trading system known as the Share Transactions Totally Electronic (STRATE), which led to the instigation of the dematerialisation and electronic settlement process. According to the JSE (2004) Annual Report the JSE held a 41% interest in STRATE and this provided an improvement on its performance. In 2002, it dematerialised all listed securities and moved to the Share Transactions Totally Electronic System (STRATE), this electronic settlement environment is responsible for the number of securities that need to be settled such as bonds and equities for the Johannesburg Stock Exchange (JSE) and derivative products.

The purpose of this development was to stimulate the number of trades and as a result, the JSE Limited has successfully traded with no failure and this helped them build the confidence of investors. Mabhunu (2004) explained this transformation as a building block in positioning the South African Equity market as a favoured destination for South African instrument. A number products and services was provided by STRATE which were the data and services in the listed and unlisted companies and clearing and settlement services, to ensure efficiency in the market.

The market activity was enhanced by this transaction in an efficient settlement system and also decreasing the settlement, operational risk in the market, reducing the costs and the enhancement of efficiency will cause improvement on the international sensitivity of the South African market (Mkhize and Msweli-mbanga, 2006). It also boosted the international competitiveness of the JSE. The settlement of trades in the South African stock market occurs in five days after the trade (T+5 basis) but it is guaranteed. The JSE has shown initiative in moving the settlement cycle from T+5 to T+3 and it has concentrated on making these planned investments to position itself as the world's favoured destination for trading the South African

investment instruments through offering a secure, lower transaction costs, efficient and settlement market and market integrity (JSE, 2003).

2.3.6 LISTING OF COMPANIES IN THE JSE

According to Harvey (2016) the JSE allows investors to raise capital in highly regulated environments through its markets, namely, Main board, Altx board, Africa board and BEE section. The main board is the primary board where the FTSE/JSE top 40 companies are listed. There are 348 listed companies on the JSE main board (JSE, 2008). The Altx board is a market where small and medium companies that do not meet the main board listing requirements are listed. In 2003, JSE launched this market in collaboration with the Department of Trade and Industry, to promote transparency, liquidity and growth for small and medium companies. The Africa board is a segment of the main board which allows the top African companies to list their shares on the JSE. It was established to attract foreign investors to the African market. Shares are listed in the same way they are listed at the main board and they are listed on the LSE trading system, JSE Trade Elect. The JSE's trade Elect main board has section of the BEE on it, which is utilised for companies that wishes to list their BEE shares scheme. This segment was initiated by South African companies wanting to allow trading of their shares in their BEE share scheme.

In 2005, the JSE launched a new market called the Yield-X where several interest rate products are traded. It permits both the trading of derivatives and spot interest rate products on one platform with multilateral netting across all products. The JSE was also demutualised as JSE Limited in 2005. This allowed unauthorised users of the JSE to get ownership interest in the JSE because ownership of JSE shares is no longer a requirement for membership of the JSE.

2.3.7 MEMBERSHIP OF THE JSE

60 equities members	120 Equity Derivatives
92 Commodity Derivatives members	102 Interest Rate and Currency Derivatives members licensed in South Africa, a mix of local and international operations

Source; JSE (2017)

The above table shows members of JSE that are registered on each market (JSE, 2017).

2.3.8 REGULATION OF THE JSE

The efficiency in the functioning of the JSE is associated with its ability to operate in accordance with financial regulations determined by the authorities to protect the interests of various market participants, and which facilitates the willingness of people and institutions to invest in the markets (Van der, Merwe and Mollentze, 2010). It is privately governed by the board of directors; its operation is licensed by the Stock Exchange Control Act 1 of 1985 (SECA) that governs equity market and the Financial Markets Control Act 5 of 1989 (FMCA) which governs the derivatives markets.

The JSE is regulated by the capital market department in the financial services board (FSB). The FSB ensures compliance with international standards with regards to the regulation and supervision of capital markets. It regulates its listed companies, central securities depositories (CSDs), clearing houses and brokerage companies based on Securities Service Act 36 of 2004 to ensure transparency, proper supervision and investor protection. To ensure sufficient disclosure of all the relevant information to investors, the JSE requires all issuers to comply with some listings requirements.

All JSE activities were subject to the supervision of the Financial Services Board (FSB) which is the primary regulator of the South African financial markets. The FSB delegates the supervision of the markets to the registrar who in turn delegates certain aspects to Self-Regulatory Organisations (SROs) which is the JSE in our case. The JSE performs its regulatory duties with the support of the Financial Markets Advisory Board (FMAB) and the FSB Directorate of Market Abuse (DMA) under the supervision of the registrar.

The registrar also stipulates some conditions that the JSE needs to act in accordance with. The registrar reports directly to the Minister of Finance in South Africa. According to the WEF (2011) report the South African Stock Exchange ranks the first position out of 142 countries for its regulation of securities exchanges. This proves the competitiveness of the JSE and its good relationship with the FSB. Proper regulation and supervision of the JSE promotes efficiency as it reduces the problem of asymmetric information by encouraging transparency in the market. This also improves its ability to mobilise savings and ensure risk diversification.

2.3.9 ANALYSIS OF TRENDS

2.3.9.1 STOCK MARKET PERFORMANCE

In the world, the Johannesburg Stock Exchange (JSE) was consistently ranked the 19th largest stock exchange, whilst on the African continent JSE was the largest stock market (JSE, 2017). The Johannesburg Stock Exchange was the 6th largest stock exchange among emerging economies and it stands behind two stock markets each from China and India, and one from South Korea (JSE, 2017).

TABLE 1: STOCK MARKETS IN SELECTED ADVANCED AND EMERGING ECONOMIES 2017.

Bourse	Value of Traded	% GDP	Capital	Turnover
Tokyo SE, Japan	118.60	127.72	6 222.27	92.84
Amman SE, Jordan	5.83	59.82	23.97	9.74
Bovespa and BM, Brazil	31.26	46.45	954.72	67.02
Deutsche Börse, Germany	42.38	61.52	2 262.22	63.58
Hong Kong	572.01	1 274.13	4 350.51	43.38
Korea Exchange	131.43	115.75	1 771.77	112.36
Johannesburg SE	117.26	352.29	1 230.98	25.74
Mexican Exchange	9.49	36.27	417.02	26.00
Indonesia SE	9.11	51.27	520.69	17.77
Santiago SE, Chile	13.75	106.35	294.68	12.89
Colombia SE	4.23	39.29	121.48	10.77
Istanbul IMKB, Turkey	44.33	26.73	227.51	165.76
Egyptian Exchange	6.13	19.78	46.55	30.71

Source: World Bank (2017)

In the stock market value traded, JSE was among the top ten (standing at number seven) and the JSE was significant in the national economy, measured, by the ratio of market capitalisation to Gross Domestic Product, was above 300%. Furthermore, this was remarkably large, and only surpassed by Hong Kong on stock market capitalisation. The JSE had better stock market turnover than other developing

countries in 2017. The study used 2017 figures in the above Table 1 from the World Bank statistics, for a selection of advanced and emerging economies.

Hassan and Van Biljon (2010) stated that the return on the aggregate stock market is the long-term average equity, more than the proxy for the risk-free rate of interest, compared to the advanced economies it was approximately 6% between the highest, but in the same order of magnitude, despite higher perceived risk. The cost of equity capital was determined by equity risk premium. However, the expenses to the listed firms from increasing equity capital in the domestic market was determined by the returns that were expected investors from holding stocks. Collective with the stages of rates of interest and other risk sources, it is a significant determinant of the overall cost of capital in South Africa which in turn determines investment, and hence growth and employment (Hassan, 2013).

TABLE 2: EMERGING EQUITY MARKETS IN SELECTED DEVELOPING COUNTRIES TURNOVER RATIO.

Region or Country	**2013**	**2014**	**2015**	**2016**	**2017**
Greece	29.07	59.92	42.64	38.51	29.19
Spain	81.94	99.88	124.29	97.84	82.84
Turkey	191.19	168.25	185.15	168.60	165.76
Russia	30.56	41.44	29.83	25.73	23.14
Hungary	54.67	49.02	42.07	40.48	32.90
Germany	67.80	73.00	84.19	74.93	63.58
Thailand	98.74	72.17	77.79	80.92	61.87
Ireland	8.76	11.55	16.35	21.06	19.71
South Africa	24.63	26.31	31.79	38.37	25.74

Source: World Bank (2017)

The South African Stock Market performs better in terms of listings on the stock market compared to other African markets and emerging markets and JSE performance was improving over the past 4 years up until 2017 when the JSE dropped to 25.74. It also surpasses other developed markets in some instances.

TABLE 3: TOTAL DOMESTIC AND FOREIGN COMPANY LISTINGS ON MAJOR NATIONAL STOCK EXCHNAGES

	Total Listings			**New Listings**		
Exchange	**Total**	**2017 Domestic**	**Foreign**	**Total**	**2017 Domestic**	**Foreign**
Abu Dhabi SE	69	66	3	-	-	-
Amman SE	194	194	0	-	-	-
Athens	200	196	4	-	-	-
Bahrain Bourse	43	42	1	-	-	-
Beirut SE	10	10	0	-	-	-
Belarusian Currency SE	0	0	0	-	-	-
BME Spanish Exchanges	3 136	3 110	26	5	0	2
Borsa Istanbul	375	374	1	0	0	0
Botswana SE	35	24	11	1	1	1
Bourse de Casablanca	74	73	1	-	-	-
BRVM	45	45	NA	-	-	-
Bucharest SE	87	86	1	NA	NA	NA
Budapest SE	41	41	0	NA	NA	NA
Cyprus SE	74	74	0	-	-	-
Deutsche Bőrse	499	450	49	0	0	0
Dubai Financial Market	61	61	NA	-	-	-
Euronext	1 255	1 093	162	1	1	0
Iran Fara Bourse SE	103	103	0	0	0	0
Irish SE	52	41	11	0	0	0
Johannesburg SE	366	294	72	3	1	2
Kazakhstan SE	103	90	13	-	-	-
Ljubljana SE	35	35	NA	-	-	-
LSE Group	2 498	2 070	428	7	2	5
Luxembourg SE	168	28	140	0	0	0
Malta SE	23	23	0	-	-	-
Moscow Exchange	234	230	4	1	1	0
Muscat Securities Market	112	112	NA	0	NA	NA
Nairobi SE	NA	NA	NA	NA	NA	NA
Namibian SE	44	10	34	-	-	-
Nasdaq Nordic Exchanges	984	944	40	3	0	3
Nigerian SE	167	166	1	0	NA	NA
Oslo Bors	225	180	45	2	0	2

Palestine Exchange	48	48	NA	NA	NA	NA
Qatar SE	45	45	NA	-	-	-
Saudi SE (Tadawul)	188	188	NA	0	NA	NA
SIX Swiss Exchange	263	228	35	0	0	0
Mauritius SE	76	74	2	1	NA	1
Tehran SE	326	326	0	0	NA	NA
Tel-Aviv SE	457	431	26	0	0	0
The Egyptian Exchange	255	252	3	0	0	0
Trop-X	24	22	2	NA	NA	NA
Tunis SE	81	81	NA	0	NA	NA
Ukrainian Exchange	96	94	2	0	0	0
Warsaw SE	890	861	29	2	0	2
Wiener Borse	536	67	469	22	22	0
Zagre96b SE	155	155	NA	-	-	-
Total Region	14.07	12.684	1.386	304	231	73

Source: World Federation of Exchanges (2017)

The above Table 3 presents that as of 2017, the Johannesburg stock market had 294 domestic companies listed and 72 foreign companies. In the same year, there was 1 new company and 2 foreign companies which listed on the South African Stock Market. As a result, this was likely to increase the functioning of the stock market and its role of pooling resources and allocating them into efficient sectors of the economy. Furthermore, the well-developed stock market and banking sector, South Africa has a deep, efficient and well-established bond market. In terms of the number of bonds listed and turnover the leader was the South African bond market (Van Zyl *et al*, 2009).

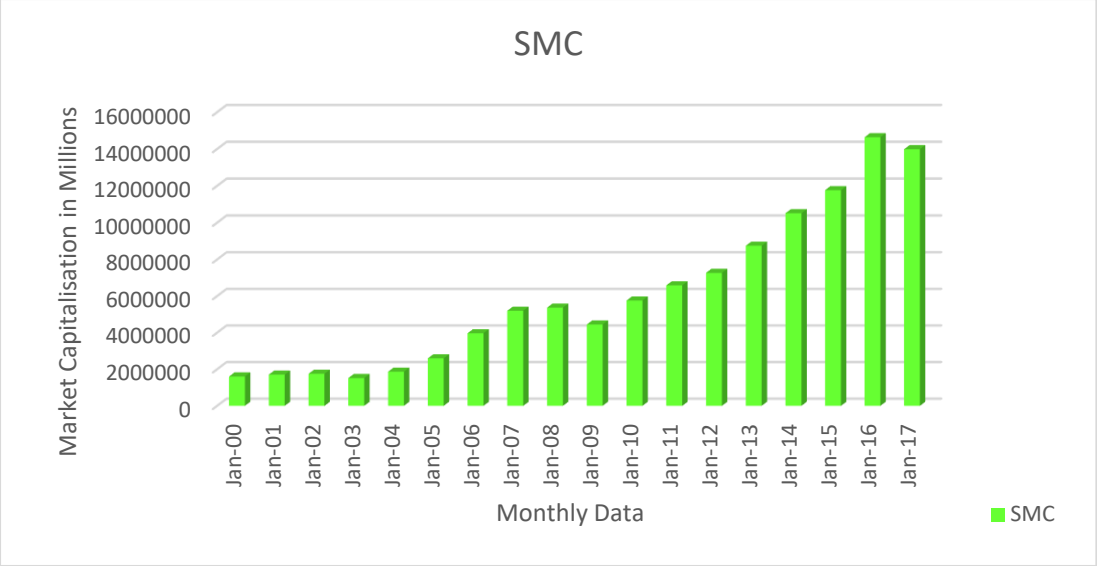

FIGURE 1: STOCK MARKET CAPITALISATION

Source: Quantec Data (2017)

The market capitalisation as a percentage of Gross Domestic Product (GDP) increased from 1604929 in year 2000 to 1751961 in 1995; however, the increase rate was low such that in some years it was insignificant. As shown in the above diagram, after year 2003 it started increasing over the years until year 2008, from which year the JSE experienced a rapid increase on its market capitalisation from 4447210 in year 2009 to 14640469 in year 2016 and a slight a fall of 13988069 in year 2017. It was a period where JSE had more than 400 listed companies (Hassan, 2013).

The JSE (2003) report stated that the trade volumes and listings dropped due to weak global equities markets. Even though the number of listed companies has not yet recovered, the development in the JSE was still well reflected by market capitalisation as it responds positively to major changes such as the introduction of new systems. Furthermore, the stock market size was assessed by a common indicator such as market capitalisation or gross domestic product, and this was equal to the market value of the listed shares divided by the relevant gross domestic product. The indicator has been widely utilised in the literature of (Levine and Zervos, 1999; Bekaert *et al*, 2006; Rajan and Zingales, 2003) as a stable measure of stock market development for two reasons.

Firstly, it was a measure of stock market size, which was positively correlated with the ability to mobilise capital and diversity risk. Secondly, it was presumed to include companies' precious retained profits and future growth prospects so that a higher ratio to GDP can signify growth prospects as well as stock market development. Hence, Adelegan and Radzewicz (2009) identified the main shortcomings of this measure were that a high ratio solely driven by the appreciated values of only a few companies with little or no change in the amount of funds raised and no change in the breadth of the stock market may be misinterpreted as stock market development.

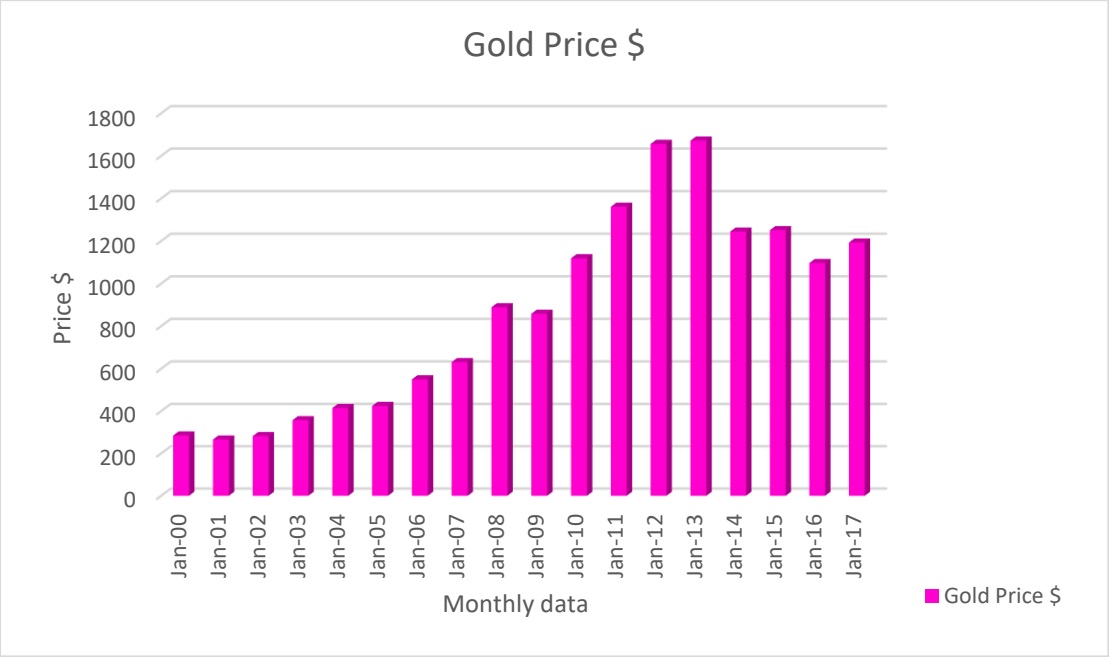

FIGURE 2: GOLD PRICE

Source: South African Reserve Bank (2017)

The SARB (2017) presented that gold price on the JSE stock market was $284,46 per ounce at the beginning of January 2000. The JSE (2011) reported that in 1980 there was a high point of $615 per ounce of the average price of gold which was primarily reached because of the Soviet invasion of Afghanistan, where after in 2000 the average of gold price dropped to $279. At the beginning of 2001 January, the gold price revived from $265, 71 to $888, 69 in January 2008, and towards the end of 2008 the price of gold recovered further up to $1118, 77 in January 2010. JSE (2011) presents that the average price of gold rose from $603 per ounce in 2006 which was caused by financial crisis between the periods of 2008/9 up to the average price of gold of $1224 in 2010.

From January 2010 to January 2013 the gold price revived with a drastic increase from $1118,77 to $1671,42, which was followed by a drastic decrease of $1243,93 to $1096,52 at the beginning of January 2014 up to January 2016. In January 2017, the JSE stock market opened with an increase in the gold price to $1192, 63. However, during 2011 gold price was in average of $ 1.668 and that was the eleventh consecutive marking of the average annual price rises. Moreover, in 2012 gold price failed to reach the level that it had reached in 2011 September, even though the stability of the Eurozone was threatened by sovereign defaults and there were serious doubts regarding the US economic recovery (JSE, 2011). The financial markets were dominated by gold that was wedged in the ebb and the flow of risk on, risk off from the equities through to commodities.

The little or no new negative news flow, currency, equity and the industrial commodity markets were characterising in some periods the relative stability and usually benefit as funds flow in, hence risk on. If the stability was seeming to be threaten by the publication of any bad news the funds would be quickly retreated, mostly in the US treasuries or the US dollar, hence risk off (SARB, 2011). In 2012, gold did not benefit significantly although it's a safe haven between other financial assets. This was caused a continued negative correlation among the dollar and the dollar gold price and this was the largest in the account, hence the stronger dollar tended to cap appreciation in the gold price (SARB, 2017).

There was reduction on the pattern due to the fact that investors frequently have to sell the profitable gold position so that they can be able to fund losses in other markets. The US Federation Reserve announced that the further round quantitative easing in mid-September, provided a boost to gold price, furthermore, in 2012 there was an average of $1.651 over the third quarters, and there was improvement on the gold price average of $1.717 that was announced in the third round of quantitative easing for the final quarter. Moreover, the final weeks of the year saw further profits taking and risk aversion as the fiscal cliff loomed and in 2013 gold price has closed with $1.613 (SARB, 2011).

TABLE 4: TOP TEN GLOBAL GOLD PRODUCERS IN 2013

China	437.3t
Australia	259.4t
US	226.9t
Russia	237.8t
Peru	182.2t
SA	168.8t
Canada	128.3t
Mexico	101.2t
Ghana	97.8t
Indonesia	94.8t

In 2013 the then Chamber of Mines presented that the gold price fell to R435, 496/kg hence the total costs production was including capex that increased to R450, 789 kg, and meaning 70% was the marginal or loss of the industry after capex whereas in 2013 the gold industry made a solid contribution. In 2015, the inflation rate continued to be low and that caused the gold price to decline throughout the year; also, the US dollar was strong (SARB, 2013).

In addition, the signs of a sustained growth momentum were encouraging the world economy at large, mostly in the US, along with the expectations of monetary policy tightening (SARB, 2011). The gold and platinum prices increased since there was a weaker exchange rate in terms of rand and all time the gold price was high, which gave support to domestic mining companies regarding revenue generation. In 2016 the precious metals prices improved but that was not reported by overall market fundamentals. And large above-ground stockpiles, combined with only a slight deficit between mine supply and demand, could limit upward price movements. According to SARB (2011) there was a significant rise from 15% in 2015 to 20% in 2016 on the gold share of mining revenue, mainly after the back of a stronger gold prices and the weaken ran. Even though this rise was from the lower base, gold revenue raised by R17.9 billion to R71.1 billion, or by 34% since 2015.

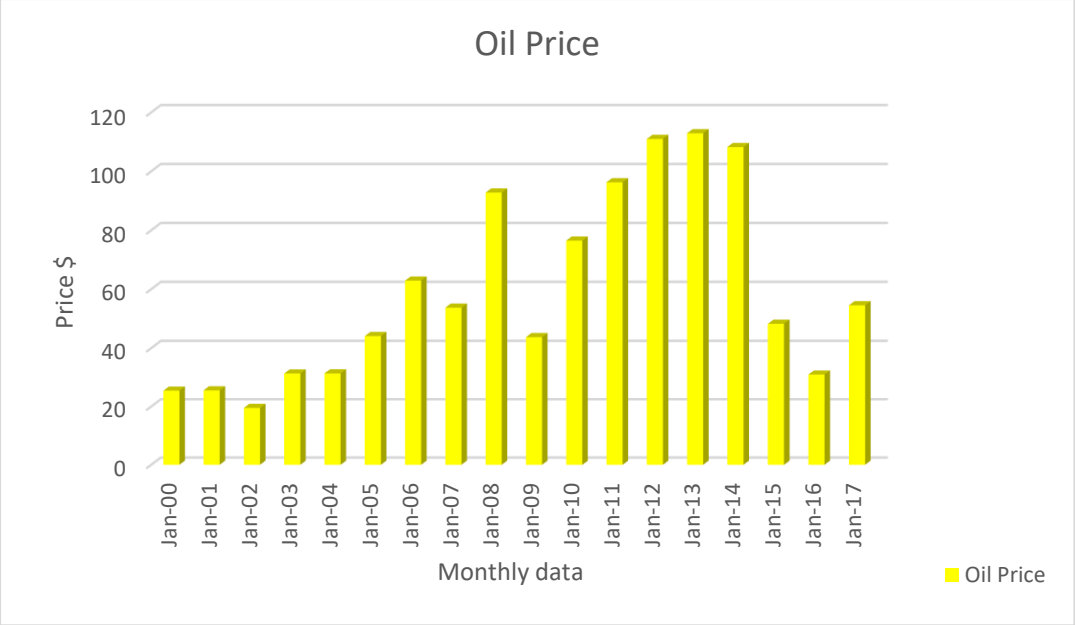

FIGURE 3: OIL PRICE

Source: South African Reserve Bank (2017)

The oil price recovered some ground by rising from $25, 41 to $25, 52 per barrel within the year from January 2000 to January 2001. There was a slight decrease to $19, 5 in the period to January 2002, which was followed by an increase in January 2003 to January 2006 January from $31, 3 to $62, 89. The oil price on the JSE stock market in January 2007 showed a decrease to $53, 72 and the following year in January 2008 the oil price increased sharply to $92, 78. In January 2009, there was a drastic decrease in the oil price to $43, 71. However, in the period of 4 years (Jan 2010 to Jan 2013) the oil price showed a drastic increase from $76, 46 to $112, 92. The oil price decreased drastically from $108.22 to $30, 93 between January 2014 and January 2016 but in January 2017 it had strengthened to $54, 53.

International crude oil prices fell sharply during 2015 and early in 2016, with supply-side factors dominating price developments. Although non-OPEC supply growth slowed, OPEC members continued with their operations and produced even more oil, exacerbating negative market developments and triggering further price collapses throughout 2015. By January 2016 the price of Brent crude oil had fallen to its lowest level since 2003, at $27.9 per barrel. It has since recovered substantially, hovering around $40 per barrel late in March 2016. However, in all countries that are importing oil, the low prices of oil are more beneficial to them. This have

disadvantage impact to many countries that are exporting oil, some countries are in Africa and this affecting their trade accounts, economic growth and fiscal revenues (SARB, 2016).

In 2016 and 2017 there was an improvement in the crude oil, although in the United States there was a stronger economic activity and China was having a less negative outlook and was supported by the expectations of demand growth. Perhaps, some of the largest oil producers were witnessed by the latter segment of 2016, as a member of OPEC, that agreed on the limit supply so that prices can be supported. In the United States the increase in the shale gas production has affected negatively the oil price even though oil price has improved.

However, SARB (2013) reported that during the financial crises in 2008 the world oil price has experienced the incomparable volatility, with ranging prices from the peak at nearly $150 per barrel in July to December when there was a low-price round to $40 per barrel. The oil price ranging between $90 to $130 per barrel in the following year. Moreover, as expected the economic growth has improved in the years following global recession between the year 2008 to 2009 and the unrest in North Africa and the Middle East have helped in keeping prices relatively high; with Brent crude oil spot price averaging $112 per barrel in 2012.

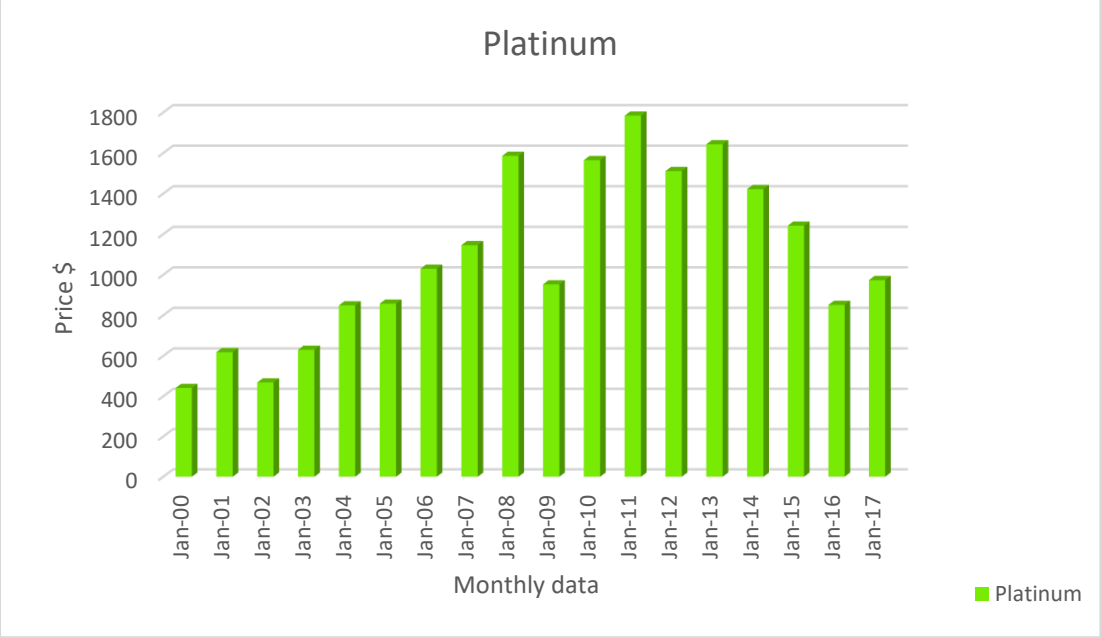

FIGURE 4 PLATINUM

Source: South African Reserve Bank (2017)

Platinum began the year 2000 with a good recovery from $440, 80 and $618, 25 in January 2001 to be followed by a slight decrease in January 2002 to $468, 18. Between 2001 and 2007 the platinum price revived from $468, 18 to $1145, 59. Then there was a drastic increase to $1586, 07 at the beginning of 2008 and this period was followed by drastic fall in the price of platinum down to $952, 43 in January 2009. In the period 2010 to 2011 the South African platinum price showed a drastic increase to $1784,29 which was followed by a slight decrease to $1510,67 in January 2012 (JSE, 2012).

The price of platinum decreased continuously from $1643, 15 to $851, 41 between January 2013 and January 2016. In 2017, the platinum price recovered up to $973, 45 and in past few months the platinum price was still doing well. The recovery in South Africa's platinum production in 2015 took place within an environment of relatively subdued global demand, thus impacting negatively on platinum prices. A market surplus and large above-ground stockpiles are not supportive of a sustained price recovery (JSE, 2015).

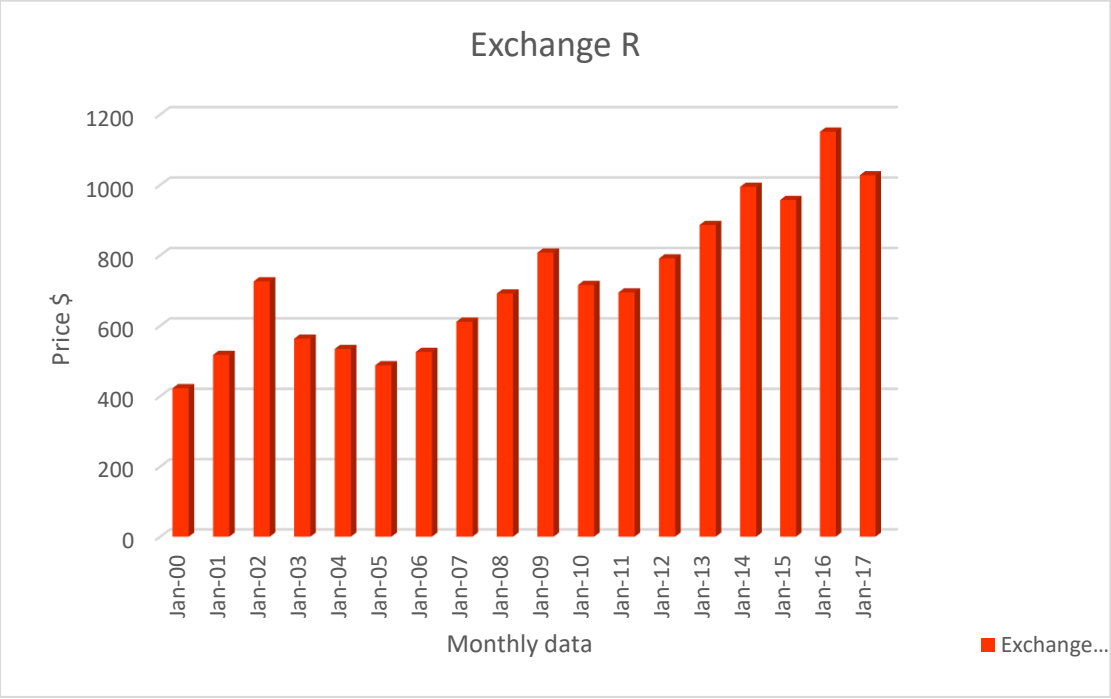

FIGURE 5: EXCHANGE RATE

Source: South African Reserve Bank (2017)

The SARB (2017) reported that the rate of exchange was rose strongly from $422, 42 to $725, 60 between January 2000 and January 2002 and during the years 2003 to 2005 it fell continuously from $563, 08 to $487, 79. In 2006, the exchange rate recovered from $525, 69 up to $807,55 at the beginning of January 2009. In the ensuing year to January 2010 the exchange rate decreased to $715, 82 and again to $694, 44 in January 2011. The South African rand exchange rate increased between the years 2012 and 2014 from $791,01 to $994,45. Within a short period at the beginning of 2015 the exchange rate decreased to $957,04. In January 2016 there was an increase in the rate of exchange to $1151, 01 preceded in the previous period by a decrease. The rate was $1027, 18 at the beginning of 2017 (JSE, 2017).

There was drastic depreciation towards the year end of 2015 up to 2016 the aftermath of the so-called Nenegate, and during this incidence in 2015 the rand has strengthened. On the 11 January 2016 the rand has traded at R16.92 per US dollar, at its weakest level, but then there was a strong appreciation thereafter the year end of 2015 and rand was trading at R13.73 per US dollar (11 % stronger than at the end of 2015). The higher commodity prices were included in the factors that supported the rand's retrieval, and the country's terms of trade has improved, on the current account (there was a smaller deficit) of the balance of payments. The county's credit rating was not downgraded by the rating agencies to sub-investment grade, and the USD also weakness. The rand has appreciated on the beginning of the year 2017 further on the back of an enhanced economic outlook, higher commodity prices and some dollar weakness. However, political developments at the end of March led to a sharp reversal in the currency's fortunes (SARB, 2017).

2.4 CHANGES AND GENERAL ASSESSMENT OF GOLD PRICE VOLATILITY AND THE PROXY OF STOCK MARKET RETURNS (ALSI) IN SOUTH AFRICA

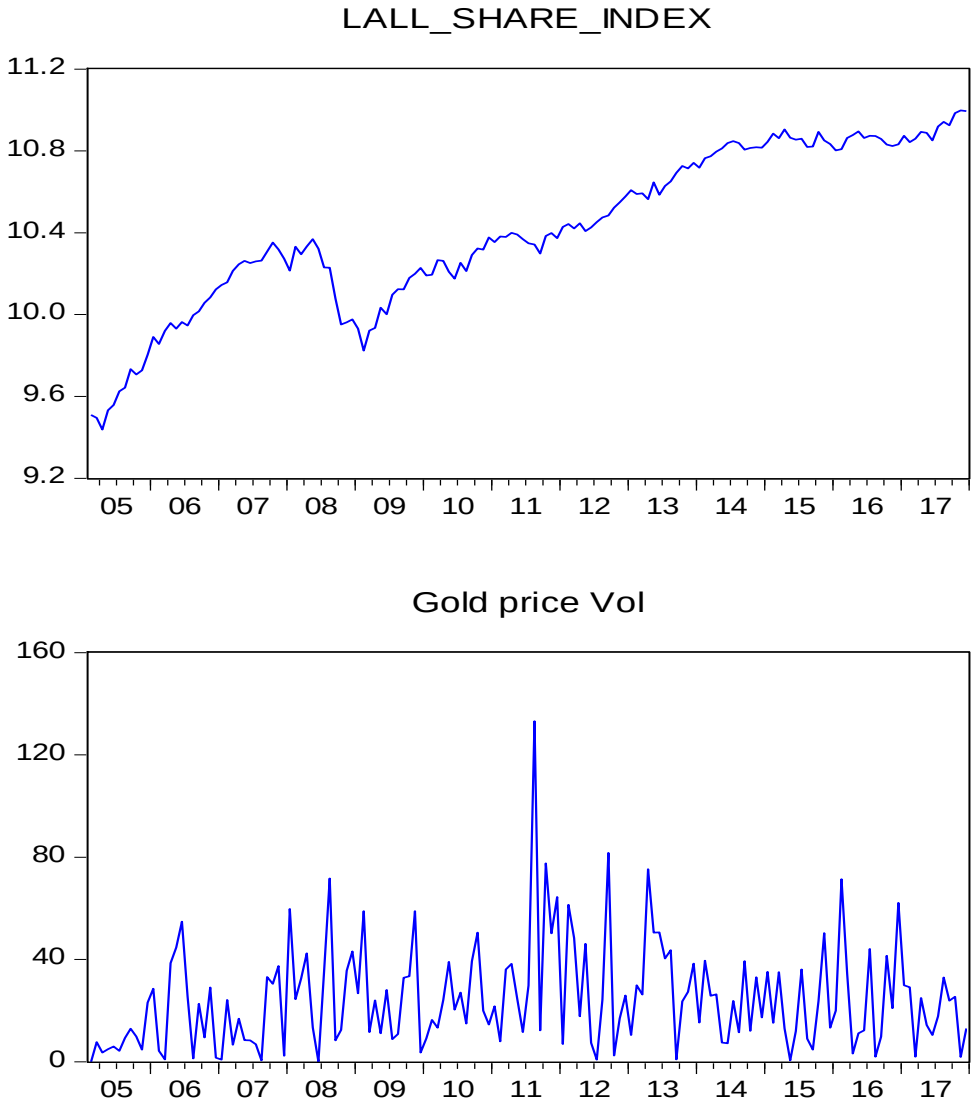

FIGURE 6: CHANGES IN ALSI AND GOLD PRICE VOLATILITY

Source: South African Reserve Bank and Quantec Data (2017)

Figure 6 illustrates the changes in the All Share Index and gold price volatility. The ALSI is used as a proxy for stock market returns to evaluate the performance of the stock market in South Africa. Observing the changes in gold price volatility and ALSI, the study states that there is a negative relationship between the two variables. The study observed that gold price volatility had a sharp decrease towards the end of 2006 to 2007, while the All Share Index was on an increasing trend from 2005 up to the beginning of 2008.This suggests that there was growth in the JSE, even though gold price volatility was volatile over this period. However, towards the year end of

2008 to 2009 the ALSI started to show a drastic decrease, whilst on the other hand gold price volatility was increasing drastically. The IMF, staff country report (2008) revealed that the rise in the All Share Index was supported by the gains in the commodity sector (gold and platinum).

Again, the study observed that between the period 2011 and 2012 gold price volatility rose dramatically whereas the All Share Index rose over the years up until the period between 2015 and 2017 where after it started to have steady growth. Furthermore, gold price volatility was very volatile (the sharp increase was followed by a drastic decrease) during the years 2015 to 2017, and vice versa. The JSE (2017) report revealed that the All Share Index showed overwhelming performance from June to the end of July 2017, having reached the 55 000-point mark for the first time having had strong support from financials, resources and industrial stocks.

During this period the South African mining sector did not have a good output due to the steep fall in gold production as deposits became increasingly difficult to access (SARB, 2017). Analysis that was done on the mining sector's performance revealed considerable volatility across the board (Chamber of Mines Report, 2017). This analysis of confirmed what has been shown above of gold price volatility trends from 2007 to 2011, that the fluctuations in gold price volatility were serious. By looking at the trends in 2011 there was a drastic increase in gold price volatility and after that the gold price was steadily volatile.

2.5 SUMMARY

This chapter showed the background of the study by analysing the fluctuations in the gold price volatility and stock market returns in South Arica pre- and post-period. Moreover, the chapter showed that the major causes of the fluctuations in gold price volatility are due to fundamentals of demand and supply and the phenomenal increase in the financialisation of the commodity markets. The trends did not indicate clearly the relationship between gold price volatility and stock market return. In the above trends, one cannot conclude that there is a positive or negative relationship between gold price volatility and the stock market. Therefore, in the following chapters the study will further investigate the effect of gold price volatility on stock market returns based on both literature and econometric techniques.

CHAPTER 3: LITERATURE REVIEW OF THE STUDY

3.1 INTRODUCTION

This chapter covers the theoretical and the empirical literature on the effects of gold price volatility on stock market returns in South Africa. The chapter will be divided into three sections: theoretical framework, empirical literature and assessment of literature. There are several factors that affect stock market and gold price volatility, that could alternatively be from the investors' point of view and display price movements.

3.2 THEORETICAL FRAMEWORK

3.2.1 THE STORAGE MODEL

The ideology of the storage model came from Gustafson (1958) and was later modified by Wright and Williams (1991). The storage model is the theory that tends to dominate in explaining the commodity price behaviour. The storage model examined the participation of speculators on commodity transections based on future expectations of changes in prices (Prakash, 2011). In this regard, the commodity will be stored when the actual price is less than what they expect to prevail in future period (long term mean of the price adjusted for interest rate costs and storage), because they want to sell the commodity at a high price in the next coming period (Prakash, 2011). Furthermore, when the existing price is higher than the expected value in the next coming period the commodity will not be stored by the peculators (Prakash, 2011). Basically, the storage model theory is based mainly on commodities that are easily stored and when the production of commodities is unpredictable.

3.2.2 SCARCITY RENT

The scarcity rent theory is among the first theories that explain metals pricing. Since the commodities are non-renewable, the investors (owners of commodity) will charge an expensive price and then receive a scarcity rent (Hotelling, 1931). Under this theory there is a Hotelling rule that draws the decision to extract commodities due to the intertemporal arbitrage which will result in changes in price corresponding to the interest rate changes (Prakash, 2011). In addition, the prediction of Hotelling is deemed not to be sufficient to explain the present observations of price movements (Prakash, 2011). Krautkraemer (1998) states the reason behind the fundamental

assumptions for a finite commodity which was undermined by technological change and constant new detections which permit for better withdrawal and use of a lower quality of minerals.

3.2.3 DISCOUNTED CASH FLOWS (DCF) APPROACH

The effect of gold price volatility on stock market returns can be clarified by utilising the valuation method based on the ideology of Discounted Cash Flows (DCF) approach. The DCF approach states that the sum of the expected future cash flows discounted is said to be equal to the value of a company and the value of its stock, for example average cost of capital (Brose Olsen and Henriz, 2014). On stock market returns there is an effect of discount rates and systematic movements in expected cash flows (Brose Olsen and Henriz, 2014).

However, Brose Olsen and Henriz (2014) state that gold is regarded as a real resource and is an essential input in the production of other goods; this displays that the expected cash flows could be affected by the future cash flows. In the case of the impact on specific stock, the results rely on whether the organisation is a net purchaser or a net manufacturer of gold, when a gold price rise would cause a decrease in the earnings of net consumer and higher earnings in net producer (Brose Olsen and Henriz, 2014). According to Huang (1996) in the world economy as a whole, gold is an input which is why a rise in gold price would reduce the aggregate stock market returns.

3.2.4 DISCOUNT RATE

The stock market returns can also be affected by gold price through discount rate. Based on the ideology of the theory of economics, the expected discount rate involves the real interest rate which was expected and the expected inflation rate. Both would rely on the expected gold price (Brose Olsen and Henriz, 2014). In this case, a country that was importing gold with an expensive gold price was considered as a net purchaser of gold and it would have a negative impact on the trade balance, there is an upward pressure on the domestic rate of inflation and a descending pressure on the country's foreign exchange rate (Brose Olsen and Henriz, 2014). Furthermore, Brose Olsen and Henriz (2014) expresses the relationship is positive between the discount rate and expected inflation rate and negative relationship with the stock market returns. Brose Olsen and Henriz (2014) postulate that in the

economy gold is a main resource; hence the price of gold also affects the real interest rate. Huang (1996) states that in taking into consideration the situation where there is a higher gold price in relation to price level in general, a rise in real interest rate would force an increase in the rate of return on corporate investment which in turn will result in a reduction in stock prices.

3.2.5 EFFICIENT MARKET HYPOTHESIS (EMH)

The efficient market hypothesis theory was developed in 1960 by Professor Eugene Fama. Mishkin (2010) stated that the theory was developed to analyse financial behaviour and estimated stock market movement. Mishkin (2010) defines the EMH theory as the prices of securities that fully reflect all available information. However, Fama (1965) delineates an efficient market as a market where the stock market reflects the publicly available information.

A capital market was only considered fully efficient if it correctly reflects all relevant information into the stock price was stated by the study of Malkiel (cited in Timmermann and Granger, 2004). Moreover, the level of efficiency is dependent on the information itself (Timmermann and Granger, 2004). Market efficiency has three levels such as weak, semi-strong and strong according to Mishkin (2010).

3.2.5.1 Weak form of market efficiency

Firstly, a weak form of market efficiency was that the stock price movement can be predicted by utilising previous price movements. This was based on the analysis of historical data and from the pattern of the movement. There was supposedly no advantage in estimating stock price trends based on past performance in a market that is showing a weak form of efficiency. However, Mlambo (2013) stated that stock prices already reflect all information that can be derived by examining market trading data such as the history of past prices, trading volume, or short interest.

This weak form also assumes that current stock prices fully reflect all security market information. Furthermore, Mlambo (2013) revealed that the market is efficient in the weak form when the price of a security reflects all historical price information and volume information. Caltado (2003) expressed that this level of market efficiency is consistent with technical analysis (TA) – the theory of historical price and volume. The Open University (2012) further maintains that if a market is weak-form efficient,

there is no correlation between successive prices, so that excess returns cannot consistently be achieved through the study of past price movements.

3.2.5.2 Semi-strong form

Secondly, semi-strong form reflects all historical and publicly available information. In the case of a market that is efficient like this, the stock prices quickly respond to information found in annual and quarterly reports. There was an argument from Kevin (2006), that the market is consistent in the semi-strong form when the price of a security reflects all historical information, including the historical price and volume presumed in the weak form. Therefore, the level of information presumed under weak form of market efficiency is fully nested in the semi-strong level of market efficiency. Caltado (2003) stated that semi-strong efficiency exists where share prices reflect all public information, but not private information. The Open University (2012) stated that if a market is semi-strong efficient, the current market price is the best available unbiased predictor of a fair price, having regard to all publicly available information about the risk and return of an investment.

3.2.5.3 Strong form

Lastly, strong form presented that none of the information either public or private source would let the investors earn an abnormal return according to (Mishkin, 2010). This was due to all the public and private available information will reflect in the stock price immediately.

Based on the implication of Efficient Market Hypothesis theory (EMH) investors should not be able to earn an abnormal return or return which was higher than equilibrium return. In shortly, the theory has been utilised to predict the stock market movement and the stock market that performed well in the past does not mean that it would perform better or worse in the future as stock market movement was unpredictable.

3.2.6 CAPITAL ASSET PRICING MODEL (CAPM)

Sharpe (1964); Lintner (1975) and Mossin (1966) developed the theory of Capital Asset Pricing Model (CAPM) in the 1960s. This theory aims to illuminate the correlation between the risk and return of a financial security; however, this correlation can be used to determine the current price of security. The CAPM theory has three assumptions: the first assumption was that investors were risk averse and

they seek to minimise their portfolio risk with a given level of expected return. The second assumption was that capital markets were perfect with no transaction costs or taxes, the information was freely to all investors, and investors were permitted to borrow and lend at the risk-free rate. Lastly, all investors had the same predictions of the expected returns, standard deviations of return and correlations between returns of all securities. These assumptions represent a very simplified and unrealistic world, but were required to reach the CAPM in its basic form according to Perold (2004).

The CAPM theory expressed that if a share helps stabilise a portfolio, that is, make it more in line with the market, then that share would earn a similar rate of return to the market portfolio. Furthermore, if a share makes a portfolio riskier as compared to the market portfolio it would be less in demand by risk-averse investors and as a result its price will fall and thus its expected rate of return would be above the market portfolio. On the other hand, if a share decreases the risk of a portfolio compared to the market portfolio it would be more in demand by risk-averse investors and as a result its price will rise and its expected rate of return would be lower than that of a market portfolio (Pilbeam, 2010). Moreover, Pilbeam (2010) designates that in an efficient market all diversifiable risk would be removed (given that there were no transaction costs), so that the only risk that would be priced by the market on a portfolio was market risk. Hence, CAPM concentrated only on the pricing of undiversifiable market risk.

According to Fama and French (2004) investors choose a portfolio that was said to be a mean-variance-efficient in the portfolio theory meaning a portfolio that maximises expected return, given their return variances or portfolios that minimise risk given their expected returns, and these must lie on the portfolio efficient frontier. CAPM states that any portfolio that was a mean-variance-efficient and was found on the portfolio efficient frontier was also equal to the market portfolio. Although, Fama and French (2004) indicate that the relationship between risk and expected return for any efficient portfolio must be the same for the market portfolio in order for equilibrium in the asset market to be maintained. The Capital Asset Pricing Model equation will be stated as below:

$E(Ri)\ R_f + \beta im\ [E(ERm) - Rf$ ……..3.1

i= 1 … N

E (Ri) = Expected return on asset *i*

Rf = Risk-free rate of return

E (Rm) = Expected return of the market portfolio

βim = Beta of the asset market

Equation 3.1 presents how in the CAPM, an asset's expected return is determined by the risk-free rate plus a risk premium, furthermore, is linearly related to the market beta. The risk premium consists of the market beta (*βim)* times the premium per unit of beta risk [*E (ERm)-Rf*]. The Capital Asset Pricing Model has been criticised for its impractical assumptions of investor behaviour as well as the condition of perfect capital markets. That the market portfolio itself shows a key weakness in the CAPM, since it does not state the asset to be included or excluded in the market portfolio, was proposed by (Roll, 1977). In conclusion, the CAPM generally relied on historical data. The beta may not predict the stock returns accurately. This was because there was another anomaly that may affect the stock return. In all, the outcome can be viewed as an approximation and reference or guidance which can be utilised to reflect the investor's expectation towards the future.

3.8.7 RANDOM WALK THEORY

The Random walk theory was introduced by Maurice Kendall in 1953. The theory specified that future stock returns are unpredictable and the investors cannot forecast them based on historical stock data (Mishkin, 2010). This was for the reason that stock prices do not follow a mean reverting process whereby the stock returns do not follow the trend path over time stated by (Chaudhuri and Wu, 2003). According to Mishkin (2010) stock market was considered following a random walk pattern given the following conditions. Firstly, it responded to news and information quickly. Secondly, share prices reflected all the available information. Lastly, the market movement was impossible to predict.

The study was conducted by Fama and French (1988). Poterba and Summers (1988) found that US stock prices do follow a mean reverting process. Besides that,

the technical analysis can be utilised to predict stock market returns by studying previous stock price data and searching for patterns such as trends and regular cycles (Mishkin, 2010). However, Gitman, *et al* (2015) stated that the stock market follows the random behaviour in which the stock returns are unpredictable in future. Moreover, random price movements might be a sign that showed the stock market does not perform properly, but the reality indicates that the stock market was performing at a higher degree of efficiency.

3.2.8 ARBITRAGE PRICING THEORY (APT)

This theory was developed by Ross (1976) as a substitute to the CAPM. The arbitrage pricing theory indicates the inadequacies of the CAPM, since there were no pre-assumptions that were made regarding the distribution of securities returns and pre-assumptions on utility theory. Additionally, the APT acknowledges numerous risk factors that may influence a security's expected return as compared to the CAPM which utilises a single risk factor to reflect market risk whereas market risk itself is made up of a number of systematic factors. However, the APT proposed that the expected return of a financial security as being influenced by numerous risk factors, thus that in the process it measures the returns related with each of these factors of risk (Ross, 1976). There are two risks involved in holding a security according to (Paavola, 2006). Firstly, the systematic risk which was inherent to market fluctuations cannot be diversified away. Secondly, the unsystematic risk that was unique to each security can be diversified away through raising the number of assets held through portfolio diversification.

The APT framework was utilised by Chen, *et al*. (1986) who concluded that economic forces affect future cash flows as well as the payouts of dividends, including risk which may be either market risk or risk that was unique to capital securities. The following equation is for the APT model with numerous factors of risk:

$E(Rit) = \lambda_0 + \lambda_1 b_{i1} \ldots + \lambda_j b_{ij}$ 3.2

Where:

$E(Rit)$ = Expected return of asset i

λ_0 = Risk-free rate of return

λ_j = Assets return security (price of risk) to factor j

b_{ij} = The beta or sensitivity of security I to the 1, 2, … j factors

The APT has assumptions where investors may borrow and lend at the risk-free rate, there are no taxes and short-selling of securities which are unrestricted. A second assumption states that a wide variety of securities exists, hence risk unique to those assets may be diversified away. Lastly, investors are risk averse and seek to maximise their wealth, stated by (Paavola, 2006). The arbitrage pricing theory assumed that securities can be described by a factor model. Based on the factor model the random asset returns can be illustrated as a linear function of a set of j factors and that there are perfectly competitive security markets that do not allow for the persistence of arbitrage opportunities (Gilles and Leroy, 1993).

The critics of the APT state that the theory sets no theoretical basis for the factors that should be incorporated in determining the risk-adjusted return of the capital security; furthermore, it does not state the number of factors of risk that should be incorporated. In addition, in both instances, it was found that the applicability of the APT in determining security returns may still be acceptable (Junkin, 2011).

3.3 EMPIRICAL LITERATURE REVIEW

This section presents the review of empirical research that has been done on gold price volatility and stock market returns. This section is divided into three parts. The first part reviews empirical studies from South Africa, the second part reviews empirical studies from developed countries. Lastly, the third part reviews empirical studies from developing and emerging countries.

3.3.1 LITERATURE FROM SOUTH AFRICA

The following studies were among the few empirical studies that provided literature on commodity prices and the stock market. Chinzara (2010); Ngwenya (2017) and Morema and Bonga-Bonga (2017) used the same estimation techniques which were the GARCH model. Their studies had similar findings although they looked at different topics. Firstly, the empirical study of Chinzara (2010) suggested that South Africa's domestic financial markets were becoming increasingly interdependent and that volatility of the gold price seemed to play a role in stock market volatility. The study further concluded that financial crisis had increased volatility on the stock market, as well as in most macroeconomic variables. Specifically, the author

examined analysis of macroeconomic uncertainty and emerging market stock market volatility.

The findings of Morema and Bonga-Bonga (2017) were in agreement with the above results; with an idea that there was significant volatility spill over between the gold price and the stock markets. Additionally, the authors found that there was an important link between futures of commodity markets and stock markets. In all, the authors noted the same thing as Chinzara (2010) that there was significance in combining gold price and stocks for effective hedging against any risks. Likewise, the authors conducted research on the impact of oil and gold price fluctuations on the South African equity market and volatility spillover and implications for portfolio management. Moreover, Ngwenya (2017) had similar findings to those of the above results; revealing that the international commodity price shocks transmitted into the South African rand and also in equity returns after financial crisis. Ngwenya (2017) studied the effect of commodity price volatility on the volatility of the South African exchange rate and the returns on the equity of commodity that were listed on the JSE for the period 1995 to 2015.

The following studies utilised different estimation techniques from the above, but they provided the same opinions with regards to the relationship that occurs between commodity prices and the stock market in South Africa. On the other hand, Mongale and Eita, (2014) supported the results that were obtained by the above studies that employed the GARCH model. The authors found that there was an increase in commodity prices that was associated with the rise in stock market performance. The authors further found a positive relationship between the stock market and macroeconomic variables in South Africa.

These findings were in line with that of Chinzara (2010) after financial crisis. The author employed the Engle-Granger test as estimation techniques to investigate the effect of commodity prices and stock market performance for the period ranging from 1994 to 2013. However, Mave, *et al*, (2016) used different variables from the above empirical studies, but also came up with similar recommendations. The authors examined the possible drivers of volatility in the South African rand since the beginning of the global financial crisis. They established that commodity price volatility does play a role in the volatility of the South African rand and global

markets. The authors recommended that rand volatility was specifically driven by commodity price volatility and global market volatility as well as domestic political uncertainty.

Furthermore, Pale (2013); Seetharam and Bodington (2015); and Bodington (2015) conducted papers on the same area, that gold acts as a safe haven or hedge on stock portfolios. Exactly so, Pale (2013) discovered that South African investors remarked that gold does not act as a hedge for international stocks. Likewise, the author noted that the relationship between gold and the stock or bond market illustrates that the return for gold was positive on the day that an extreme negative shock occurs in the stock market. The outcomes of Seetharam and Bodinton (2015) were in agreement with what was found by Pale (2013). The study of Seetharam and Bodinton (2015) found that gold has the potential to reduce systematic risk when added to a portfolio of stock and the gold price depends on real GDP. However, the authors examined the potential benefits of investing in several gold investment vehicles in terms of risk and return from a typical South African investor's prospective.

On the other hand, Bodington (2015) also studied papers on the same topic and this paper used similar variables with the above empirical studies. The paper showed that in the South African context, gold preserved as a safe haven and a hedge by investors. It also revealed that South African investors invest in South African equities. The paper additionally found gold as a safe haven or a hedge for the South African bond market. Possibly, the findings of this paper were exactly the same as the above results, thus, the paper found that South African investors perceived that gold does not act as a hedge for international stocks.

3.3.2 LITERATURE FROM DEVELOPED COUNTRIES

Ratner and Klein (2008); Sumner, *et al* (2010); Hood, *et al* (2013) and Erdogdu (2016) are empirical studies that observed the relationship between gold price and the stock market in the same country – the United States. Ratner and Klein (2008) revealed that the gold price had an insignificant impact on the US stock markets. The paper applied the GARCH model on the daily data for the period November 1995 to November 2010. After many years, Erdogdu (2016) piloted research to analyse the most significant factors that influence the price of gold on the US Stock Market using

the same estimation techniques and found that there was a negative correlation between gold prices and the US stock market. The results of Sumner, *et al* (2010) were consistent with the above findings, instituting that there was not a very strong effect of the gold price on stock returns. Nonetheless, the linkage between these two variables was found to be negative. In addition, Hood, *et al* (2013) stated that the gold price does not have a negative correlation with the US stock market. From the above analyses there was pattern that revealed a negative relationship between the gold price and the US stock market.

Smith (2001) and Gilmore, *et al* (2009) were studies that contributed to literature in United States between gold price and stock prices using diverse models. These authors used the same estimation techniques, i.e. VECM tests and Granger causality for analyses. The relationship between the price of gold and stock price indices was investigated by Smith (2001), from the period January 1992 to October 2001. The study revealed that the relationship between stock prices and gold price was small and negative. The author further found that US stock prices and gold price indices were not co-integrated over the examined period. The Granger causality test showed that there was a unidirectional causality between returns on gold price and the US stock price index. The empirical results of Gilmore, *et al* (2009) were similar to the above results, though the authors examined the relationship between gold prices and stock price indices. The authors utilised the VECM model to test the variables; however, the test revealed that both gold price and large-cap stock prices adjust to disturbances to restore the long-term relationship between the variables. The paper further found that in the short term there was a unidirectional causal relationship that moves from gold price to large-cap stock prices.

Adding to the literature that was conducted in United States, Herbst (1983); Smith (2002); Kaliyamoorthy and Parithi (2012); and Rahman and Mustafa (2017) piloted research between the gold price and stock market performance and their empirical findings were in agreement, but used different methods for analyses. Firstly, Smith (2002) conducted research to assess the effect of the gold price on stock market performance in the case of Japan and a European country. The study used three London Gold Prices 17 stock indexes from Japan and a European country. The author employed Ordinary least squares, ARCH, cointegration and Engle granger to achieve the objective of the study. The study claimed that there is weak negative

short-run correlation between the gold price and the stock indexes. On the other hand, the same study found no evidence of a long-run relationship between the variables. In the developed world, for example in the US, even the study that was conducted by Herbst (1983) in the early 80s found the same results as the above studies. The paper tested the long-run relationship between the gold price and stock market performance. The author found that gold prices and stock prices are negatively related for a specific period.

Conferring on the above literature, Rahman and Mustafa, (2017) examined the effects of changes in crude oil and gold prices on US Stock market movement in the United States (USA) utilising daily data ranging from the periods of January 1986 till December 2016. The time series property of the variables in terms of stationarity or non-stationarity was examined in this study by applying the unit root tests (DF-GLS and Ng-Perron). However, the study also utilised ARDL Bounds testing for cointegration. Both the tests (DF-GLS and Ng-Perron) confirm the non-stationarity of each variable and the ARDL Bounds test confirms cointegration among the variables. The outcomes of the study provide evidence of long-run convergence among all these variables. In addition, in the short run there were negative effects of changes in gold and crude oil prices on US stock market returns were observed. However, the effect was statistically significant from gold price changes, but insignificant from crude oil price changes.

Wang, Wang and Huang (2010) used daily data and time series method to explore the impacts of fluctuations in crude oil price, gold price and US dollar on the stock price indices of the US, Germany, Japan, Taiwan and China. The study demonstrated the existence cointegrations amongst fluctuations in oil prices, gold prices and exchange rate (US dollar vs various currencies) and the stock markets in Germany, Japan, Taiwan and China. In the case of US, the study found that there is no long-term relationship amongst these variables. The empirical study of Kaliyamoorthy and Parithi (2012) found out same results with the above findings. During the period from June 2006 to June 2010, the authors found that no relationship exists between gold price and stock prices.

Al-Ameer, *et al* (2018) examined the relationship of the gold price and the stock market in Germany. The study employed VAR models in assuring that data was

stationary for the Johansen's cointegration test and the Granger causality test, with data that ranged from the period August 2004 to September 2016 which was a monthly series. The outcomes of the study revealed that there was a correlation relationship between the gold price and the stock market. Furthermore, the authors noted that there was a moderate positive correlation between the two economic variables. Hence, the cointegration tests outcomes showed that there was a long-run relationship between the gold and stock markets. But the Granger causality tests presented different results that there was no Granger causality between gold and the stock market.

Baur and Lucey (2010) used GARCH estimation to investigate if gold is a hedge or safe haven. The authors reflected on constant and time varying relations between US, UK and German stock; bond returns and gold returns in investigating gold as a hedge and a safe haven. The study found that gold is a hedge against stocks on average and a safe haven in extreme stock market conditions.

The determination of factors that affect the gold price were presented by Toraman, Basarir and Bayramoglu (2011) using the MGARCH model in the United States of America, from the period June 1992 to March 2010. The study used these variables: USA real interest rate, price of oil, USA rate of inflation, USA rate of exchange for data that will be used in the model. The results of their study found that a USA exchange rate and gold price had the highest correlation which was negative and gold prices and oil price had a positive correlation.

3.3.3 LITERATURE FROM DEVELOPING COUNTRIES

The empirical studies by Mishra, *et al* (2010); Bhunia and Das (2012); Contuk, *et al* (2013) looked at gold price volatility and stock market returns in different countries, using different estimation techniques. Starting with the study conducted in Turkey by Contuk, *et al* (2013), the authors employed MGARCH model to analyse the effect of gold price volatility and stock market returns. Moreover, the study utilised daily time series and the data from the period 1 January 2009 to 31 December 2012 for the raw data which was transformed into earnings yields and analysed. The results revealed that both stock exchange and gold price were affected by each other's shocks. The empirical findings of Mishra, *et al* (2010) and Bhunia and Das (2012) were in agreement with the above results, even though the authors applied the same

estimation technique of VECM to test Granger causality. Both Mishra, *et al* (2010) and Bhunia and Das (2012) piloted research to analyse the causality between stock market returns and gold price volatility in India; using different data from the period 1991 to 2009 and another study from 2001 to 2011. Both studies found that stock market returns affect the gold price and the gold price affects the stock market, respectively. In the above analyses, the study observed that all three empirical studies were conducted after 2008, which was the year of the global financial crisis.

Hussin, *et al* (2013); Tan, *et al* (2014); Chong, *et al* (2014); Akgul, *et al* (2015) and Ostwal and Sharma, (2017) conducted studies before and after financial crises in different countries. These empirical studies had the same objective of checking the bidirectional or causality relationship between gold price and stock market indices using the same estimation techniques. The study by Akgul, *et al* (2015) had data starting from the 1980s, which was long before the financial crises escalated. The authors utilised the VECM and VAR methods to evaluate the link between gold prices and stock market indices in Turkey. The data was from the period April 1986 to November 2013. The study found that gold price provides a declining response to S&P 500 shocks; but on other hand, the S&P 500 index gives a different response to gold price shocks. In all, the authors found both negative and positive responses from the S&P 500 index to gold prices in different periods.

Conversely, Hussin, *et al* (2013) used data from the period January 2007 (which was the year before the financial crises started), to December 2011. The authors mainly focused on examining the effect of the gold price and the oil price on the Islamic stock market, and utilised VAR and VECM models as estimation techniques. The variables crude oil price, Kijang gold price and FTSE Bursa Malaysia Emas Shariah Index (FBMES index) were used in this study. The analysis of cointegration test revealed that there was no cointegration relationship between the Islamic stock market and strategic commodities (gold price and oil price) in the long run. The Granger causality analysis presented that FBMES index does not affect gold price and also gold price does not affect FBMES index in Malaysia.

The study piloted by Chong, *et al* (2014) contributed to the empirical literature of Malaysia and China and the empirical findings of this study disagree with the results of Hussin, *et al* (2013), maybe because the authors Chong, et al (2014) included

another country, which was China, in their study. Chong, *et al* (2014) conducted research between two countries, Malaysia and China, in examining the connection between global commodity prices and stock markets (the stock markets were selected as target areas which were the Kuala Lumpur Composite Index (KLC) and Shanghai Stock Exchange (SSE). The paper utilised data from 2003 to 2012 which was over 10 years, and the Granger causality test for analyses. The researchers noted that a commodity price has a short-term bilateral effect across the stock markets whereas other commodity prices have only unilateral effect.

Prior to the financial crises, Tan, *et al* (2014) found results that were totally different from the above results regarding the analyses of the cointegration test. With regards to Granger causality analyses, the studies were in agreement with above findings, even though the study added other variables such as gold price, crude oil price, exchange rate, the Asian financial crisis in 1997 and Subprime Mortgage crisis in 2007 and the Hong Kong stock market and the proxy was Hang Seng Index. The primary aim of the study was to test Granger causality through VECM, conduct analysis on VAR tests and Ordinary Least Squares (OLS) analysis for the relationship between the four determinants of gold price, crude oil price, exchange rate, the Asian financial crisis in 1997 and Subprime Mortgage crisis in 2007 and the Hong Kong stock market and the proxy was Hang Seng Index. The data utilised on the study was from the period 3 January 1994 until 31 December 2013 and the total sample size that was used in this study was 5 217 to run an empirical analysis. The empirical results from VECM illustrated that all the variables (including gold price) were significant in affecting the Hong Kong Stock market, and also gold price positively affected the Hong Kong stock market. Moreover, the authors found that only gold price and the exchange rate had bidirectional causality with the Hang Seng Index.

Deliberating on the above literature, the study of Ostwal and Sharma (2017) was recently conducted during the year 2008 when financial crises arose using data from 1 January 2008 to 31 December 2016. The authors found different results from the above findings. Specifically, the study hypothesised the dynamic relationship between gold price and the Indian Stock Market. The authors employed two estimation techniques such as VECM to investigate Granger causality among variables and VAR tests. The authors mainly used the classical Granger causality

test to check whether one variable causes the other. As expected, the authors found that there was bidirectional causality between the gold price and the Indian stock market index (SENSEX), and vice versa. On the hand, the authors further found unidirectional relationship that flows from gold prices to NIFTY. The VAR tests illustrated that Indian stock market and gold prices were strongly exogenous and also indicated that there were positive shocks on gold prices that were very little but persistence and rising effects on the Indian Stock Market. The authors provided importance of their paper that the results would increase the understanding of relationship between the gold price and Indian stock market and would also help foreign investors to understand the Indian stock market with respect to movement of gold prices. From the analysis above the gold price and stock market indices were having different reactions or responses to each other in periods and countries, even though their focus areas were the same. The study cannot conclude that gold price and stock market indices are bidirectional or not because the empirical literature from the above provided different outcomes.

Narang and Singh (2012); Patel (2013); and Sreekanth and Veni (2014) provided empirical literature from the same country which is India, and they looked at causal relationships between gold price and stock market indices (which are SENSEX "known as the S&P Bombay Stock Exchange Sensitive Index", NSE Nifty index and BSE index) using different estimation techniques. Almost all the empirical studies above used same variables and their findings are in agreement with one another stating that gold price does affect stock market. Firstly, Narang and Singh (2012) conducted research trying to investigate the existence of unidirectional or bidirectional relationship between gold price and Indian stock market index (Sensex) in India for the ranging period 2002 to 2012 which is 10 years. The empirical findings of this paper revealed that there was no causality between the gold price and Sensex (index).

The empirical results of Sreekanth and Veni (2014) were different from the results obtained by Narang and Singh (2012) above, although the authors conducted research to test cointegration and causal relationship between gold price and Indian stock exchange index (NSE Nifty) and used data from the period January 2003 to December 2013 which 10 years with 2 888 observations. The authors utilised daily per troy ounce international gold prices and the daily NSE nifty data which was

obtained from the authenticated sources. The study applied time series techniques to analyse the cointegration and causal relationship among the variables. The outcomes of this paper revealed that there was unidirectional causality relationship between gold price and NSE Nifty index. On the other hand, the findings of Patel (2013) were in agreement with the above results by providing evidence that there was Granger causality that runs from gold price to Nifty only out of the three indices. The author further stated that gold price comprises some significant information to forecast Nifty return. Basically, this author was investigating the causal relationship between stock market indices and gold price over the period January 1991 to December 2011 using monthly time series data in India. The monthly data was for Mumbai gold prices and the three stock market indices (specifically, Sensex, BSE 100 and S&P CNX Nifty). The Augmented Dickey-Fuller unit root test, Johansen cointegration test and Granger causality test in the Error Correction Model were employed in this paper. The author provided a conclusion at the end that all the series were I(1) and there was long equilibrium relation that exists among all variables.

From the analysis above it is essential to note that the paper that was conducted by Patel (2013) was mainly looking at the causal relationship between gold price and the three different stock market indices in India (specifically, Sensex, BSE 100 and S&P CNX Nifty). Conveniently, the findings of this paper were in agreement with both the results of Narang and Singh (2012) and Sreekanth and Veni (2014); revealing that there was only one Granger causality that runs only from gold price to the Nifty index. Narang and Singh (2012) and Sreekanth and Veni (2014) observed indifferent stock market indices when they explored the causal relationship between these two variables (gold price and stock market indices). Moreover, Ray (2013) obtained the same results with the above studies, even though the author hypothesised the relationship between gold price and stock price in India using data for the period 1990 to 2010. The author made use of the Johansen cointegration test and the Granger causality test and found that there was a long-run relationship between the variables. Results also indicated that there was one causality direction running from gold prices to stock prices.

In contrast to the above empirical studies, Srinivasan (2014) provided empirical results that were consistent with the findings of Narang and Singh (2012). However,

the author conducted a paper to investigate the causal nexus between gold price, stock price and exchange rate over the period June 1990 up until April 2014 in India. This author utilised monthly time series data and the Autoregressive Distributed Lag (ARDL) bounds testing approach and Granger causality test was employed in this paper. The author found that there was no causality that runs from gold price to stock price or vice versa in India. On the other hand, the author also revealed that there was no evidence of a stable long-run cointegration relationship between gold price and stock price. Moreover, the conclusion of this paper suggested that domestic gold price does not contain any significant information to forecast stock price in India.

Nevertheless, the conclusion that was suggested by Srinivasan (2014) disagrees with the suggestions that were provided by Mishra, *et al* (2010) and Patel (2013). The suggestion of Srinivasan (2014) articulates that domestic gold price does not contain any significant information to forecast stock price in India. On the other hand, Mishra, *et al* (2010) and Patel (2013) proposed that gold price comprises some significant information to forecast stock market returns (Nifty index). The suggestion that was proved by Hussin, *et al* (2013) in Malaysia supports the conclusion of Srinivasan (2014) in India, that gold price was not a valid variable to predict changes in stock or share price.

To add, Shiva and Sethi, (2015); Mukhuti and Bhunia (2013); Bhunia (2013); Bhunia and Pakira (2014); Tripathy and Tripathy (2016) and Bouri, et al (2017) contributed to the empirical literature of India. These studies were common in examining cointegration and causal relationship between gold price and stock market utilising diverse estimation techniques.

The study that was piloted by Bhunia (2013) to check the cointegration relationship between domestic gold price, crude oil price and selected financial variables (such as exchange rate and stock price indices) during the period of 2 January 1991 to 31 October 2012, used secondary data that was collected from different sources “that is” NSE database, BSE database and World Gold Council database. The analyses of the study were based on the results of ADF unit root test, Johansen cointegration and Granger causality test. The outcome from the Johansen cointegration test was similar to the outcomes of (Srinivasan, 2014). Thus, the test outcomes demonstrated

that there was a long-term relationship between gold price and stock market. The Granger causality test results designated that there should be either a bidirectional or no causality between gold price and stock price indices. These findings were in agreement with both the outcomes of Narang and Singh (2012) and Srinivasan (2014). At the same time, these findings differed with the results of (Patel, 2013; Sreekanth and Veni, 2014).

Again, Bhunia and Pakira (2014) investigated the impact of gold price and exchange rates on Sensex in India, and utilised daily time series data between the period January 1991 to 31 October 2013. The difference between the studies of Bhunia (2013) and Bhunia and Pakira (2014) was that Bhunia (2013) looked at the relationship between gold price and stock price indices as stated above, whereas the study of Bhunia and Pakira (2014) looked at the impact of gold price on the overall of Sensex index. Bhunia and Pakira (2014) used the same estimation techniques that were utilised by Bhunia (2013); such as unit root test, Johansen Cointegration and the Granger causality test. This revealed that both these studies found related results, although the authors looked at different segments of the relationship (or impact) that took place between the two variables. The results of the study of Bhunia and Pakira, (2014) showed that there was also a long-term relationship between gold price and Sensex, and also that there must be either bidirectional or no causality between gold price and Sensex.

On the other hand, the findings by Tripathy and Tripathy, (2016) supported the above results, employing the unit root test, Correction test, Granger causality test and the Johansen Cointegration test in investigating the integration among the variables (gold price and stock market price (Nifty). The study collected monthly time series data over the period of July 1990 up to April 2016. The authors found that there was no causal relationship existing between gold price and stock market price in the short run. The authors noted that there was a cointegration long-run equilibrium relationship between gold price and stock market prices. In all, the authors highlighted that these variables were moving together. When the authors employed the CUSUM test they found also that this type of test confirmed the results of the Johansen Cointegration test that a long-run relationship was present between gold price and stock market price and these results shows the stability of the coefficient. The recommendations of these authors expressed that the integration

between gold price and stock market price requires the need for global investors to follow portfolio stock selection strategy to add value from investments in India. The results of Bouri, *et al* (2017) were similar to the above findings, although, the study utilised implied volatility to examine cointegration and non-linear causality between international gold, crude oil prices and the India stock market. The outcome of the study indicates that there was a presence of cointegration relationships and positive impact of the implied volatility of gold and oil prices on the implied volatility of the India stock market.

In addition to the above empirical studies; Shiva and Sethi, (2015) piloted research to understand the dynamic relationship between gold price, exchange rate and stock market over the period January 1998 to April 2014. The study used different variables (or indices) from the above studies such as the Bombay Stock Exchange's Sensex, National Stock Exchange's Standard and Poor's (S&P) Financial Services LLC CNX NIFTY1 (S&P CNX NIFTY) and the US dollar/Indian rupee (USD/INR) exchange rate. The study employed the Vector Error Correction Model (VECM) to check short run and long run causality and Johansen Cointegration test to find long-run cointegration between variables. The study noted that the Wald's coefficient diagnosis and residual analysis exposed that gold prices, SENSEX, USD/INR and S&P CNX NIFTY were in equilibrium in the short run and long run. The results from the Granger causality test of this study were consistent with the findings of Patel (2013); and Sreekanth and Veni (2014). The test finally confirmed that there was presence of unidirectional causality that runs from gold prices to S&P CNX NIFTY.

Mukhuti and Bhunia (2013) also attempted checking the reaction of Indian gold price and Indian stock market index (SENSEX and NIFTY), for the period January 1991 until August 2012 in India. The study used different estimation techniques such as the Bivariate and Multivariate cointegration test, and daily time series was utilised. The feedback of the bivariate cointegration test disagrees with findings of the above empirical studies that used the Johansen Cointegration test, the bivariate test exhibited that there was no cointegration relationship between gold price and the two stock market indices. Unlike multivariate cointegration test provided results that were consistent with the above studies that utilised Johansen Cointegration test, that is, the test indicated that there was presence of steady cointegration relationship among gold price and the two stock market indices in India.

Studies by Mukhuti and Bhunia (2013); Bhunia and Pakira (2014) had similar views on Indian investments. Mukhuti and Bhunia, (2013) noted that during the national crisis, bank failure, rupee depreciation and in case of negative real interest rate, people considered gold to be a solid asset and safe haven and likes to invest in the yellow precious metal because there was little chance of getting better returns in the stock investment due to the fragile economic and financial position. A year later, Bhunia and Pakira (2014) noted as well that Indian investors are demonstrating unease in the stock markets due to the continuous increase of gold prices on account of there being no fear and no future loss. The findings of Kumar (2014) suggested the same thing to Indian investors that stock-gold portfolio offered better diversification benefits than stock portfolios. The causal relationship between stock market index, gold prices and crude oil prices was investigated by Singh (2014); with data that was over the period from April 1990 to March 2009 in India. The estimation techniques that were employed by the study were the Johansen cointegration and Granger causality test, the analyses was done through Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP), and unit root test. The cointegration test results confirmed that there was a long-run relationship between the stock market index, gold prices and crude oil prices. However, the suggestion of the Granger causality presents that there was a unidirectional causality between BSE Sensex and gold prices and crude oil prices. The outcomes of the study revealed that there was a positive association between the stock index and the prices of gold and oil.

The studies by Bilal, *et al* (2013); Devkota (2016); Tursoy and Faisal (2017); were conducted in different countries, with some agreeing and some disagreeing with the above results that were obtained from India. Basically, these studies are common in terms of estimation techniques (such as Granger causality test and Johansen Cointegration test) that were used to answer their research objectives. The long-run relationship between gold price and Karachi Stock Exchange (KSE) and Bombay Stock Exchange (BSE) were examined by Bilal, *et al* (2013) in Malaysia. The study employed Unit Root Augmented Dickey-Fuller test, Phillip Peron, Johansen cointegration and Granger causality tests to measure long-run relationship among gold price, KSE and BSE. The research was piloted over the period from July 2005 to June 2011 and monthly data was utilised. However, the analysis from the cointegration test disagreed with results that were found in India, as the test

discovered that there was no long-run relationship that took place between the variables (gold price and KSE stock index. Thus, the Granger causality test indicated that there was no causal relationship that exists between gold prices, KSE and BSE stock indices. In all the findings, the study by Bilal, *et al* (2013) is not in agreement with what was discovered by the empirical studies from India.

The results that were found by Devkota (2016) in Nepal were similar to the empirical findings from India, while the author's results were not in agreement with the results of Bilal, *et al* (2013) from Malaysia. The author investigated the causal relationship between the Nepalese Stock Exchange (NEPSE) index, interest rate, gold price and the USD exchange rate using from the ranging period 2006 January to 2016. The study employed Ng-Perron unit root test and Johansen's cointegration test, the Granger causality test was done through Vector Error Correction Model (VECM) and the analyses were done based on time series data. The empirical findings revealed that there were short- and long-run relationships that existed between the variables (gold prices and Nepalese stock exchange index).

The research findings of Tursoy and Faisal (2017) in Turkey were consistent with the empirical outcomes of Devkota (2016); however, they disagreed with the above results of Bilal, *et al* (2013). In detail, Tursoy and Faisal (2017) explored the long-run and short-run relationship among gold prices, oil prices and stock prices for the period January 1956 up to November 2016, using monthly time series data. The Autoregressive distributed lag (ARDL) model to check cointegration and the robustness of the ARDAL bounds test of cointegration was confirmed utilising the newly-developed combined cointegration that also provided same evidence for a strong long-run relationship and the Granger causality test were used in this paper. The empirical results of this paper showed that both short run and long run results confirm a negative relationship among gold prices and stock prices. Additionally, the Granger causality test presented that there was a short-run, long-run and joint unidirectional causation from gold prices to stock prices.

The literature that was piloted by Chkili (2016) and Mensi, *et al* (2017) in a case of BRICS, supported the above analyses on the views of Mukhuti and Bhunia, (2013); Bhunia and Pakira, (2014); and Kumar, (2014). Firstly, Chkili (2016) scrutinised the dynamic relationships between gold and stock markets in BRICS countries and

utilised data from these countries. The study mainly estimated asymmetric DDC model for weekly stock and gold data. The reason behind the author conducting this study was to examine the time-varying correlations between the two assets and to check the effectiveness of gold as a hedge for equity markets. The findings of the study revealed that the dynamic conditional correlations switch between positive and negative values. Furthermore, the negative correlations were lower during the major financial crisis and the suggestion was that gold can act as a safe haven against extreme market movements. The author continued by revealing the implications for portfolio diversification and hedging effectiveness for gold/stock pairs. The findings of the author proposed that adding gold to a stock portfolio increases its risk-adjusted return.

The conclusions of Mensi, *et al* (2017) were consistent with the above results. The authors specifically investigated the co-movements between five of the most important emerging stock markets in BRICS countries (Brazil, Russia, India, China and South Africa) and gold prices. The findings of the study were based on the wavelet approach indicating that there was no evidence between BRICS index returns and gold price. The authors further stated that gold can act as a hedge or a safe haven asset for the BRICS countries against extreme market movements.

Kaur and Kaur (2015); Wai, *et al* (2014) and Raza, *et al* (2016) found positive relationship between gold prices and stock market in different countries, although Kaur and Kaur (2015) investigated the dynamic relationship between gold prices and the Indian stock market between the periods of 2007 to 2016. The study utilised secondary data and the econometric regression was used to analyse the effect of gold price on Indian stock market. The authors found that gold prices have a significant influence on the Indian stock market. Wai, *et al* (2014) analysed the relationship between gold price effect and stock market changes using real financial data in Malaysia, Thailand and Indonesia. The authors used Markov Switching Vector Error Correction (MS-VECM) models to analyse the relationship of variables. The outcomes of the study showed that gold price has a positive relationship with Malaysia, in all the increase of the gold price impacts a rise of the stock market index. In addition, Raza, *et al* (2016) supported the above results. The specific examination of the asymmetric impact of gold prices, oil prices and their volatility on stock prices of emerging markets was investigated by Raza, *et al* (2016) during the

period January 2008 to June 2015 using monthly series. The authors employ nonlinear ARDL approach in order to find short-run and long-run asymmetries. The outcomes show that gold prices had a positive impact on stock market prices of large emerging BRICS economies and a negative impact on the stock markets of Mexico, Malaysia, Thailand, Chile and Indonesia.

Shaique, Aziz and Herani (2017) investigated the long-term relationship between gold prices and stock market behaviour in the case of Pakistan. In their study, the authors employed monthly data consisting of 248 months from October 1993 to May 2014. In addition, the authors employed various econometric tests such as Johnson Cointegration test and vector autoregressive model (VAR). Based on their findings, the authors argue that there is no long-run relationship between KSE 100 index and the prices of gold in the context of Pakistan. Furthermore, the authors postulated that there was no cointegration between the two variables (gold price and stock market index); investors should not consider changes in gold prices as a major determinant of stock market returns. Moreover, the authors declare that a previous gold price has a direct bearing on the current price of gold. Sinton (2014) explored the long-run and causality relationship between exchange rate, gold prices and the stock market returns in Indonesia. In particular, the study determined the cointegration relationship and causality relationship between the prices of gold, exchange rate and Jakarta composite index for the period spanning from January 2014 to December 2013. The author argues that there is no cointegration between gold price, exchange rate and stock market returns. This implies that a long-run relationship between the variables under study does not exist. Furthermore, the author shows that there is no causality relation from the prices of gold to exchange and stock market prices.

Kit, Hin, Yan, Yueng and Long (2014) investigated the nexus between stock market performance and gold price in Hong Kong. The Hang Seng Index (HSI) measured stock market performance. The sample of the study was made up of 5 217 countries. The study employed the Johansen cointegration test and vector error correction model, Granger causality and ordinary least squares on the data from 1994 to 2013. The authors argued that gold prices significantly affect stock market performance. The study further argued that the gold price has a positive effect on the performance of the Hong Kong stock market. Using Granger causality, the study also argued that gold has a bidirectional relationship with the Hang Seng index. Bashir (2011)

examined the relationship between prices of gold and stock price indices for Armenia and Iran over the period starting in January 2005 to December 2010. The study also found that gold prices and Armenian market capitalisation (a measure of stock market performance) are not cointegrated whilst gold prices and the Tehran stock exchange are not cointegrated. Granger causality tests did not provide any evidence of causality between gold prices and stock market performance in either country.

3. 4 ASSESMENT OF LITERATURE

The chapter has reviewed the studies that were done concerning the relationship between gold price volatility and stock market returns. The chapter has considered different theories that link the main variables of the study. Thus, consideration was given to theories such as the storage model and the scarcity model which only focused on the process of trading the commodities and price movements of commodities. However, the discounted cash flows approach and discount rate prove that there is a relationship that exists between the two main variables of the study. Concerning empirical literature there is no consensus as some studies argue that gold price volatility and stock market returns have a bidirectional causality relationship, other studies argue that there is a unidirectional relationship between the two variables. Some argue that there is a negative relationship between gold price volatility and stock market returns, whilst other research found positive results between the main variables. In addition, after reviewing studies that were conducted in South Africa, a few empirical studies have actually investigated the relationship between commodity prices and the stock market. This study, therefore, draws on relevant aspects of the foregoing studies but defines its scope somewhat differently to achieve the intended as highlighted in the following chapter.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter outlines the methodology applied to establish the effect of gold price volatility on stock market returns in South Africa and also describes the analytical framework that is used in this study based on the literature reviewed in Chapter 3. The chapter starts by identifying the methodology approach, specifying the model followed by the definition of variables and a priori expectations, data sources and estimation techniques which includes the various assumptions and diagnostic tests. The last section is the summary of the chapter.

4.2 MODEL SPECIFICATION

The model for the effect of gold price volatility on stock market returns will be adopted from the works of Toraman, Basarir and Bayramogly (2011); Er and Vuran (2012) and Monjazeb and Shakerian (2014) with some modifications. The theoretical underpinning ~~of~~ this empirical approach is based on the internal-external balance framework of gold price volatility on stock market returns.

Equation (4.1) below shows a general model is expressed as:

$SMR_t = f\ [RGOLDV_t, ROIL_t, GDP_t, ER_t, M3_t]$ ..... (4.1)

The below equation (4.2) shows econometric model is expressed in log-linear form:

$LSMR_t = \beta_0 + \beta_1 LRGOLDV_t + \beta_2 LROIL_t + \beta_3 GDP_t + \beta_4 ER_t + \beta_5 M3_t + e_t$ ..... (4.2)

Where: *SMR= Stock Market Returns*

RGOLD= Gold Price Volatility

ROIL= Oil Price

GDP= Gross Domestic Product

ER= Exchange Rate

M3= Broad Money Supply

Where: β_0 is a constant $\beta_1, \beta_2, B_3, \beta_4, \beta_5$ are estimated coefficients and e_t is an error term.

4.3 METHODOLOGICAL APPROACHES

The study deals with large volumes using the statistical models. However, the study uses secondary data sources to achieve the aim and goals outlined in Chapter 1. Hence, the study will use the most appropriate approach to achieve the outlined objectives which is the quantitative approach. The reason behind utilising the quantitative approach is because it plays an essential role in ensuring that the research obtains its aim and objectives. The most important reason for the study using secondary data not primary data is because it validates the use of the quantitative approach instead of qualitative or mixed approaches. However, Newman and Benz (1998); Balnaves and Caputi (2001) both revealed that quantitative research is primarily utilised for description, explanation and prediction, and this type of research is (quantitative research) mostly deals with quantitative data, primarily on the analysis of variables. Moreover, quantitative research concentrates on the measurements and the amounts showed by events or people and utilises a number of statistical methods (Wyse, Hayward and Pandya, 2015).

4.4 DEFINITION OF VARIABLES AND A PRIORI EXPECTATIONS

4.4.1 DEPENDENT VARAIBLE – STOCK MARKET RETURNS

A stock market is a complex of institutions and mechanisms through which funds for purposes longer than one year are pooled and made available to business, government, and individuals and through which instruments already outstanding are transferred. However, stock market returns are the returns that the investors generate out of the stock market (Baker and Wurgler, 2007). All Share Index is used as a proxy for stock market returns. This proxy was also utilised on the investigation of the relationship between stock market returns and inflation in South Africa by Eita (2012).

4.4.2 INDEPENDENT VARIABLES

4.4.2.1 GOLD PRICE VOLATILITY

Gold is one of the commodities that is exported from South Africa and is an important independent variable in the model. Gold is an ancient, precious, highly liquid, financial instrument, and it is categorised in very important asset class (Bhunia and Mukhuti, 2013). Gold price is the price at which gold is traded within the gold market. The sensitivity of stock market returns in gold price volatility is judged by the

level of fluctuations. The volatility of the gold price will be calculated using a standard deviation formula on Excel. Smith (2002) and Raza, *et al* (2016) supported the above expected sign, specifically Smith (2002) found a negative relationship between gold price volatility and stock market returns in USA. However, Raza, *et al* (2016) stated that gold prices have a negative impact on stock market prices.

4.4.2.2 OIL PRICE

Oil is a group of liquid hydrocarbons of liquid origins comprising Crude (that is, unprocessed) oil, liquids extracted from natural gas (NGL) and fully or partly processed products from the refining of Crude oil (Mabro, 1984). Oil price is the spot price of one barrel of the benchmark crude oil (Farzanegan and Markwardt, 2009). The expected sign for oil price is negative on stock market returns, hence, Kang, *et al* (2015) presents that oil price has a negative impact on stock price.

4.4.2.4 GROSS DOMESTIC PRODUCT (GDP)

Gross Domestic Product (GDP) is defined as the total value of goods and services in the economy. It is one of the most important barometers of the performance of the economy stated by (Mohr, *et al*, 2008). The expected sign between relationship of gross domestic product and stock market returns is positive. The conclusion of (Adjasi, 2011) reveals that gross domestic product would lead to an increase in stock market performances; in other words, there is a positive relationship between the variables.

4.4.2.5 EXCHANGE RATE

Van der Merwe and Mollentze (2010) define exchange rate as a relative price that shows the price of one currency in terms of another currency. When the price of one currency is given in terms of the other currency and vice versa, this is referred to as bilateral. The expected sign is negative between exchange rate and stock market returns. Khumalo (2011) proved that the relationship between exchange rate and stock prices is negative.

4.4.2.6 BROAD MONEY SUPPLY (M3)

Das (2010) provided definitions of money supply by stating that money supply is considered as currency notes and coins with the public excluding the balances of central and state governments held at treasuries and cash on hand of scheduled and reporting non-scheduled banks and state cooperative banks. Moreover, the demand

deposits (excluding inter-bank demand deposits) of scheduled and non-scheduled banks and state cooperative banks, and the other deposits held with RBI excluding the balance of the International Monetary Fund. Additionally, the scheduled and cooperative banks' demand deposits include the interbank deposits and some other demand liabilities. However, the public means all holders of money other than government and the banking system (Das, 2010). The hypotheses showed that money supply has an influence on the valuation of S&P 500 index stated by (Picha, 2017).

4.5 TESTING FOR STATIONARITY OR UNIT ROOT

This test is used to assess whether or not the underlying stochastic process of the time series can be assumed to be invariant over time (Brooks, 2008). However, if the mean and variance of a time series are constant over time, meaning that the time series is said to be stationary. In addition, when the time series data was said to be non-stationary, and the variance and mean are not constant over time. The non-stationary data yield spurious and misleading results according to (Gujarati, 2009). Moreover, the non-stationary data can be made stationary through differencing. The study employed two unit root tests to check whether a series is stationary or not. The Dickey-Fuller test is the most basic test. The unfortunate part is that it is the least powerful unit root test stated by (Alexander, 2008). As a result of this weakness the Augmented Dickey-Fuller and Phillips-Perron test are utilised by this study. The main difference between each test is how each calculates the unit root test statistics.

4.5.1 THE AUGMENTED DICKEY-FULLER TEST

The Dickey-Fuller test is conducted to calculate the autoregressive model and to test whether the coefficient is statistically different from one expressed by (Mernard, 2008). Furthermore, if it is not, it will be necessary to difference the series in order to achieve stationarity. The following model is the Dickey-Fuller test:

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \varepsilon_t \quad (4.6.1)$$

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

$$H_0: \gamma = 0$$

$$H_1: \gamma > 1$$

The serious issue about the ordinary Dickey-Fuller test is that their critical values are biased if there is autocorrelation in the residuals of the Dickey-Fuller regression. In order to correct this issue, Dickey and Fuller (1981) developed the augmented version of the Dickey-Fuller Test. In their test they included more lagged variables than necessary to remove any autocorrelation in the residuals. Sarkar (2012) reveals that the Augmented Dickey-Fuller approach controls the higher order correlation by adding lagged differences terms of the dependent variables to the right hand side of the regression. However, Mishra and Sethi (2008) held that the Augmented Dickey-Fuller Test will have the following model:

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + {}_1\Delta Y_{t-1} + \delta_2 \Delta Y_{t-2} + \ldots\ldots\ldots\ldots + \delta_p \Delta Y_{t-p} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.6.2)$$

This augmented specification model is then tested for:

$$H_0: \gamma = 0$$

$$H_1: \gamma > 1$$

The Augmented Dickey-Fuller tests will be employed in this study.

4.5.2 PHILLIPS-PERRON TEST

The Augmented Dickey-Fuller test can sometimes behave poorly, especial in the presence of serial correlation, although it is one of the most commonly used tests. As a result of this, thus, Phillips-Perron conducted a more comprehensive theory of unit root non-stationarity. The Phillips-Perron test is more similar to the Augmented Dickey-Fuller tests, but they incorporated automatic correction to the Dickey-Fuller procedure to allow for autocorrelated residuals. Cashins and McDermott (2006) stated that the Phillips-Perron yields (or performs) better results than the Augmented Dickey-Fuller test in terms of comparative power and yields tighter confidence intervals.

Additionally, Sarris and Hallan (2006) held that the Phillips-Perron tests are non-parametric tests of the null of the unit root and are considered more powerful, as they use consistent estimation of the variance. Normally, the Phillips-Perron unit root differs from the Augmented Dickey-Fuller tests mainly on how they deal with serial correlation and heteroscedasticity in the errors. The model of Phillips-Perron test is expressed as follows:

$X_t = \eta + \beta_t + \pi X_{t-1} + \Psi_t$ …… (4.7.1)

The unit root null hypothesis will be presented in this form $H_{0:}\ \pi = 1$; the stationary process Ψ_t is not assumed to be white noise and serial correlation and heteroscedasticity in the Ψ_t term are handled in the test statistic stated by (Donner and Barbosa, 2008).

4.6 DIAGNOSTIC TESTS

The diagnostic tests should be performed as assumed by Gujarati (2004) so that the model finally chosen is a good model in the sense that all the estimated coefficients have the right signs, in all they will be statistically significant on the basis of the *t* and *F* tests, and the R-squared value is reasonably high. Therefore, this study will employ the Histogram and Normality test, and the Ramsey test, Serial Correlation LM test.

4.6.1 NORMALITY TEST

The series, if normally distributed, is tested using the Jarqure-Bera since is a test statistic. The difference between the skewness and kurtosis of the series is measured with the statistic test and also those from the normal distribution. The Jarque-Bera test is based on the fact that skewness and kurtosis of a normal distribution is equal to zero. However, the absolute value of these parameters could be a measure of deviation of the distribution from normal. The idea of a normality test utilising the classical skewness and kurtosis coefficients was proposed by Jarque and Bera. Furthermore, the Jarque-Bera test is a goodness of fit measure to departure from normality, based on the sample kurtosis and skewness. The test statistic of Jarque-Bera is defined as follows, as stated by (Machiwal and Jha, 2012).

$JB=n/6\ (S^2 + (k-3^2/4))$…… (4.7.1.1)

Where *n* = number of observations, *S* = sample skewness and *k* = sample kurtosis. The *JB* test is based on the result that a normally distributed random variable has skewness equal to zero and kurtosis equal to 3. In all the test of normality compares skewness and kurtosis to 0 and 3, their values under normality. The statistic JB has an asymptotic chi-square distribution with two degrees of freedom and can be used to test the null hypothesis that the data are from a normal distribution. Machiwal and Jha (2012) emphasis that for some normally distributed variables such as, *S = 0* and

K = 3, meaning the *JB* test of normality is a test of the joint hypothesis that *S* and *K* are *0* and *3*, respectively. The Jarque-Bera (JB) test is utilised in this study to test whether gold price volatility and stock market returns individually follow the normal probability distribution.

4.6.2 RESIDUAL DIAGNOSTICS/CORRELOGRAM-Q-STATISTICS

A test whether a volatility model has adequately captured all of the persistence in the variance of gold price volatility and stock market returns is to look at the correlogram of the standardised squared residuals. If the model is adequate then the standardised squared residuals should be serial uncorrelated revealed by (Knight and Satchell, 2007). The q-statistic of squared residuals are expressed as follows:

$Q^* = T(T + 2)$……(4.7.2.1)

Where Tis the sample size, m represents the maximum length and t_k are the correlation coefficients. The null hypothesis is $H_0 = \beta_1 = \ldots\ldots \beta_m = 0$, where β_i is the coefficient of $\alpha_t{}^2{}_{-1}$ of linear regression:

$\alpha_t{}^2 = \beta_0 + \beta_1 \alpha_t{}^2{}_{-1} \ldots \ldots \beta_{t-m}{}^2 + \varepsilon_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots$ (4.7.2.2)

For $t = m + 1 \ldots \ldots, T.$

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

4.6.3 SERIAL CORRELATION TEST

The serial correlation occurs when there is dependence between error terms. The error terms of the equation estimate should be distributed independently of each other and hence the covariance between any pair of error or residual terms must be zero as stated by Lhabitant (2004); the serial correlation when the covariance is not zero. The use of the time series data often leads to the problem of autocorrelation that means, after positive stock market returns for one month there follow positive stock market returns for the subsequent month. Serial correlation is a problem because standard errors (even heteroskedastic robusts) are not constant, affecting statistical inferences (hypothesis testing). Durbin-Watson is the most commonly used test in time series. However, it is important to know that it is not relevant in many instances; in this case if the error distribution is not normal, or if there is a dependent

variable in a lagged form as an independent variable this is not an appropriate test for autocorrelation. A test that is suggested that does not have these limitations is the Lagrange Multiplier test (LM test).

4.6.3.1 VOLATILITY CLUSTERING IN THE RESIDUALS

It is essential to test whether the GARCH model is an appropriate technique; hence there are two conditions that have to be met by data such as volatility clustering in the residuals and arch effects in the residuals according to Enders (2010). The volatility clustering is mostly illustrated graphically, while the ARCH effects are mostly tested empirically. The study presents evidence of volatility clustering below and the following point 4.7.3.2 is the evidence of ARCH effects.

There is volatility clustering in the residuals, however, volatility clustering (that is, time-varying variance) is identified from the data when large changes tend to follow large changes and small changes tend to follow small changes (Lee, 2003). This is tested by estimating the mean mode (one without independent factors controlled).

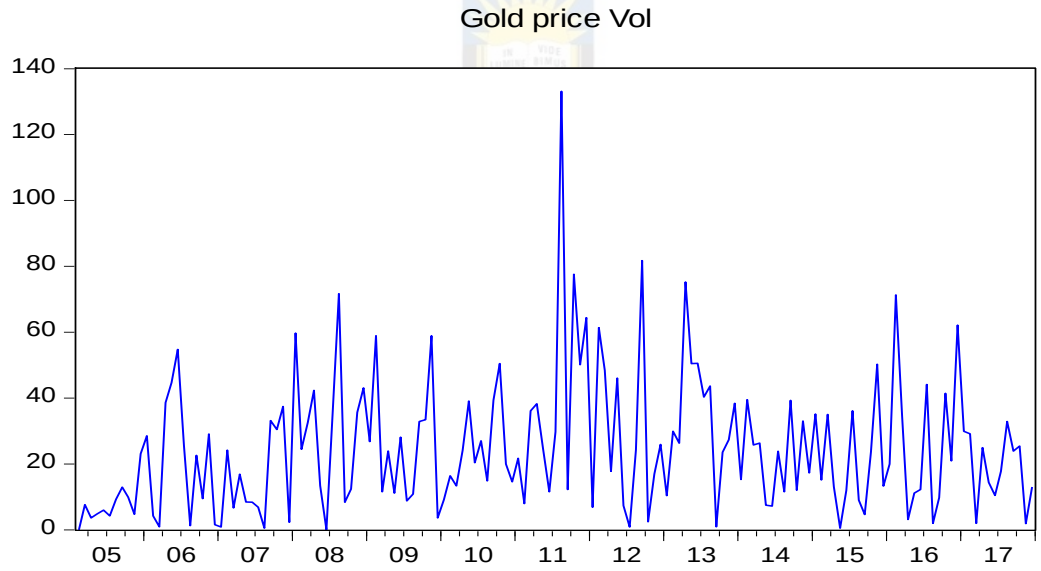

FIGURE 7: VOLATILITY CLUSTERING VOLATILITY IN RESIDUALS

Source: Author's computation using E-views 9 econometric software

The above graph of the residuals, which is applied to the monthly changes of the gold price volatility (which is the main controlling variable of the study), indicates periods of high volatility and other periods of relative composure – which is based on the differenced approach. The residuals plotted above indicate a period's characteristics by high levels of dispersion and other that have substantially lower

levels of dispersion. This series indicates non-random patterns that show volatility clustering is present. This exhibits that the series is a good candidate for autoregressive conditional heteroscedasticity (ARCH) modelling based on volatility clustering condition.

4.6.3.2 ARCH EFFECTS TEST (HETEROSCEDASTICITY TEST)

It is essential to first check if there are any ARCH effects (heteroscedasticity test) in the residuals of the model before the estimation for GARCH model can be done. Testing ARCH effects in the residuals, which is the post-estimation test run with null hypothesis that there are no ARCH effects versus the alternative that states that there are ARCH effects. This is done through the ARCH test of heteroscedasticty. The LM test for ARCH was then proposed by Engle (1982) based on the R^2 of an equation in which the squared residuals from an original regression (μ_t^2) are regressed on their lags ($\mu_{t-1}^{2\cdots}$ ($\mu_{t-k}^{2.}$), and an intercept term was stated in the research of Armstrong (2001). The test is based on the regression of squared residuals on lagged, squared residuals. The statistic is distributed as X^2 and provides a test of the hypothesis that the coefficients of the lagged squared residuals are all zero – that is no ARACH (Choi and Doukas, 1998). The statistic is the outcome of the Langrange Multiplier (LM) test and has an asymptotic distribution with degrees of freedom equal to the number of lagged squared residuals.

4.6.3.3 LAGRANGE MULTIPLIER TEST (LM TEST)

Song, *et al* (2009) stated that the calculation of the LM test is based on an auxiliary equation as shown below:

$$\varepsilon t = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t} + \ldots \ldots + \beta_k X_{kt} + P_1 \varepsilon t\text{-}1 + P_2 \varepsilon t\text{-}2 \ldots \ldots + P_p \varepsilon t\text{-}p + \mu_t \quad \ldots\ldots\ldots (4.7.3.1.1)$$

Where $X_{it}s$ are independent variables, the $\beta_i s$ and $p_j s$ are parameters and $\varepsilon t - js$ are the lagged residuals from the regression model. Under the null hypothesis of no autocorrelation:

$$H_0: p_i = p_2 = \ldots \ldots \ldots Pp = 0$$

Song, *et al* (2009) additionally stated that the test statistic is $n\ R^2$, where n is the sample size. In large samples, the test statistic has X^2 distribution with p degrees of

freedom. If the value of $n\ R^2$ exceeds the critical value of X^2, this suggests the presence of autocorrelation.

4.7 ESTIMATION TECHNIQUES

The many studies that have researched this topic indicate that the Standard deviation method, least squares method and the Granger Causality method can be used to analyse the relationship between the two investment instruments stated by (Engel, 1982). However, to determine price volatility and the dynamic relations between the variables the GARCH (Generalised Autoregressive Conditional Heteroscedasticity) model, a nonlinear method, provides more effective results (Contuk, Burucu and Gungor, 2013). The study introduces the GARCH model which allows for a more flexible lag structure, which is the reason that the GARCH model is the most appropriate model to use when modelling volatility and forecasting financial returns (Abdalla, 2012). The data indicates autoregressive conditionally heteroscedasticity, which shows GARCH effect and volatility clustering (time-vary variance) and there is high frequency of data, GARCH model is an accurate model that captures high volume of data.

Hence, many financial time series such as stock market returns and gold price volatility, showed changes in volatility in time and these changes tend to be serially correlated. In this regard, the evidence reviews that the distribution of time series data such as gold price volatility is characterised by leptokurtosis, fat tails, skewness and volatility clustering (Lee, 2003). GARCH models account for fat tails, leptokurtosis and volatility clustering that are commonly associated with financial time series. The argument of (Dowd, 2005) was that the GARCH model is tailor-made for volatility clustering, and this clustering produces returns with fatter than normal tails even if the innovations – the random shocks – are themselves normally distributed. Generally, the presence of leptokurtic tendencies on the time series returns suggests the presence of volatility clustering; since the modelling of such phenomena is recommended through use of the GARCH. In the GARCH effects such as volatility clustering and leptokurtosis are captured by letting the conditional variance be a function of the squares of previous observations and past variances. The study will utilise the ARCH/GARCH model to analyse the effect of gold price volatility on stock market returns.

The ARCH effect is a nonlinear phenomenon of the variance behaviour, found in the residual series from the linear models that fitted in daily and monthly data. A clear evidence of the existence of autoregressive conditional heteroscedasticity (that is, the ARCH effect) is found from the McLeod-Li test and Engle's Lagrange Multiplier test. Furthermore, the ARCH effect can be fully explained by seasonal variations in variance for monthly data, while there is only partial explanation for daily data. Volatility clustering is a phenomenon known as conditional heteroscedasticity, and is modelled by ARCH-type models, such as the ARCH model that was introduced by Engel (1982) and Bollerslev (1986) propose GARCH (Generalised-ARCH) model which is an extension of ARCH model.

4.7.1 GENERALISED AUTOREGRESSIVE CONDITIONAL HETEROSKEDASTICITY (GARCH) MODEL

The ARCH (Autoregressive Conditionally Homoscedasticity) model was first developed by Engel (1982) which was a stationary non-linear model, Bollerslev (1986) independently generalised Engle's model to the GARCH model and the perspective is that the GARCH model is more realistic (Fryzlewicz, 2007). The GARCH model was similar in spirit to the ARMA model reported by Reider (2009). Hence, Engel (1982) defined the error term of the ARMA mean equation as an autoregressive conditional heteroskedastic (ARCH) process where all ε_t are of the form:

$\varepsilon_t = Z_t \delta_t$ …………………………………………………………………….. ... (4.5.2.1)

and

$\delta_t^2 = \dot{\omega} + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2$ ………………………………………………………… … (4.8.2.2)

Where Z_t is an independent and identically distributed (i.i.d) variable has a distribution with a zero mean and a unit variance stated by Poit-Lepeti and M'Barek (2011). While it is a serially uncorrelated, its conditional variance δ_t^2 may change over time. Furthermore, the ARCH model has two shortcomings. The first one is that the ARCH (p) model is regarded as a short memory process because only recent p residuals have an effect on the current variance. Hence, the ARCH specification looked more like a moving average specification, but with an auto regression. Hence,

the GARCH model lets the conditional variance be a function of the squares of previous observations and past variances. This has imposed an autoregressive structure on the conditional variance allowing shocks to persist over time. However, Bouchet, *et al* (2003) revealed that the GARCH (1, 1) model is based on the fact that over time the variance tends to get pulled back to the long-run average level and it can be expressed as shown below:

$\delta_t^2 = yV + \alpha\, \delta_{t^{-1}}^2 + \beta\mu_{t^{-1}}^2$ … …….. …. (4.5.2.3)

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

$\delta^2 = \dot{\omega} + \alpha\, \delta_{t^{-1}}^2 + \beta\mu_{t^{-1}}^2$ … …… … (4.5.2.4)

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

In this case the error term has a conditional variance that is a function of the magnitudes of past errors. The 1, 1 in the GARCH (1, 1) model means that the conditional variance depends on the 1 most recent squared residual and the most conditional variances.

The GARCH model allows a longer memory process in which all the past residuals can affect the current variance either directly or indirectly through the lagged variance terms reviewed by Poit-Lepeti and M'Barek (2011). GARCH models have become widespread tools for dealing with time series heteroskedastic models. The goal of such models is to provide a volatility measure derivation that can be used in financial decisions concerning risk analysis, portfolio selection and derivative pricing. Thus, these are the extensions of GARCH model in general, which are EGARCH, MGARCH and TGARCH. Under the GARCH model there are three different assumptions that are assumed in terms of Error Distribution, such as normally distributed standardised innovations, standardised t-distributed innovations and GED distributed innovations.

4.7.1.1 ASSUMPTIONS OF GARCH MODEL

The assumption of normality produces very weak results: the vast majority of models, irrespective of sample size chosen, understate the true one-day 95% VaR estimate and the exception rates are higher than the 5% predicted level. In very few

cases, the estimated exception rate is close enough to the expected one (e.g. for the S&P 500 and the NIKKEI 225 indices, the AR(1) GARCH(1,1) and the AR(1) EGARCH(1,2) models achieve the closest fit, respectively). Moreover, in almost all cases, the different specification of the conditional mean or the introduction of only ARCH terms in the conditional variance do not improve either the unconditional or the conditional coverage of the models significantly.

Student's-t and the Generalised Error Distribution (GED) are adequate for the thickness of tails; these two different distributional assumptions are used for the standardised residuals. The GED behaves similarly to the normal for the 95% confidence level but yields better results at the 99% confidence level: given that such a distribution exhibits thicker tails than the normal, it seems that the hump problem is resolved. The use of the Student's-t distribution improves probability values, as they range from 80% to 95%, for all volatility models and all sample sizes like S&P 500. For the 95% VaR level, under Student's-t assumption, there is evidence that GARCH or EGARCH models produce better forecasts than the corresponding TARCH model, while for the GED this is the case only for the GARCH family.

The study will use normal distribution assumption because this assumption of normally distributed standardised residuals provides us with adequate forecasts only at the 95% level. In this assumption, there is at least one family of ARCH processes, producing convenient predictions. In addition, the GARCH model in the conditional variance plays an important role since it provides models with a longer memory and a more flexible lag structure. Secondly, the choice of the sample size is important in generating adequate conditional variance forecasts

The GARCH model allows for a more flexible lag structure, thus, a simple GARCH model offers a marginally better fit and a more plausible learning mechanism than an ARCH model with an eighth-order linear declining lag structure (Engle and Kraft, 1983). GARCH models start from Engle's model, while Bollerslev (1986) defined the conditional variance as an ARMA process, which is expressed below.

$\varepsilon_t \mid \Psi_{t-1} \sim N(O,h_t)$, …….. 1,

as

$$h = \alpha + \sum_{i-1}^{q} \alpha\varepsilon + \sum_{i=1}^{p} \beta h$$

and

$= \alpha_0 + A(L)\varepsilon_t^2 + B(L)h_t$ 3,

Where

$p \geq o, \qquad q > 0$

$\alpha > 0, \qquad \alpha \geq 0, \quad i = 1, \ldots., q,$

$\beta \geq 0, \qquad i = 1, \ldots \ldots, p,$

The above equations are different from the ARCH model; GARCH (p, q) process introduced the lagged conditional variance. The process of p = 0 reduces the ARCH (q) process, and p = q = 0 ε_t is just a white noise. However, the ARCH (q) process has a conditional variance which is stated as a linear function of the past sample variance only, while the GARCH (p, q) process permits the lagged conditional variance to enter as well (Bollerslev, 1986).

4.8 DATA SOURCES AND ANALYSIS

Data employed in the study is from 2005 to 2017, in monthly series. Data for the variables will be obtained from the World Federation of Exchange, World Bank, Quantec and South African Reserve Bank (SARB) online query Stock Market Returns (All Share Index), Gold Price volatility, Oil Price, Gross Domestic Product (GDP), Exchange Rates and Money Supply (M3). The study will utilise secondary data and all information and data that will be utilised on this study will be used with greatest integrity and will be not manipulated with all ethics upheld, and ethical consideration will be done according to the University policy. An application for ethical clearance will be made to GMRDC.

4.9 SUMMARY

The chapter focused on specifying the empirical model to test the effect of gold price volatility on stock market returns in South Africa. The selection of the variables which are likely to influence the behaviour of the stock market was done following both theoretical and empirical literature. The major variables included in the study are stock market returns, gold price volatility, oil price, gross domestic product, money supply and exchange rate. The study will utilise unit root tests to check stationarity among variables (Augmented Dickey-Fuller and Phillips-Perron tests), Diagnostic tests such as Normality test, Ramsey RESET test and the LM test were discussed in the study. The model that is chosen as the estimation technique for the study is the GARCH model for the effect of gold price volatility on stock market returns. The following chapter will show the regressions and the interpretations using the final GARCH model through the econometric package EVIEWS 9.

CHAPTER 5: ESTIMATION AND INTERPRETATIONS OF RESULTS

5.1 INTRODUCTION

The previous chapter presented an essential analytical framework and estimation technique that will be utilised by the study. This chapter presents the main results of regressions. The influence that gold price volatility has on stock market returns is estimated utilising other significant macroeconomic variables which were presented in the previous chapter. It is through this chapter that the objective of this study can be achieved. The chapter is divided into six sections, the first of which illustrates the results of descriptive statistics. The second section outlines the collinearity test and ARCH effect tests, which is followed by stationarity tests in third section. The fourth and fifth sections respectively, present results and diagnostic tests. The last section presents discussions of results and the conclusion of the chapter.

5.2 DESCRIPTIVE STATISTICS OF MONTHLY CHANGES IN THE EFFECT OF GOLD PRICE VOLATILITY ON STOCK MARKET RETURNS.

Xuezheng, Russell and Tiso (2001); Brooks (2008); Mlambo, *et al* (2013) stated that there are many financial and economic series that show leptokurtosis and time-varying volatility. These two features have been the subject of extensive studies ever since Mandelbrot (1997) and Fama (1965) first reported them. Therefore, it is important to conduct descriptive statistics in order to determine whether gold price volatility and All Share Index (proxy of stock market returns) show leptokurtosis and time-varying volatility characteristics. The descriptive statistics of the variables are illustrated in table 5. Thus, the table below exhibits statistics that are associated with skewness, kurtosis and JB which are suggestive of non-normality of the variables.

TABLE 5: DESCRIPTIVE STATISTICS

	All Share Index	Gold Price Vol	Oil Price$	M3	GDP Growth	LExchange Rate
Mean	10.40931	7.364523	78.10019	10.89058	2.599896	6.683013
Median	10.37985	7.615139	73.20000	7.740000	2.390509	6.673311
Max	10.99831	11.12563	133.8600	27.25000	5.822685	7.078426
Mini	9.437951	0.806481	30.93000	0.120000	-1.876852	6.185900
Std.Dev.	0.387679	2.035854	26.44159	6.960956	2.006655	0.221296
Skewness	-0.380380	-0.728435	0.251828	0.830099	-0.123885	-0.242047
Kurtosis	2.327119	3.622522	1.714595	2.322944	2.525014	2.194036
Jarque-Bera	6.661939	16.21044	12.30917	20.76138	1.853557	5.708685
Probability	0.035758	0.000302	0.002124	0.000031	0.395827	0.057594

Source: Author's computation using E-views 9 econometric software

According to Brooks (2008), a normally distributed series has a skewness of 0 and kurtosis of 3 and is symmetric and said to be mesokurtic. The kurtosis coefficient measures asymmetry. The above table exhibits a negative coefficient (-0.380380) of skewness for the all shares index. This is indicative of a distribution that has an asymmetric tail that extends toward more negative values (Cisar and Cisar, 2010). The above outcomes indicate that there is asymmetry in the variable (all shares index). In addition, the skewness coefficient of gold price volatility (-0.728435), exchange rate (-0.242047) and gross domestic product (GDP-Growth) (-0.123885) are negative, whereas oil price (0.251828) and money supply (M3) (0.830099) are positive, respectively. All the variables have asymmetry because a variable that follows a normal distribution should be asymmetric. Sommerfeld, *et al* (2006) stated that some researchers believe that investors prefer positive skewness, which, all else being equal, means they should prefer portfolios with distributions offering a relatively large frequency of unusually large payoffs.

The kurtosis coefficient measures peakedness or flatness of a distribution (Cisar and Cisar, 2010). In addition, a positive kurtosis shows a relatively peaked distribution. The kurtosis values of all shares index (2.327119), oil price (1.714595), money supply (M3) (2.322944), exchange rate (2.194036) and gross domestic product (GDP-Growth) (2.525014) are positive, this suggests that there is peakedness and these variables which have coefficients that are less than 3 are said to be platykurtic. Gold price volatility (3.622522) is the only variable that has a coefficient that is greater than 3, meaning this variable is said to be leptokurtic. The kurtosis coefficient for gold volatility is positive which suggest that gold price volatility shows peakedness. Since gold price volatility has kurtosis coefficient that is greater than 3 and also Jarque-Bera statistic is significant at 1% level and this indicates much higher distributions than the normal distribution. From this it can be observed that the gold price volatility variable shows significant deviations from normality.

Brooks (2008) stated that a kurtosis value greater than 3 is said to be leptokurtic and less than 3 is platykurtic. However, the mean equation should be subjected to the autoregressive conditional heteroscedasticity (ARCH) as shown by the descriptive

statistics. The evidence of the ARCH effect underscores the appropriateness of GARCH estimation.

The standard deviations of the all shares index (0.387679), gold price volatility (2.035854), oil prices (26.44159), money supply (M3) (6.960956), exchange rate (0.221296) and gross domestic product (GDP-Growth) (2.006655) are illustrated in the above table of descriptive statistics, respectively. From the monthly standard deviation, it can be noticed that the oil price is much more volatile than that of the gold price hence there is a need for it to be captured under the GARCH model. It is essential to test for collinearity in the variables prior to the estimation technique.

5.3 TESTING FOR COLLINEARITY

The test for collinearity was done to see that there is no linear correlation among independent variables. The reason behind assumption of no multicollinearity is if two variables are collinear it becomes difficult to separate the individual effect of each variable on the dependent variable. To avoid misleading results due to multicollinearity, it is necessary to check for multicollinearity. In order to check multicollinearity between explanatory variables, a correlation analysis was performed. In the sense that the closer the r coefficient approaches plus or minus one, regardless of the direction, the stronger evidence that it indicates a more linear relationship between the two variables. According to Mlambo, *et al* (2013) the rule of thumb is that, if the correlation between the two variables is greater than 80%, multicollinearity may be severe and pose a serious problem. Table 6 below presents the results of the correlation analysis.

TABLE 6: TESTING FOR COLLINEARITY - MATRIX OF CORRELATION (ALL SHARES INDEX)

Variables	Gold price Vol	Oil Price	M3	Lexchange Rate	GDP Growth
Gold price Vol	1.000000	0.233022	-0.128156	-0.025436	-0.056282
Oil Price	0.233022	1.000000	-0.124078	-0.038308	0.162807
M3	-0.128156	-0.124078	1.000000	-0.559800	0.715421
Lexchange Rate	-0.025436	-0.038308	-0.559800	1.000000	-0.660651

GDP GROWTH	-0.056282	0.162807	0.715421	-0.660651	1.000000

Source: Author's computation using E-views 9 econometric software

The above table shows that the highest correlation coefficient value is 0.715421 which is lower than 0.8 or 80%. Since the highest correlation numbers are lower than 80%, the results clearly indicate that none of the explanatory variables are highly correlated and no multicollinearity between the explanatory variables exists.

5.4 TESTING FOR ARCH EFFECT

It is important first to compute the Engle (1982) test for ARCH effects to make sure that the model is appropriate for the data before estimating for GARCH model (Brooks, 2008). In this regard, testing for the ARCH effect is a prerequisite to GARCH model estimation technique. The results are demonstrated by Table 7 below for All Share Index.

TABLE 7: HETEROSKEDASTICITY: ARCH TEST FOR ALL SHARE INDEX

F-statistic	110.9328	Prob. F(1,152)	0.0000
Obs*R-squared	64.97345	Prob. Chi-Square(1)	0.0000

Source: Author's computation using E-views 9 econometric software

The above table illustrates that the statistic labelled "Obs*R-squared" is the ARCH test of auto-correlation in the squared residuals. The p-value for the All Share Index is (0.0000) that can allow the study to reject the null hypothesis of no heteroscedasticity in the residuals. In all, the zero-probability value strongly shows the presence of heteroscedasticity in the residuals. However, the presence of heteroscedasticity makes the use of GARCH more apparent in this study. The correlogram of squared residuals was also conducted to complement the ARCH test in detecting heteroscedasticity. The table 8 below presents the results of the correlogram of squared residuals.

5.5 CORRELOGRAM OF SQUARED RESIDUALS

Table 8 below provides proof of ARCH effects as judged by the autocorrelations of the squared residuals. Looking on the results of All Share Index all the p-values are significant, and resultantly the no ARCH hypothesis is rejected. There was agreement of Sumter (2013) that the auto-correlation of squared residuals or

absolute returns suggests the presence of strong dependencies in higher moments, something that in turn is indicative of conditional heteroscedasticity. Since the autocorrelation is observed, it means that there is heteroscedasticity in the residuals. The auto-correlation of squared or absolute returns suggests the presence of strong dependencies in higher moments, something that in turn is indicative of conditional heteroscedasticity. The also confirms that there is a need for GARCH model.

TABLE 8: CORRELOGRAM OF SQUARED RESIDUALS

All Share Index				
Lags	AC	PAC	Q-stat	Prob
1	0.649	0.649	66.652	0.000
2	0.399	-0.039	92.008	0.000
3	0.248	0.007	101.87	0.000
4	0.149	-0.010	105.45	0.000
5	0.006	-0.144	105.46	0.000
6	-0.102	-0.076	107.15	0.000
7	-0.070	0.110	107.95	0.000
8	-0.057	-0.027	108.48	0.000
9	-0.004	0.087	108.49	0.000
10	0.042	0.038	108.79	0.000
11	0.081	0.006	109.90	0.000
12	0.098	0.014	111.54	0.000
13	0.052	-0.069	112.01	0.000
14	0.010	-0.036	112.03	0.000
15	-0.009	0.027	112.04	0.000
16	-0.026	-0.011	112.16	0.000
17	-0.017	0.054	112.21	0.000
18	0.073	0.162	113.16	0.000
19	0.094	-0.052	114.72	0.000
20	0.097	0.013	116.44	0.000
21	0.043	-0.101	116.78	0.000
22	0.038	0.002	117.04	0.000
23	-0.000	-0.030	117.04	0.000
24	0.004	0.093	117.04	0.000
25	0.032	0.067	117.23	0.000
26	0.010	-0.025	117.25	0.000
27	-0.045	-0.118	117.63	0.000
28	-0.069	-0.031	118.55	0.000
29	-0.051	-0.024	119.05	0.000
30	0.006	0.095	119.06	0.000
31	0.030	0.047	119.24	0.000
32	-0.008	-0.072	119.25	0.000
33	-0.042	-0.045	119.60	0.000
34	-0.053	-0.037	120.17	0.000
35	-0.036	0.020	120.43	0.000
36	-0.035	-0.001	120.68	0.000

Source: Author's computation using E-views 9 econometric software

5.6 STATIONARITY TEST

It is of great importance prior to conducting the formal tests on the unit root, to plot the time series graphically (Gujarati, 2004). Moreover, the graphical plots deliver information on the properties of the time series. In addition, graphical plots include visual plots of series and make a comparison of different variables possible. If the mean and variance are stable over time that means the series is stationary. In standard econometric theory stationarity is very important. Without the stationarity test the study cannot acquire consistent estimators.

In this regard, if the process is stationary the series is plotted against time. The representation of graph takes the form of time series plots and provides a particularly useful way of envisioning information and conducting comparative analyses over time. However, when using the graphical plots, if a variable fluctuates around the zero mean, that is, it is means reverting and it exhibits stationarity and non-stationarity. At the same time when a graph crosses the mean of the sample many times, the chances are that the variable is stationary, then that is an indication of persistent trends away from the mean of the series. However, if the mean and variance change, the series is non-stationary.

5.6.1 INFORMAL TEST RESULTS

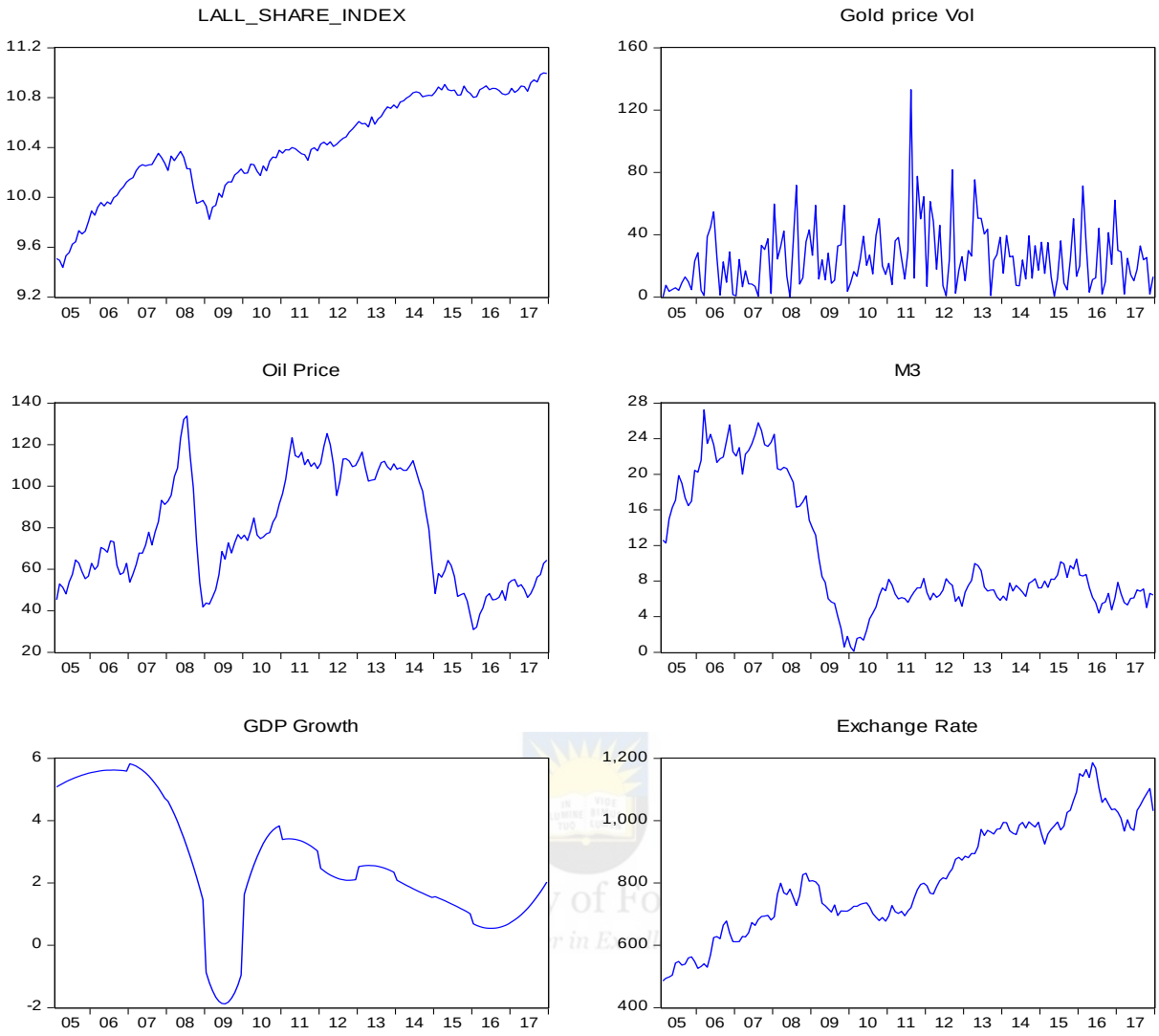

FIGURE 8: LEVEL SERIES

Source: Author's computation using E-views 9 econometric software

Figure 9 above illustrates variables at level series; however, observing data series of the All Share Index is strongly linearly trended or it is pivoting away from the mean hence it is found non-stationary. The gold price volatility level series data indicates no tendency to return to its mean showing the need for differencing. All the variables are non-stationary at level series as they are found not to be mean reverting. This could likely provide spurious results if variables are not stationary. Figure 10 below displays data that fluctuates around the mean; this allows the study to conclude that all variables are becoming stationary or mean reverting after first differenced.

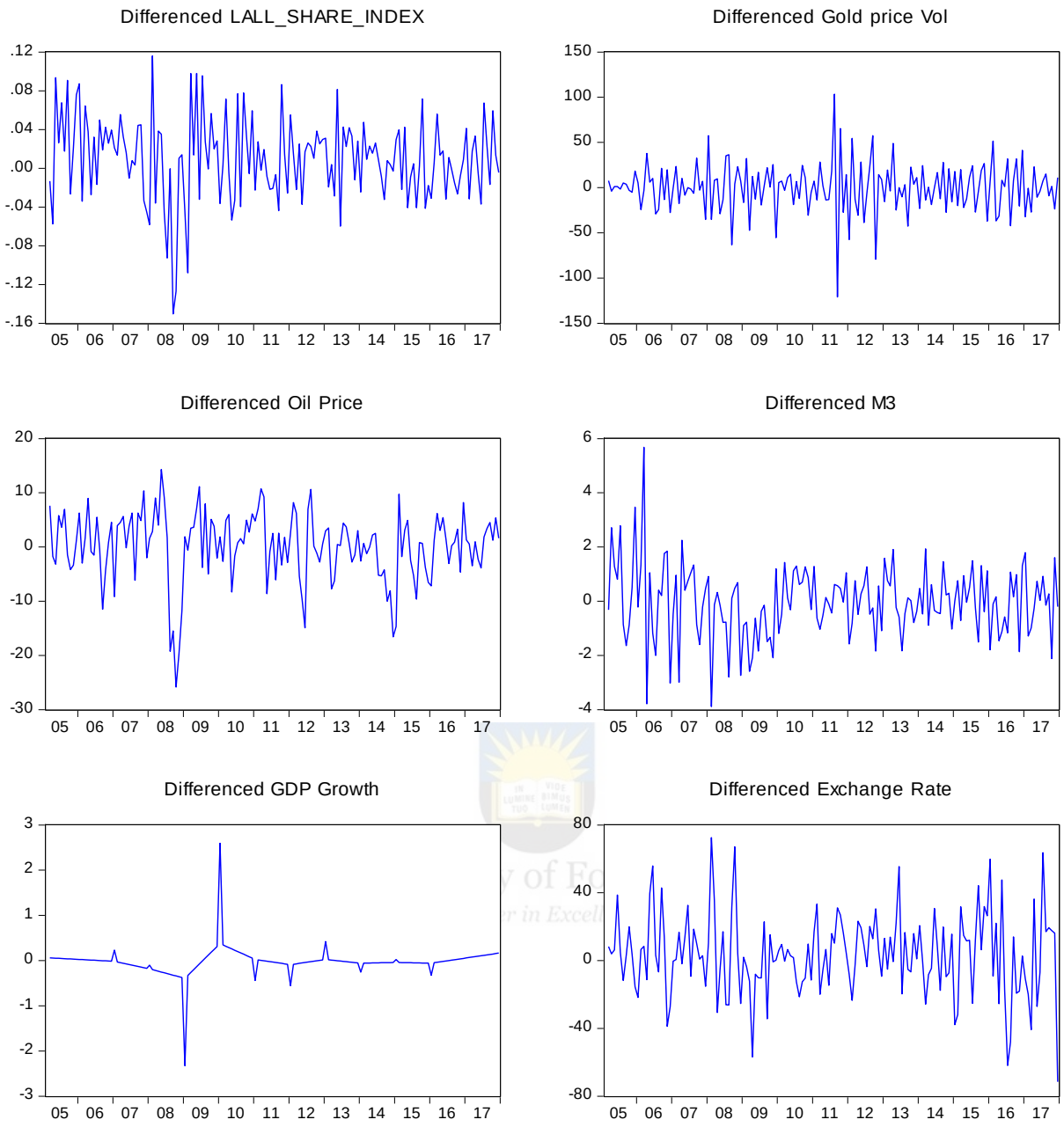

FIGURE 9: DIFFERENCED DATA

Source: Author's computation using E-views 9 econometric software

Nonetheless, Chuma (2015) expressed that it essential to come up with soil decisions regarding stationarity by conducting formal tests. Moreover, the graphical unit root analysis, formal econometric tests are approved to unambiguously decide on the actual nature of the time series (Mlambo *et al*, 2013). The above graphs indicate that the first differenced variables show a sign of returning to their mean suggesting that the series is strongly stationary. After the first differenced, the run sequence plots show that the data have a constant location and variance, and the

pattern of residuals indicates that the data is moving along with model in an orderly way. In all, based on this analysis, the stationarity status of the variables is clear.

The study utilised the standard formal procedure of stationarity test by using Augmented Dicky-Fuller (ADF) test. The common weakness of the ADF is its low power, thus the study utilised Phillips-Perron (PP) to test complement the ADF. The following Tables 9 and 10 display stationarity results.

5.6.2 FORMAL TEST RESULTS

TABLE 9: STATIONARITY TESTS (LEVEL SERIES)

AUGMENTED DICKEY-FULLER				PHILLIPS-PERRON		
Variables	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None
All shares index	-1.851794	-2.587683	2.696751	-1.819422	-2.795970	2.377221
Gold price Vol	-8.557304***	-8.554184***	-0.605615	-8.395656***	-8.372668***	-2.260815**
Oil Price$	-2.381097	-2.409503	-0.688603	-2.229507	-2.258079	-0.542336
M3	-1.113920	-1.821363	-0.913545	-1.097791	-1.874811	-0.904539
GDP Growth	1.909319	-2.040726	-1.672855*	-1.940050	-2.125050	-1.530980
Exchange Rate	-1.978317	-2.574516	1.990877	-1.966791	-2.761908	1.909319

*** Statistically significant at 1%; ** statistically significant at 5%; *statistically significant at 10%

Source: Author's computation using E-views 9 econometric software

The ADF test of Unit Root results shows that the null hypothesis that variables are non-stationary at level series, meaning that the variables cannot be rejected at 1 percent level of significance as showed in the above table. This shows that all variables have the unit root problem at levels series except for gold price volatility. However, the Phillips-Perron tests reveal results that concur with the ADF outcomes and the test presents that the null hypothesis that variables are non-stationary at level series cannot be rejected at 1% significance level. The alternative hypothesis cannot be accepted in all variables except for gold price volatility as indicated above.

Moreover, the above table shows that both the unit root test presents that all shares index, money supply (M3) exchange rate and gross domestic product (GDP-Growth) are not stationary at level series. Gold price volatility is stationary at 5% level based on the results ADF test, this is confirmed by Phillips-Perron tests.

Both the unit root test findings are consistent with the previous explanation of the informal test. The ADF and Phillips-Perron tests mostly yield the same findings with the informal test in some cases. In level series most variables are not stationary, they are differenced in Table 10 below.

TABLE 10: STATIONARITY TESTS (DIFFERENCED DATA)

AUGMENTED DICKEY-FULLER				PHILLIPS-PERRON		
Variables	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None
LAll shares index	-13.12795***	-13.19708***	-13.19708***	-13.20175***	-13.23469***	-12.84391***
LGold price Vol	-8.609617***	-8.282207***	-8.640067***	-45.26546***	-60.94460***	-47.84393***
Oil Price$	-8.039292***	-8.029652***	-8.065969***	-8.092644***	-8.084898***	-8.118820***
M3	-12.96222***	-12.92827***	-12.99382***	-12.95318***	-12.91971***	-12.98391***
GDP Growth	-4.172866***	-5.769055***	-4.123993***	-9.272023***	-9.273897***	-9.278169***
Lexchange Rate	-10.38370***	-10.42629***	-10.19233***	-10.28803***	-10.33130***	-10.12023***

*** Statistically significant at 1%; ** statistically significant at 5%; *statistically significant at 10%

Source: Author's computation using E-views 9 econometric software

Table 10 above shows that both ADF and Phillips-Perron tests indicate that all variables are stationary at all significance levels. The null hypothesis that all variables are non-stationary is rejected and the alternative hypothesis provides that all the variables are stationary cannot be rejected at 1% significance level as both unit root tests (ADF and Phillips-Perron) confirmed. The study confirmed that all the series are stationary at 1% significance, thus, that stationarity of the series helps to eliminate the danger of obtaining regressions.

5.7 PRESENTATION OF THE RESULTS

Since Table 10 shows that the variables are stationary, this permits the study to present the empirical findings of GARCH model in the following section. Table 11 below shows the GARCH results for gold price volatility on stock market returns (All Share Index is a proxy) in South Africa.

TABLE 11: GARCH RESULTS

Dependent variable: ALL SHARE INDEX

VARIABLE	COEFFICIENT	STD.ERROR	Z-STATISTIC	PROBABILITY
LGold Price Vol	-0.005286	0.002649	-1.995454	0.0460
OIL Price $	-0.000386	0.000245	-1.572832	0.1158
M3	0.003019	0.001495	2.0195149	0.0434
Lexchange Rate	1.823590	0.021340	85.45295	0.0000
GDP-Growth	0.033328	0.007255	4.593982	0.0000
C	-1.771554	0.135683	-13.05652	0.0000
VARIANCE EQUATION				
C	0.008578	0.003694	2.322199	0.0202
RESID(-1)^2	0.978699	0.251002	3.899166	0.0001
GARCH(-1)	0.008074	0.107231	0.075293	0.9400
LGOLD Price Vol	-0.000790	0.000358	-2.207426	0.0273

Source: Author's computation using E-views 9 econometric software

The mean equation of the All Shares Index

As expected, gold price volatility has a negative sign; therefore, a one percent increase of gold price volatility decreases the All Share Index by -0.005286. The outcomes showed that there is a negative relationship between the two variables. The value of gold price volatility is statistically significant and it is negative, meaning that an increase in gold price volatility will lead to a fall in the All Share Index on the stock market. Smith (2002) confirms that there is a negative relationship between gold prices and stock market returns in the short run, but the relationship is not significant in the long run.

A one percent increase of oil prices decreases the All Share Index by -0.000386. The oil prices coefficient is negative and it is not statistically significant, but an increase in oil price dampens the All Share Index (stock market activities). The sign of oil prices was expected to be negative. The oil price movement has a negative relationship with stock market prices as stated by Jones and Kaul (1996). The authors suggested that the increase of oil prices is associated with a rise in energy costs which was central to the cost of production. Furthermore, with the rise in cost production the investors will tend to devalue firms due to lower expected returns in line with the weighted average cost of capital.

As expected, the sign of money supply (M3) is positive, a one percentage point increase of money supply increases the All Share Index by 0.003019. The money supply has a positive coefficient and statistically significant showing that an increase in money supply will cause a rise in stock market activities. An increase in money supply leads to increase in liquidity that eventually results in upward movement of nominal equity prices. Jonathan and Oghenebrume (2017) found that broad money supply was positive related to stock market prices which were captured by the All Share Index. And the study that was conducted by Li (2012) also found a positive relationship between money supply and stock market capitalisation.

The sign of exchange rate turned out to be positive; a one percent increase in exchange rate will lead to an increase in the All Share Index by 1.823590. These results are consistent with economic theory, as the flow oriented model maintains a causal relationship that runs from exchange rate to stock price. According to this theory, exchange rate movements affect stock prices. Joseph (2002) stated that exchange rate changes affect the competitiveness of firms through their impact on input and output prices.

As expected, the sign of the gross domestic product (GDP-Growth) is positive; therefore, a one percent increase of gross domestic product increases the All Share Index by 0.033328. The value of gross domestic product is statistically significant and it is positive, meaning that an increase in gross domestic product will lead to an increase in All Share Index on the stock market. Silva, Perera and Silva (2018) revealed the empirical literature of Sri Lanka, in which the authors found that there was a strong relationship between stock market performance and economic growth.

The variance equation of the all shares index

The variance equation represents the GARCH model and it is in this equation that the volatility of gold price volatility and stock market returns were captured. The interpretation of the results is discussed below:

An evaluation of variance equation of the All Share Index indicates that gold price volatility has a negative coefficient of -0.000790 and is statistically significant. Additionally, the probability of the gold price volatility is 0.0273 that shows gold price volatility is statistically significant in explaining the movements in the All Share Index (stock market returns). The results indicated that a percentage increase in gold price volatility decreases the All Share Index by -0.000790. In other words, the increase in gold price volatility leads to a decrease in All Share Index.

5.8 DIAGNOSTICS TESTS

Diagnostic tests should be performed according to Gujarati (2004) so that the model finally chosen is a good model in the sense that all the estimated coefficients have right signs, they are statistically significant on the basis of the *t and F* tests. In this regard, the study will employ histogram and normality tests, a heteroscedasticity test and a correlogram of squared residual test as diagnostic tests.

5.8.1 NORMALITY TEST

The Normality test was conducted to test the residuals' normality. Economic theory expects the residuals to be normally distributed. The table below presents the results of the Normality test.

TABLE 12: NORMALITY TEST RESULTS

	OLS	Normal GARCH
Skewness	-0.590955	0.165644
Kurtosis	3.349199	2.845457
Jarge-Bera	9.809256	0.863065
Probability	0.007412	0.649513

Source: Author's computation using E-views 9 econometric software

Table 12 above shows the normality test. The results shown in the previous table for All Share Index presents that the normal GARCH model has reduced the fat tails problems and volatility clustering. More specifically, the results in the table for the All Share Index the normal GARCH model best reduced the problems of fat tails and

volatility clustering. Looking at both tables the results display that the normal GARCH can model these problems better. In Table 12 the skewness is positive (0.165644) which is greater than skewness (-0.590955) of OLS and Kurtosis (2.845457) is smaller under the normal GARCH compared to the kurtosis (3.349199) of OLS. The skewness for OLS (-0.426731) and are negative respectively. The coefficients of kurtosis for OLS (5.016405) and normal GARCH (7.509475) are positive. This provides assurance that the normal GARCH model has modelled the problems of fat tails and better and as a result it was chosen for the estimation purposes.

The reason for running the test for OLS, is that the study noted that there is still some asymmetry in the residuals as shown in Tables 12 by the kurtosis coefficients and some positive skewness coefficients. However, it must be realised that before the GARCH was used in this study, there was excess kurtosis on All Share Index which was reflecting some fat tails and also there was asymmetry in the residuals by looking on skewness coefficient of All Share Index. Hence with the use of GARCH excess skewness and kurtosis were reduced.

The normal GARCH displays that the JB value has been reduced from 9.809256 to 0.863065 with the p-value of 0.649513. The argument of Gujarati (2004) states that if the computed p-value of the JB statistic in an application is sufficiently low, which will happen if the value of statistic is very different from zero, one can reject the hypothesis that the residuals are normally distributed. In this case the study can conclude that the residuals are not normally distributed. However, it must be noted that the residuals have been drawn towards normality.

The non-normality of residuals in volatility time series data has been observed in the various studies. Arouri et al (2010) came up with similar results in their research on the dynamics of emerging markets using GARCH model. The study also concluded that the results provided strong support for the ability of GARCH models to correct the heteroscedasticity in the gold price volatility and other variables.

5.8.2 ARCH EFFECT

TABLE 13: ARCH TEST RESULTS

F-statistic	1.119899	Prob. F(1,152)	0.2916
Obs*R-squared	1.126336	Prob. Chi-Square(1)	0.2886

Source: Author's computation using E-views 9 econometric software

Table 13 demonstrates the results for the ARCH test. Engle's LM test shows that there are no more ARCH effects. When p-value of the Obs*R-squared is not significant; it is greater than 0.05 and this shows that there is no ARCH present. The p-value for All Share Index table is 0.2886, this indicates that there is no heteroscedasticity in the residuals. In other words, the ARCH test results strongly suggest the absence of ARCH in the residuals. This provides strong support that the GARCH can eliminate the problem of heteroscedasticity. In the beginning, with OLS, there was the presence of ARCH in the residuals. This made the use of the GARCH necessary and with the use of the GARCH technique, the ARCH effects in the residuals were eliminated.

5.8.3 TESTING FOR AUTOCORRELATION

5.8.3.1 Q-STATISTIC TEST

The stylised fact of volatility clustering in returns manifests itself as autocorrelation in the residuals from the estimated conditional mean equation according to Andersen *et al* (2009). The significance of the autocorrelation may be tested utilising the Q-statistic. The Q-statistic test was conducted to check if there was no correlation in the residuals after the application of the GARCH techniques. The table below shows the results for Q-statistic test.

The table present that the Q-statistics are all significant at all lags under the normal GARCH model, showing that there is no significant serial correlation in the residuals. The p-values are above 0.05 with the normal GARCH model and as a result of this the null hypothesis of no serial correlation is not rejected.

The table below presents that there is no correlation in the residuals. Therefore, the test accepts the hypothesis of no correlation up to order 36. In all this indicates that the mean equation was correctly specified. According to Ur (2005) if the mean

equation (conditional variance equation) is correctly specified, all Q-statistics of standardised residuals should be insignificant with no observable autocorrelation. Further to the correlation of the residuals, the Portmanteau test for white noise is conducted below to check for robustness of the model.

TABLE 14: Q-STATISTIC TEST

Lags	AC	PAC	Q-stat	Prob
1	0.085	0.085	1.1544	0.283
2	0.028	0.021	1.2825	0.527
3	0.056	0.052	1.7859	0.618
4	-0.095	-0.106	3.2442	0.518
5	-0.045	-0.031	3.5776	0.612
6	-0.015	-0.007	3.6123	0.729
7	-0.066	-0.052	4.3234	0.742
8	0.008	0.013	4.3334	0.826
9	-0.098	-0.106	5.9365	0.746
10	-0.046	-0.027	6.2917	0.790
11	-0.060	-0.065	6.8914	0.808
12	0.004	0.026	6.8946	0.864
13	-0.048	-0.067	7.2962	0.886
14	0.031	0.030	7.4662	0.915
15	-0.078	-0.103	8.5139	0.902
16	-0.029	-0.023	8.6567	0.927
17	-0.110	-0.128	10.798	0.867
18	-0.094	-0.085	12.372	0.827
19	-0.052	-0.062	12.863	0.845
20	0.040	0.028	13.156	0.871
21	-0.015	-0.042	13.197	0.902
22	-0.059	-0.118	13.830	0.907
23	-0.024	-0.046	13.939	0.929
24	0.088	0.055	15.365	0.910
25	0.032	0.009	15.558	0.927
26	0.008	-0.071	15.569	0.946
27	0.270	0.253	29.395	0.342
28	0.004	-0.093	29.399	0.393
29	0.018	0.037	29.464	0.441
30	0.013	-0.065	29.500	0.491
31	-0.074	-0.011	30.566	0.488
32	0.000	-0.029	30.566	0.539
33	-0.001	0.007	30.566	0.589
34	-0.062	-0.065	31.333	0.599
35	0.095	0.084	33.149	0.558
36	-0.031	-0.030	33.349	0.595

Source: Author's computation using E-views 9 econometric software

5.9 CONCLUSION

The chapter presented the results from econometrics analysis as outlined in the previous chapter. Stationarity tests were conducted in order to avoid spurious regressions using both the informal and formal tests of unit root. After stationarity tests, the GARCH technique was estimated. The empirical results indicate that gold price volatility affects All Share Index (stock market returns). However, the results also showed oil price, money supply (M3), exchange rate and gross domestic product (GDP-Growth) are statistically significant in explaining variations in All Share Index (stork market returns). Interestingly, the findings indicate that gold price volatility affects stock market returns negatively in South Africa. The following chapter will presents policy recommendations necessary for gold price volatility on stock market returns in South Africa basing on the empirical results that are presented in this chapter. Hence, Chapter 6 will achieve the last objective stated in the opening chapter.

CHAPTER 6: STUDY SUMMARY, CONCLUSIONS, POLICY IMPLICATIONS AND RECOMMENDATIONS

This chapter presents conclusions from the outcomes of the study, by means of recommendations for future policy formulation as well as to articulate the implications of the findings on South Africa and in broader context on developing and emerging market economies.

6.1 SUMMARY OF THE STUDY AND CONCLUSIONS

The study examines the effect of gold price volatility on stock market returns in South Africa using monthly series from the period January 2005 to December 2017 as highlighted C 1. The study conducted many assessments in order to achieve the fundamental objectives. The overview of gold price volatility and stock market are presented in Chapter 2 of the study. It was observed that the gold prices in South Africa are volatile. Moreover, Chapter 2 shows the volatility in gold price is a common experience in the market for gold with factors such as demand and supply factors being singled out as the most crucial variable in explaining the fluctuations in the prices of gold.

The theories of gold price volatility and stock market returns were reviewed in Chapter 3 which includes the storage model, scarcity rent, discounted cash flows approach, discount rate and efficient market hypothesis. However, some theories state that commodities will be stored until the actual price is less than what the companies expect to prevail in the future period; if not so the commodity won't be stored. Basically, these theories focused mostly on the process of trading commodities and price movements of commodities. Other theories postulate that there is a relationship that exists between gold price volatility and stock market returns. Moreover, the empirical literature shows the results of other scholars that the majority of studies find that gold price volatility and stock market returns have bidirectional causality relationship, meanwhile, other studies found that gold prices volatility and stock market returns were affected both by each other's shocks and their own shocks (Mishra, Das and Mishra, 2010; (Contuk, Burucu and Gungor, 2013). On the other hand, some studies find that there is unidirectional relationship that exists between gold prices and stock market indices. Yet other groups found that there is a positive or negative relationship between the variables.

Nevertheless, the literature review and the availability of data have played a crucial role in the selection of the variables to include in the model. Thus, this study has included variables such as stock market returns (All Share Index), gold price volatility, oil prices, exchange rate, money supply and gross domestic product. As mentioned earlier on, the selection of the variables was dictated by literature and the availability of data. In Chapter 5 the study employs the descriptive statistics to examine the statistical properties of the main variables such as gold price volatility and stock market returns (All Share Index). However, the results from the descriptive statistics indicated that the all shares index, gold price volatility, exchange rate, gross domestic product were negatively skewed except the oil prices and money supply which was positively skewed. The positive skewedness on these variables shows that the tail on the right side was longer than the left side.

The main objective of examining the effect of gold price volatility on stock market returns in South Africa was achieved in the previous chapter. However, the main objectives that were mentioned in Chapter 1 have been achieved in Chapter 5. The GARCH model was the estimation technique that the study utilised to achieve the objectives. However, before the study employs the estimation technique, unit root tests were carried out utilising the ADF and Phillips-Perron tests and all the variables were found stationary after first differencing. Furthermore, the ARCH-LM test was conducted in order to test for the presence of ARCH effect. The results of the GARCH model were presented in Chapter 5 which shows that the gold price volatility is statistically significant in explaining both the level and the variance of the all shares index (stock market returns). In addition, variation in gold price volatility was found positive and significant in explaining movements in the all shares index. These results corroborate with the following studies: Smith (2002) and Raza (2016) which show that gold price volatility was negatively related to the All Share Index.

6.2 POLICY IMPLICATIONS AND RECOMMENDATIONS

The findings of the study have a number of policy implications and recommendations necessary for the stability of the South African economy. In terms of commodity price policy implications these mostly depend on whether the country is a net commodity export or import. South Africa is a net commodity export. The report of SARB (2008) presented that recently the commodity price boom has resulted in significant relative price changes across the globe.

The domestic price movements have been magnified by exchange rate movements in the case of South Africa. In the case of relative price changes the economy has to adjust to those changes, the theory proposed that the changes should be temporary, and the policy should accommodate the relative price shift, that is, there is no need for structural changes in the economy. But it is a different case when the changes are permanent; then the macroeconomic policy in general should facilitate or accommodate a structural change in the economy. Furthermore, in South Africa within the inflation target regime, the problem could be reduced to one of accommodating relative price changes as long as long-term inflationary expectations are well fixed. In other words, the main monetary policy challenge is to prevent second-round price effects from taking hold.As highlighted in the previous chapter, the negative relationship between the gold price volatility and the all shares index (stock market returns) implies that a unit increase in the gold price leads to a depreciation of the all shares index relative to the stock market returns and the opposite is true. On other hand, the negative relationship between the gold price volatility and the all shares index (stock market returns) confirms that the commodity price leads to a fall in the value of the stock market.

6.3 POSSIBLE AREAS FOR FURTHER STUDY

There are few studies that examined the relationship between the gold price volatility and stock market returns utilising annual data, quarterly data and monthly data, including this study. Thus, it must be noted that weekly or daily data provide more useful results than the above-mentioned data frequencies. Therefore, the suggestion is that the significance of this study's findings can be improved by employing weekly or daily data. The utilisation of more frequent data captures the dynamics of gold price volatility and stock market returns.

6.4 LIMITATIONS OF THE STUDY

Since there was limited literature on this area of research, it was a challenge to find theories that are directly link the two variables gold price and stock market. Even to obtain empirical literature that was conducted in South Africa is not easy to be found. In South Africa is difficult to find weekly or daily gold prices data, that is why the study ended up using monthly data.

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APPENDICES

ARCH EFFECT BEFORE GARCH TEST

Heteroskedasticity Test: ARCH

F-statistic	110.9328	Prob. F(1,152)	0.0000
Obs*R-squared	64.97345	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 12/09/18 Time: 17:37
Sample (adjusted): 2006 2159
Included observations: 154 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005681	0.001838	3.090441	0.0024
RESID^2(-1)	0.649611	0.061677	10.53246	0.0000

R-squared	0.421905	Mean dependent var	0.016251
Adjusted R-squared	0.418102	S.D. dependent var	0.025054
S.E. of regression	0.019112	Akaike info criterion	-5.064110
Sum squared resid	0.055520	Schwarz criterion	-5.024669
Log likelihood	391.9365	Hannan-Quinn criter.	-5.048089
F-statistic	110.9328	Durbin-Watson stat	1.945380
Prob(F-statistic)	0.000000		

GARCH TESTS

Dependent Variable: LALL_SHARE_INDEX
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 12/09/18 Time: 18:00
Sample: 2005 2159
Included observations: 155
Failure to improve likelihood (non-zero gradients) after 39 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(7) + C(8)*RESID(-1)^2 + C(9)*GARCH(-1) + C(10)
*LGOLD_VOL

Variable	Coefficient	Std. Error	z-Statistic	Prob.
LGOLD_VOL	-0.005286	0.002649	-1.995454	0.0460
OIL_PRICE	-0.000386	0.000245	-1.572832	0.1158
M3	0.003019	0.001495	2.019514	0.0434
LEXCHANGE_RATE	1.823590	0.021340	85.45295	0.0000
GDP_GROWTH	0.033328	0.007255	4.593982	0.0000
C	-1.771554	0.135683	-13.05652	0.0000
Variance Equation				
C	0.008578	0.003694	2.322199	0.0202
RESID(-1)^2	0.978699	0.251002	3.899166	0.0001
GARCH(-1)	0.008074	0.107231	0.075293	0.9400
LGOLD_VOL	-0.000790	0.000358	-2.207426	0.0273

R-squared	0.837024	Mean dependent var	10.40931
Adjusted R-squared	0.831555	S.D. dependent var	0.387679

S.E. of regression	0.159111	Akaike info criterion	-1.632454
Sum squared resid	3.772148	Schwarz criterion	-1.436104
Log likelihood	136.5152	Hannan-Quinn criter.	-1.552701
Durbin-Watson stat	0.219319		

ARCH EFFECTS AFTER GARCH TESTS

All share index

Heteroskedasticity Test: ARCH

F-statistic	1.119899	Prob. F(1,152)	0.2916
Obs*R-squared	1.126336	Prob. Chi-Square(1)	0.2886

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 12/09/18 Time: 20:55
Sample (adjusted): 2006 2159
Included observations: 154 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.942289	0.136844	6.885873	0.0000
WGT_RESID^2(-1)	0.085489	0.080783	1.058253	0.2916

R-squared	0.007314	Mean dependent var	1.030217
Adjusted R-squared	0.000783	S.D. dependent var	1.349847
S.E. of regression	1.349318	Akaike info criterion	3.449978
Sum squared resid	276.7404	Schwarz criterion	3.489419
Log likelihood	-263.6483	Hannan-Quinn criter.	3.465999
F-statistic	1.119899	Durbin-Watson stat	2.001768
Prob(F-statistic)	0.291619		

DATA

Date	All share Index	Gold price Vol	Oil Price	GDP Growth	Exchange Rate	M3
2005/02				5,079282407		12,6
2005/03	13476,59	0	45,34	5,13900463	485,85	12,28
2005/04	13298,58	7,657966	52,95	5,19525463	494,12	14,99
2005/05	12555,96	3,613316	51,22	5,248032407	498,03	16,27
2005/06	13787,02	4,886108	48,05	5,297337963	504,38	17,08
2005/07	14154,73	5,967981	53,86	5,343171296	543,07	19,86
2005/08	15143,64	4,263854	57,49	5,385532407	547,98	19
2005/09	15414,01	9,277241	64,44	5,424421296	536,26	17,36
2005/10	16875,65	12,91177	62,98	5,459837963	539,25	16,48
2005/11	16433,1	9,913637	58,82	5,491782407	559,12	16,98
2005/12	16774,54	4,709331	55,46	5,52025463	562,86	20,45
2006/01	18096,54	23,08704	56,64	5,54525463	547,44	20,23
2006/02	19745,16	28,51762	62,89	5,566782407	525,69	21,57
	19085,35	4,214356	59,91	5,584837963	532,21	
				5,599421296		

2006/03	20351,74	0,947523	61,56	5,610532407	540,67	27,25
2006/04	21135,51	38,6151	70,51	5,618171296	529,47	23,46
2006/05	20565,46	44,68208	69,66	5,622337963	569,1	24,51
2006/06	21237,87	54,77249	68,15	5,623032407	624,91	23,33
2006/07	20885,57	25,53363	73,66	5,62025463	628,12	21,33
2006/08	21953,8	1,286934	73,2	5,61400463	621,5	21,74
2006/09	22374,58	22,61327	61,74	5,604282407	664,32	21,95
2006/10	23338,16	9,46816	57,44	5,591087963	677,85	23,71
2006/11	23949,95	29,07623	58,31	5,822685185	639,06	25,56
2006/12	24915,2	1,576848	62,89	5,79212963	611,72	22,54
2007/01	25447,73	0,848528	53,72	5,747685185	611,35	22,05
2007/02	25795,99	24,15477	57,68	5,689351852	611,97	23,01
2007/03	27267,24	6,639733	62,19	5,61712963	628,62	20,02
2007/04	28170,6	16,85035	67,83	5,531018519	626,73	22,27
2007/05	28627,79	8,428713	67,69	5,431018519	640,54	22,67
2007/06	28337,22	8,372144	71,57	5,31712963	673,13	23,41
2007/07	28561,81	6,844794	77,85	5,189351852	663,83	24,46
2007/08	28660,35	0,551543	71,71	5,047685185	682,33	25,8
2007/09	29959,19	33,17745	77,97	4,89212963	692,38	24,94
2007/10	31334,99	30,49044	82,83	4,722685185	693,29	23,34
2007/11	30307,8	37,45545	93,19	4,622106481	696,19	23,13
2007/12	28957,97	2,298097	91,19	4,421412037	681,04	23,59
2008/01	27317,14	59,70103	92,78	4,203356481	691,31	24,5
2008/02	30673,74	24,45175	95,66	3,967939815	763,85	20,61
2008/03	29587,51	32,51984	104,7	3,715162037	799,31	20,48
2008/04	30743,49	42,3557	108,73	3,445023148	768,61	20,8
2008/05	31841,27	13,40674	123,04	3,157523148	763,17	20,65
2008/06	30413,43	0,06364	132,15	2,852662037	780,18	19,87
2008/07	27719,67	35,3412	133,86	2,530439815	754,05	19,1
2008/08	27702,06	71,67941	114,61	2,190856481	727,87	16,3
2008/09	23835,97	8,365073	99,12	1,833912037	759,54	16,41
2008/10	20991,72	12,40972	73,26	1,459606481	826,65	16,89
2008/11	21209,49	35,6099	53,57	-0,868518519	830,94	17,58
2008/12	21509,2	43,11937	41,8	-1,196296296	805,58	14,84
2009/01	20570,05	26,77813	43,71	-1,460185185	807,55	13,94
2009/02	18465,33	58,86664	43,14	-1,660185185	804,02	13,17
2009/03	20363,91	11,54705	46,61	-1,796296296	791,88	10,58
2009/04	20647,03	23,93556	50,25	-1,868518519	734,99	8,49
2009/05	22770,62	11,12279	57,42	-1,876851852	726,99	7,86
2009/06	22049,42	28,09335	68,56	-1,821296296	716,85	6,02
2009/07	24258,51	8,831764	64,77	-1,701851852	706,62	5,65
2009/08	24929,42	10,86116	72,72	-	729,5	5,5
2009/09	24910,85	32,84511	67,75		695,2	4,01
2009/10	26360,55	33,43201	72,84		710,38	2,68
2009/11	26894,74	58,85957	76,66		709,64	0,59
2009/12	27666,45	3,592102	74,62		709,94	1,79
2010/01	26675,95	9,114606	76,46		715,82	0,6
2010/02	26764,61	16,37659	73,79		725,33	0,12

2010/03	28747,56	13,32189	78,69	1,518518519	724,95	1,55
2010/04	28635,76	24,13355	84,7	-	731,49	1,67
2010/05	27145,36	39,07472	76,38	1,271296296	734,37	1,35
2010/06	26258,82	20,37175	74,74	-	736,06	2,47
2010/07	28355,21	26,99027	75,52	0,960185185	723,43	3,77
2010/08	27253,87	14,89874	77,06	1,632638889	702,08	4,39
2010/09	29456,04	39,36463	77,66	1,978472222	689,64	5,09
2010/10	30430,9	50,48035	82,62	2,295138889	679,21	6,36
2010/11	30266,4	19,96162	85,36	2,582638889	688,96	7,23
2010/12	32118,89	14,58054	91,47	2,840972222	677,43	6,92
2011/01	31398,75	21,68696	96,27	3,070138889	694,44	8,2
2011/02	32272,09	7,940809	103,35	3,270138889	727,81	7,57
2011/03	32204,06	36,10487	114,08	3,440972222	707,89	6,53
2011/04	32836,23	38,28983	123,3	3,582638889	702,45	6
2011/05	32565,73	24,69217	114,69	3,695138889	709,06	6,14
2011/06	31864,54	11,57534	113,83	3,778472222	694,52	6,03
2011/07	31208,04	29,80455	116,36	3,832638889	710,4	5,6
2011/08	31005,5	133,1341	110,28	3,394212963	720,63	6,22
2011/09	29674,2	12,23295	112,83	3,409490741	751,77	6,79
2011/10	32348,54	77,56961	109,53	3,415046296	778,65	7,26
2011/11	32812,64	50,15508	111,3	3,41087963	795,01	7,23
2011/12	31985,67	64,41036	108,45	3,396990741	799,32	8,28
2012/01	33792,48	6,873078	110,97	3,37337963	791,01	6,7
2012/02	34296	61,34151	119,15	3,340046296	767,51	5,89
2012/03	33554,21	48,40146	125,38	3,296990741	764,82	6,65
2012/04	34399,04	17,75545	119,98	3,244212963	788,01	6,16
2012/05	33142,61	46,08215	110,41	3,181712963	807,44	6,43
2012/06	33708,31	7,368053	95,5	3,109490741	816,48	7
2012/07	34596,9	0,848528	102,47	3,027546296	812,93	8,27
2012/08	35389,45	24,24669	113,1	2,472453704	833,06	7,79
2012/09	35757,98	81,70619	113,24	2,390509259	845,88	7,54
2012/10	37156,28	2,467803	112,12	2,318287037	876,38	5,7
2012/11	38104,61	16,92814	109,36	2,255787037	882,25	6,26
2012/12	39250,24	25,88011	109,94	2,203009259	872,93	5,17
2013/01	40482,92	10,40861	112,92	2,159953704	886,03	6,75
2013/02	39709,56	29,89647	116,45	2,12662037	880,98	7,51
2013/03	39860,84	26,30437	108,74	2,103009259	894,8	8,07
2013/04	38735	75,27152	102,47	2,08912037	894,13	9,98
2013/05	42016,45	50,4945	102,93	2,084953704	916,4	9,75
2013/06	39578,1	50,53692	103,19	2,090509259	971,83	9,17
2013/07	41292,84	40,35458	107,61	2,105787037	952,16	7,34
2013/08	42228,34	43,67091	111,32	2,528009259	968,77	6,88
2013/09	44031,83	0,940452	112,02	2,546064815	963,58	7
2013/10	45517,56	23,57494	109,26	2,557175926	956,93	7,02
2013/11	44975,669	27,34382	107,8	2,561342593	972,86	6,23
2013/12	46256,226	38,40297	110,81	2,558564815	973,87	5,85
2014/01	45132,096	15,28765	108,22	2,548842593	994,45	6,32
2014/02	47328,924	39,53434	108,87	2,532175926	993,66	5,85
				2,508564815		
				2,478009259		
				2,440509259		

2014/03	47770,922	25,79526	107,63	2,396064815	967,96	7,78
2014/04	48870,098	26,32559	107,6	2,344675926	959,63	6,89
2014/05	49632,699	7,488261	109,81	2,087731481	955,03	7,5
2014/06	50945,26	7,212489	112,31	2,030787037	985,81	7,16
2014/07	51396,074	23,81536	107,11	1,975231481	994,01	6,74
2014/08	50959,02	11,53291	101,79	1,921064815	976,42	6,28
2014/09	49336,307	39,31514	97,59	1,868287037	996,19	7,74
2014/10	49722,882	12,0491	87,58	1,816898148	986,65	7,97
2014/11	49911,372	33,00067	79,49	1,766898148	979,37	8,26
2014/12	49770,597	17,31705	62,92	1,718287037	994,9	7,23
2015/01	51266,805	35,17149	48,24	1,671064815	957,04	7,24
2015/02	53344,201	15,16744	57,97	1,625231481	925,17	8
2015/03	52181,946	35,00886	56,2	1,580787037	956,93	7,29
2015/04	54440,429	13,04612	59,31	1,537731481	971,76	8,23
2015/05	52270,861	0,53033	64,24	1,562268519	983,36	8,19
2015/06	51806,946	11,98546	61,78	1,519212963	995,29	8,69
2015/07	52053,266	36,11194	56,51	1,474768519	970,06	10,18
2015/08	49972,331	8,980256	46,89	1,428935185	982,38	9,94
2015/09	50088,856	4,673976	47,71	1,381712963	1026,64	8,43
2015/10	53793,739	23,65979	48,38	1,333101852	1033,03	9,74
2015/11	51607,828	50,29651	44,62	1,283101852	1064,88	9,35
2015/12	50693,764	13,28654	38,11	1,231712963	1091,26	10,47
2016/01	49141,939	19,98284	30,93	1,178935185	1151,01	8,68
2016/02	49415,307	71,33293	32,14	1,124768519	1141,85	8,58
2016/03	52250,277	34,59166	38,32	1,069212963	1163,88	8,74
2016/04	52957,323	3,153696	41,37	1,012268519	1138,49	7,28
2016/05	53905,21	11,15107	46,77	0,68912037	1186,1	6,16
2016/06	52217,716	12,27537	48,29	0,640509259	1168,36	5,58
2016/07	52797,578	44,11639	45,26	0,60162037	1106,45	4,41
2016/08	52733,123	1,951615	45,51	0,572453704	1058,47	5,48
2016/09	51949,834	9,772216	46,4	0,553009259	1072,44	5,64
2016/10	50590,077	41,41524	49,68	0,543287037	1053,15	6,62
2016/11	50209,433	20,93743	45,03	0,543287037	1035,15	4,76
2016/12	50653,543	62,11933	53,22	0,553009259	1037,86	6,07
2017/01	52788,118	29,9389	54,53	0,572453704	1027,18	7,86
2017/02	51146,045	29,16108	55,06	0,60162037	1007,23	6,58
2017/03	52056,057	1,972828	51,58	0,640509259	966,51	5,59
2017/04	53817,306	24,96794	52,55	0,68912037	1002,84	5,33
2017/05	53562,571	14,39669	50,26	0,747453704	975,73	6,06
2017/06	51611,014	10,42275	46,41	0,815509259	968,83	6,09
2017/07	55207,407	17,75545	48,25	0,893287037	1032,51	7,01
2017/08	56522,114	32,90875	51,64	0,980787037	1049,62	6,86
2017/09	55579,923	23,90728	56,16	1,078009259	1068,97	7,13
2017/10	58980,108	25,3922	57,39	1,184953704	1086,67	5,01
2017/11	59772,834	1,866762	62,75	1,30162037	1102,88	6,62
2017/12	59504,673	13,01784	64,37	1,428009259	1031,39	6,42
				1,56412037		
				1,709953704		
				1,865509259		
				2,030787037		