The effect of oil price and currency volatility on the stock price of oil and gas companies in South Africa

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By

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Above all, I would like to thank God for all the blessings

Dedicated to my parents Francinah and the late Hophniel Aphane

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ABSTRACT

Oil Price volatility is a measure of the variation in the oil price over a given period of time. This measure gives an indication of the risk associated with the asset. In this study, oil price volatility and the rand dollar exchange were studied. The effects of these parameters on Sasol share price, a major player in the oil and gas sector of the listed companies in the stock was studied. Results showed that the Brent crude oil price volatility was mean reverting. Daily returns on the oil price showed a heteroscedastic type of behaviour. Cross sectional analysis of the results of Brent crude oil price and the rand dollar exchange show an inverse proportionality between the oil price movement and the rand dollar exchange rate. This inverse proportionality can also be interpreted as the lagged response of the rand dollar exchange to the oil price. Sasol share price showed a positive correlation with the oil price.

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CHAPTER 1: RESEARCH ORIENTATION

1.1 Introduction

Volatility is a statistical measure of dispersion. Dispersion can be of return for a given security or market index, asset price, currency exchange etc. In other words volatility refers to the amount of uncertainty or risk about the size of changes in an asset value. High volatility means that an asset value can potentially be spread out over a larger range of values. A lower volatility means that an asset's value does not fluctuate dramatically, but changes in value at a steady pace over a period of time. Generally, the asset risk is directly proportional to the volatility of that asset. Volatility can be measured using the standard deviation or the variance.

This study looks at the effect of oil price and currency exchange volatility on the underlying stock price of oil and gas companies in South Africa. Oil is a commodity that is generally traded in dollars. Since South Africa is a rand denominated country, the effect of the rand/dollar fluctuations have a tremendous effect on the performance of oil and gas companies. For example it is estimated that a US$1 increase in global oil price translates into R555 million increase in operating profit of Sasol and ten cents appreciation in the rand causes R627 million loss in operating profit for Sasol (Pretorius and Naidoo, 2011). Therefore, there is no doubt that these performance measures will have a bearing on the value of the company and its stocks. It is against this background that investors need to understand this market dynamics in order to time their investment properly.

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Oil price volatility does not only affect oil and gas companies' stocks, it also affects the macroeconomic activities of both the exporting and importing countries. Oil price volatility raises the uncertainty about future oil prices and thus causes delays in investments. On the other side oil price volatility induces resource reallocation, for example, from more adversely influenced sectors to less adversely influenced sectors and such reallocation is costly. This, coupled with currency exchange volatility in non dollar denominated countries can exacerbate the situation. This study provided some understanding on the behaviour of Brent crude oil price, rand dollar exchange and the price of stocks of oil and gas companies in order to address the problem statement.

1.2 Problem Statement

Oil price volatility has as significant influence on the value of the stock of oil and gas companies. This can be exacerbated by the fluctuation in the currency exchange in non dollar denominated countries. This study was undertaken to impart more understanding into the influence of oil price and currency volatility on the value of oil and gas companies' stocks. Thus the problem statement that:

"Investors in oil and gas companies' stocks require knowledge about the factors that contribute to the value of these stocks in order to time their investment correctly"

The problem statement was further broken down into subproblems in order to focus the efforts of the research.

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1.2.1 Subproblems

Oil price movements are underpinned by fundamental economic principles such as demand and supply of this commodity. These fundamentals are in turn influenced by the macroeconomic environment where Political, Economical, Social, Technological, Legal and environmental (PESTLE Model) issues play a critical role. It is against this background that the following sub-problems were formulated:

1. To determine the environmental factors contributing to the oil price and currency exchange volatility

2. To establish the correlation between Brent crude oil price, currency exchange (Rand/U.S.Dollar) volatility and the stock price of oil and gas companies.

Due to the complexity of the study and the fact that the broader economy is heavily dependent on the oil price, it is important to focus the study as described above. The next section outlines the area that would not be covered by this study.

1.3 The delimitations

This study only looked at the volatility of crude oil price and Rand/dollar exchange and their impact on South African Oil and Gas companies not on the whole economy. The researcher did not look at the effect of these factors on the downstream petrol price or any other currency exchanges. The researcher did not model the implied volatility but made some inferences to the existing models. The next section looks at the limitations that affected the study.

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1.4 Limitations

The limitations of the study are that the factors that affect the data could not be controlled in order to evaluate the extent to which the data had been affected. Data on the stock price of oil and gas companies might also be affected by investor sentiments or government intervention and this can create problems in the interpretation of the data. The other limitation is the unavailability of data during non trading days such as weekends and holidays. The lack of sufficient data on the Rand index (RAIN) since it was only established in 2010 makes it difficult to use this index in the study particularly when looking at the currency exchange. The gas and oil sector of the JSE consists of only three companies. Since Sasol is the dominating company in this sector. The study used Sasol, as a representative of the oil and gas sector of the JSE.

1.5 Definitions of terms

Currency exchange – Rand/Dollar

Oil and gas Stock – Sasol (Sol). Stacoil (Sac) and Oando

Volatility – Standard deviation or the variance

JSE – Johannesburg Securities Exchange

NYSE – New York securities exchange

NYMEX – New York Mercantile Exchange

RAIN – Rand Index

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1.6 The assumptions

The assumption in this study is that the Brent crude oil price is universal therefore, the data should be valid irrespective of the source. It was also assumed that the market sentiments on the oil and gas companies stocks is already taken into account as an integral part of the oil price data used. The next section puts the importance of the study into perspective.

1.7 The importance of the study

The importance of the study is to help investors to firstly, understand the relationship between oil price and the currency exchange (Rand/Dollar) and secondly, the movement of the price of oil and gas stocks relative to the movement of the prices of both commodities (i.e. Brent crude oil price and currency exchange). This understanding can help investors to take advantage of the inherent lag effect of the JSE to respond to these changes and thus maximise their profits.

1.8 Background

South Africa is a net importer of crude oil (ca 85%) and coupled with the inadequate refining capacity to meet the demand, 7% of the country's refined products are also imported (Pretorius and Naidoo, 2011). Both crude oil and imported refined products are priced in dollars. Therefore, the volatility of these commodities has a major influence on the economic performance of South Africa and in particular the oil and gas sector. It is against this background that the study of the effect of oil price and

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currency volatility on the stock price of oil and gas companies in South Africa is crucial.

Volatility is defined as the statistical measure of the dispersion of the return for a given asset or market index. Generally, when the volatility is high the risk of the asset is also high. Understanding the behaviour and role of volatility is important because it affects prices, production and inventories in two principal ways (Pindyck, 2004). "Firstly, it directly affects the marginal value of storage, i.e. the flow of benefits from an extra unit of storage. When prices and hence production and demand are more volatile, there is a greater demand for inventories, which are needed to smooth production and deliveries and reduce marketing costs. Thus an increase in volatility can lead to inventory build ups and raise prices in a short run. Secondly, for a depletable resource like oil, volatility affects the total marginal cost of production via the "option premium". Producers hold operating options, with an exercise price equal to direct marginal production cost and a payoff equal to the spot price. Total marginal cost equals the direct marginal cost plus the opportunity cost of exercising the incremental operating option. An increase in price volatility raises the value of this option and the associated opportunity cost and can thus result in a decrease in production.

1.8.1 Oil Price Volatility

Literature on oil price, show that prior to the oil shock of the 1970s the price of the crude oil was fairly stable (Guo and Kliesen, 2005). This oil shock was brought about by the fundamental change in the structure of the oil market (Figure 1-1). Between the late 1930 and the late 1960s the Texas Railroad commission (TRC) acted as the dominant producer by prorationing Texas production to match demand. This reduced

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volatility of the real oil price (Dees *et al.,* 2007). Starting from the early 1970s Organisation for Petroleum exporting countries (OPEC) became the dominant oil producer. OPEC had a different political agenda that of a Cartel. This led to a tremendous increase in oil price volatility. This coupled with geopolitical and economic situations contributed immensely to the oil price volatility.

According to IMF (Lipsky, 2009) oil price is more volatile than any other commodity or asset prices (Figure 1-2). Yang *et al.* (2002) and Dees *et al.* (2007) attributed the oil price volatility to the following factors:

1. The market structure of OPEC

2. The stable and unstable demand structure

3. Related elasticity of demand.
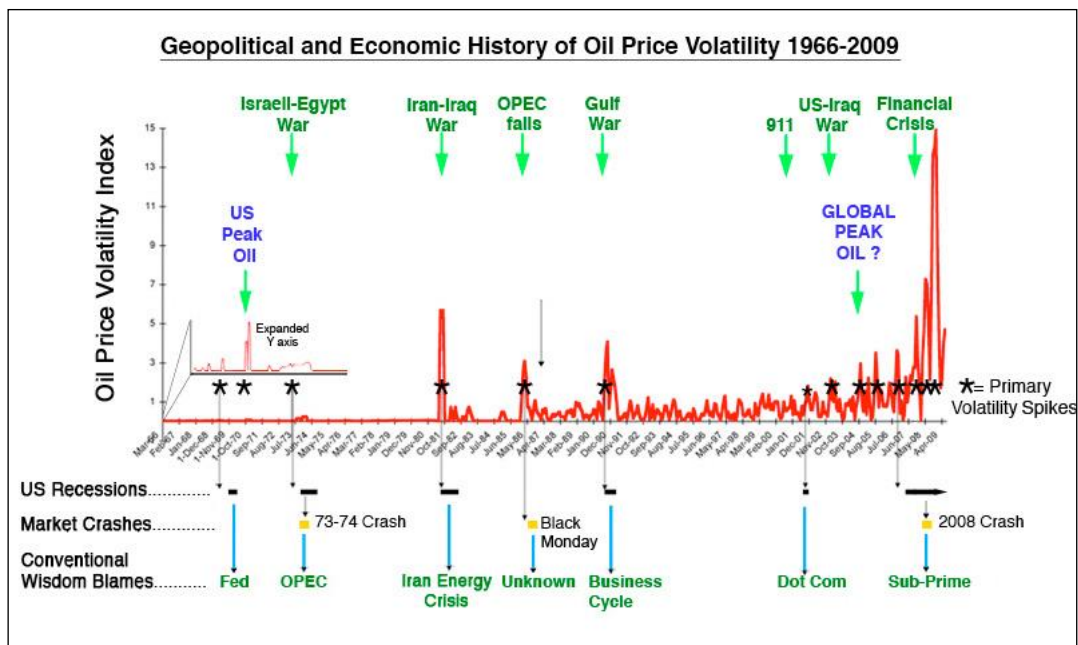
Figure 1-1: Geopolitical and Economic history of oil price volatility

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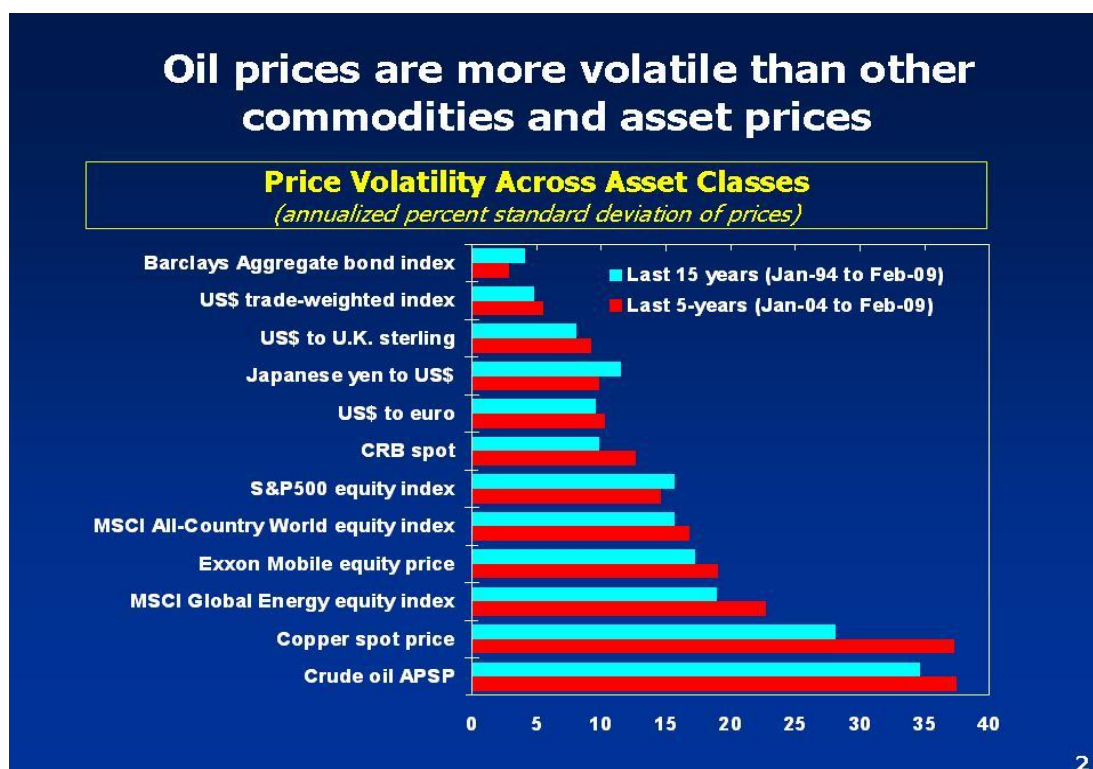
Figure 1-2: Oil Price Volatility relative to other Assets and commodities

Source: Lipsky (2009)

1.8.2 Currency Volatility

South Africa is a rand denominated country and oil and refined products that the country imports are dollar priced. It is against this background that the study of the volatility of the currency exchange becomes important when looking at oil and gas companies stocks since this has significant effect on translational transaction as described in Section 1.1. Recently, 2010, the JSE introduced an index called Rand Index (RAIN). The purpose of RAIN is to track the movement of the rand against the currencies of South Africa's top 5 trading partners (Euro; Dollar; Chinese Yuan; UK Pound and Japan Yen).

Much like the SAVI acts as a thermometer of the volatility in the equity market, a 'fear gauge' for perceived risk in this market, the RAIN gauges the rand and volatility

versus that of South Africa's key trading partners' currencies and so should prove a useful tool in determining whether the rand is under or over valued. The Index would be particularly useful to those users wanting to measure the competitiveness of South African goods in international import and export markets. Figure 1-3 presents the rand /dollar exchange fluctuation in 2010. Currency exchange volatility over the last three month of the year is also illustrated. This variation has a significant effect on the value of oil and gas companies.
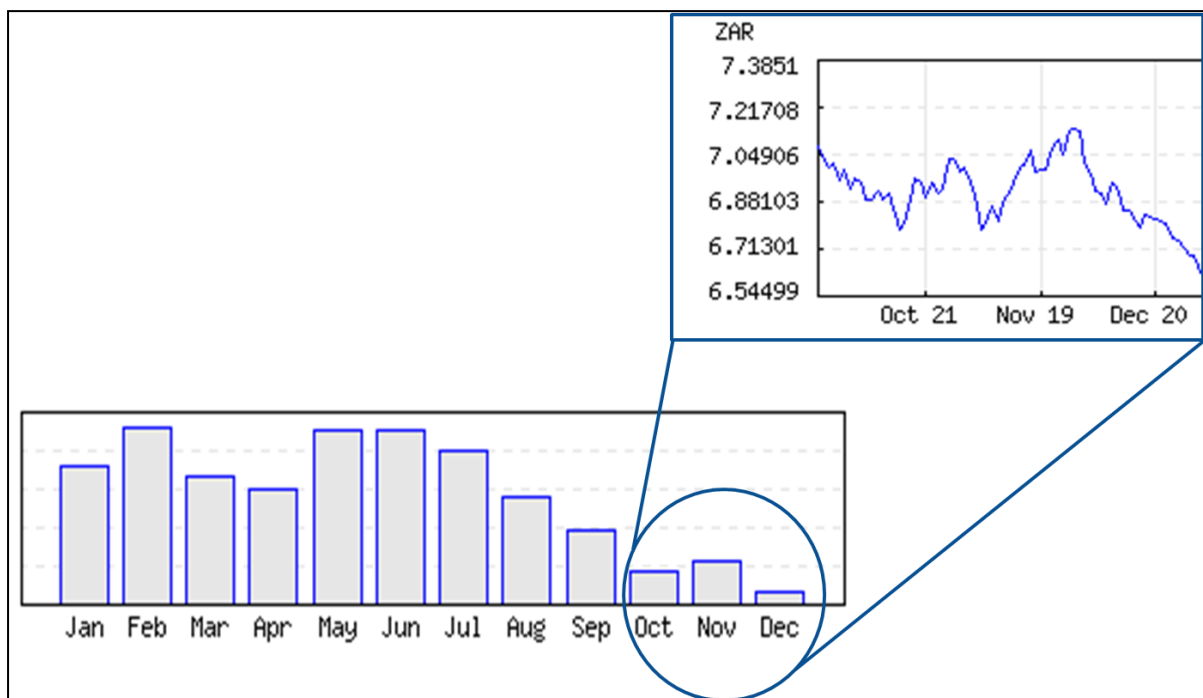
Figure 1-3: Rand dollar/Dollar exchange in 2010
Source: www.fin24.co.za

1.8.3 Oil and gas stocks

Three companies, namely Sasol, Sacoil, and Oando, form the Oil and Gas sector of the JSE.

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Figure 1-4 to Figure 1-6 presents share price and financial information of these companies over the last five years. From beginning of 2007 to mid 2008, all shares were characterised by an unprecedented growth which was attributed to the general world economic growth. This was followed by the world economics "bubble bust" led by the crash in the financial markets. This crash led to the reduction in the demand for crude oil and the oil price dropped as consequence of this. Sasol and Sacoil stocks show signs of recovery in line with the recent increase in the Brent crude oil price underpinned by the disruption in the production and supply due to political unrest in the Middle East, Libya and Egypt.

Market Cap:247.07bn
P/E Ratio:13.34
EPS: 12.97
Dividend:10.80
Dividend yield:2.74%
Shares Outstanding:641.80m
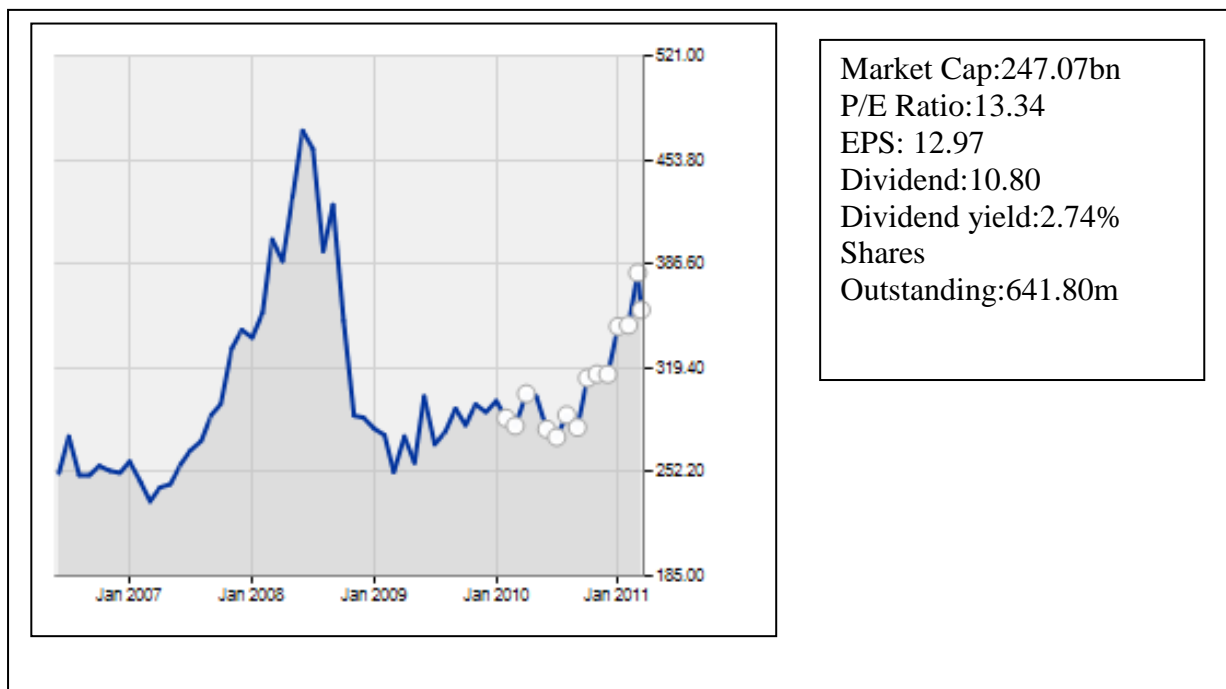
Figure 1-4: Sasol Share Price (5yrs) and its financial information.

Source: www.fin24.co.za

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Market Cap:5.34bn
P/E Ratio:2.93
EPS: 0.24
Dividend:0.00
Dividend yield:4.00%
Shares Outstanding:1.81bn
```

Figure 1-5: Oando's Share Price (5yrs) and its financial information. Source: www.fin24.co.za


```
Market Cap:1.36bn
P/E Ratio:-116.76
EPS: -0.02
Dividend:0.00
Dividend yield:0.00%
Shares Outstanding:674.89m
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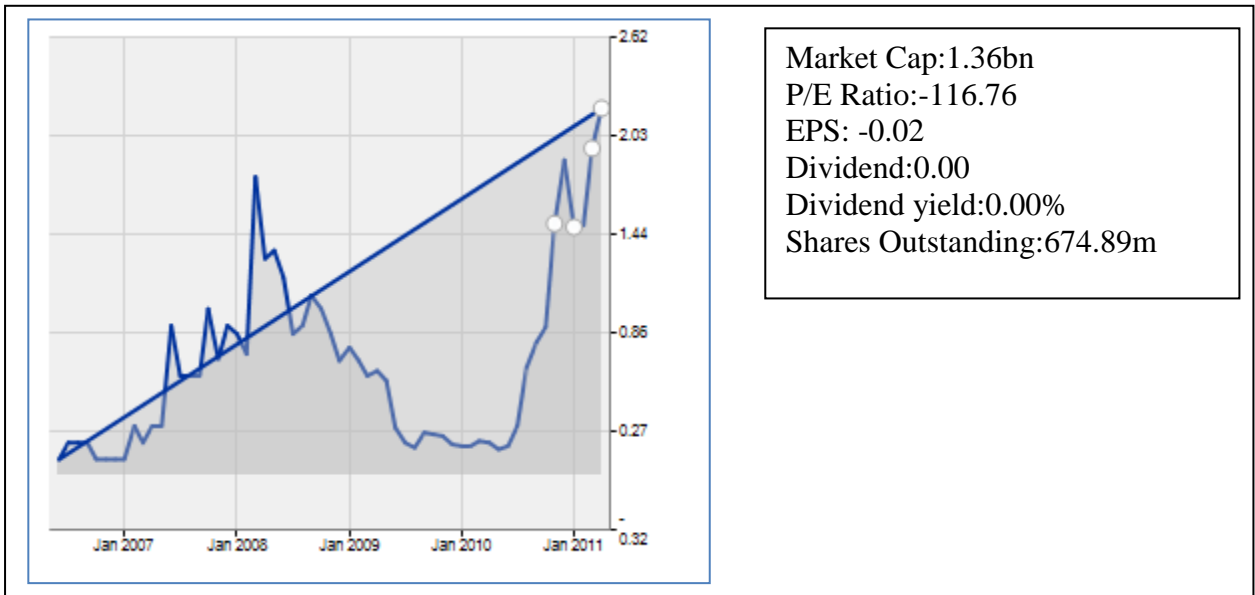
Figure 1-6: Sacoil's Share Price (5yrs) and its financial information. Source: www.fin24.co.za

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In general, the trend observed in the share movement seems to follow the world major activities. And since oil price movement is a global phenomenon, it is expected that its volatility will have a bearing in the share price movement. Sasol is the major player in the oil and gas sector of the JSE with a market capitalisation of over R240 billion. Therefore, Sasol's share was used as a representative of the oil and gas sector in this study. The next section presents the sources of data.

1.9 Data and its treatment

The data required in this study is the Brent crude oil price, rand dollar exchange and Sasol's stock price from January 2005 to August 2011. The data was obtained from the published data from the different entities such as Johannesburg Securities exchange (JSE), New York Securities Exchange (NYSE), OPEC etc.

Statistical procedures applied to the data involved among others estimation of the correlation between oil price and rand dollar exchange and Brent crude oil price and Brent crude oil price and Sasol's stock price.

1.9.1 Research Methodology

Quantitative research methodology was used in this study. Secondary data on the oil price, rand dollar exchange and the price of oil and gas companies as published in reputable sources were used to impart some understanding on how these factors interplay each other in the market. The correlation between crude oil price, currency exchange volatility and the stock price of oil and gas companies was investigated.

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1.10 Ethics

Ethical issues are important to consider in any research. Honesty with professional colleagues and maintaining research integrity are the two main ethical issues that were considered in this study. These ethical issues were addressed by ensuring that the data presentation and interpretation were not intentionally misleading others. No data was fabricated to support a particular conclusion no matter how seemingly noble that conclusion might be.

1.11 Summary

This chapter gave an overview of the proposed approach to the study. The study imparts some understanding on the relationship between the oil price and the rand dollar exchange and how these two factors affect the stock performance of oil and gas companies in the Johannesburg stock exchange. This study is important to investors since it can be used to monitor market indicators, in this case the oil price and the rand dollar exchange, to determine the best time to invest in oil and gas company stocks. In order to do this quantitative research approach that used secondary data available in the open literature such as the JSE was used. This study did not attempt to develop a new model for understanding volatility but it simply made some inferences to the existing models. The next chapter presents the foundation of the study in which the history of oil price together with the factors that influence the oil price volatility rand dollar exchange are discussed.

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CHAPTER 2: FOUNDATION OF THE STUDY

2.1 History of the Oil Market

Between the late 1930 and the late 1960s the Texas Railroad commission (TRC) acted as the dominant producer by prorationing Texas production to match demand. This reduced volatility of the real oil price (Dees *et al.*, 2007). Starting from the early 1970s Organisation for Petroleum exporting countries (OPEC) became the dominant oil producer. OPEC had a different model hinged on the fundamentals of Cartel in which it is a price maker and a competitive model in which it is a price taker. These behaviours brought about oil price volatility in the market. This coupled with geopolitical and economic situations contributed immensely to the oil price volatility.

Since the 1980s, there has been a marked shift in power from OPEC to the oil market. The oil markets became the new determinants of oil price. The historical circumstances that led to the shift in pricing power are the US decision in 1981 to deregulate state control over the oil industry. Soon other industrialised countries followed suit. Once oil consuming states had deregulated control over oil supply and oil imports, oil exporting states were forced to cede oil pricing to the oil market (Momani, 2008). This was coupled with the fact that the OPEC's share of world oil production was nearly halfed as smaller and new competitors entered the production market.

In response to the new regulatory environment and exploration developments of the late 1980s, two oil markets were created (*ibid*):

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- the British North Sea Brent Crude (Brent) – traded on London International Petroleum exchange (IPE) until 2005 and thereafter on London's Intercontinental Exchange and

- the US gulf crude – traded on the West Texas Intermediate (WTI) operating out of the New York Stock Exchange (NYSE).

Oil companies now had three means of purchasing oil:

- a bilateral contract with oil exporting country

- on the spot or a cash market

- a futures contract at oil markets.

Oil market soon became the primary means of oil trade and hence these oil markets became the new "oil markers". Since the bilateral contract with oil exporting country is less affected by market dynamics such as oil price volatility, it is not discussed further.

2.2 Oil Price Volatility

Oil price volatility is the amount of uncertainty or risk about the size of changes in oil price. A higher volatility means that oil price can potentially be spread out over a large range of values. A lower volatility means that the oil price does not fluctuate dramatically but changes in value at a steady pace over a period of time. Volatility can be measured using the standard deviation or the variance of the oil price. Therefore, volatility can be considered as a measure of risk. As in a portfolio of

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stocks, the relative volatility of the stock is measured by the beta of that stock. That is the risk contribution of an individual stock to the overall risk of the portfolio.

The volatility of oil prices creates uncertainty which is disruptive to the economies of both oil exporting and importing countries. Higher prices result in an increase in inflation and subsequent recession in oil consuming nations as high oil prices are negatively correlated to economic activities (Yang *et al.*, 2002; Guo and Kliesen, 2005 and Mork *et al.,* 1994). Oil price increases lower the economic growth in oil importing countries because it increases the production costs. In addition to this, aggregate output is adversely affected as businesses delay their investment or reallocate their resources to sectors which have a certain degree of certainty. This is termed sectoral resources reallocation. The same negative effect can be observed in oil exporting countries since the high oil price raise the cost of imported capital goods therefore, adversely affecting the prospects of higher profits for firms in oil exporting countries.

The increase in oil price can also lead to what is termed the "Dutch disease" hypothesis (Jahan-Pavar and Mohammadi, 2011). According to the hypothesis, the inflow of oil windfalls into an oil exporting country may cause appreciation of the real exchange rate, reduce its competitiveness in the non-oil exporting sectors, and limit its ability to build a diversified export base. The culprit for the disease is the "spending effect". More specifically, higher oil income may increase the demand for non-traded goods, and increase their price relative to those of traded goods. This appreciation of real exchange rate will reallocate resources from non-oil traded

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sector into the non-traded sector, contracting the former to the extent that it is exposed to international competition.

The reciprocal to this is that in oil exporting countries, high oil prices can have a positive effect on the economy. Increase in government revenue leads to an increase in public expenditure on infrastructure and other mega projects. Generally, this leads to an increase in local business activities (Onour, 2007). On the other hand, lower oil prices could prohibit economic development and might generate political instability and social unrest in some oil producing countries.

The following factors are thought of as the determinants of oil price volatility (*ibid*):

- Market structure of OPEC

- The stable and unstable demand structure

- Related elasticity of demand

- Geopolitical instability

Oil like most commodities offers a wide variety of empirical properties that make it strikingly different from stocks, bonds, and other conventional financial assets. Notable properties of commodities are (Leonid *et al.,* 2009; Bryan *et al.,* 2000):

- future prices are often backward dated in that they decline with time to delivery
- Spot and futures prices are mean reverting for many commodities
- prices are strongly heteroscedastic
- price volatility is correlated with the degree of backwardation and

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- Unlike financial assets, many commodities have pronounced seasonality in both price levels and volatilities.

The concept of backwardation can best be described by futures price curve. In equilibrium, backwardation implies that immediate ownership of the physical commodity entails some benefits or convenience which deferred (via a long forward position) does not. This benefit expressed as a rate is termed the "convenience yield".

The shape of the futures curve (Figure 2-1) is important to commodity hedgers and speculators. Both care about whether commodity futures markets are contango markets or normal backwardation markets. In contango, futures prices for a given maturity date are falling. In normal backwardation, futures are rising. Therefore, in a contago deferred ownership (via a long forward position) has some benefits.

Fluctuations in energy prices are caused by demand and supply imbalances. A fundamental driver of volatility in oil prices is the fact that current stocks can be stored for consumption in the future but future production cannot be borrowed to meet the immediate need. This market asymmetry implies that the magnitude of price increase in a given period due to disruption in current supplies is likely to be larger as compared to a price drop in response to oversupply (Sharma, 1998).

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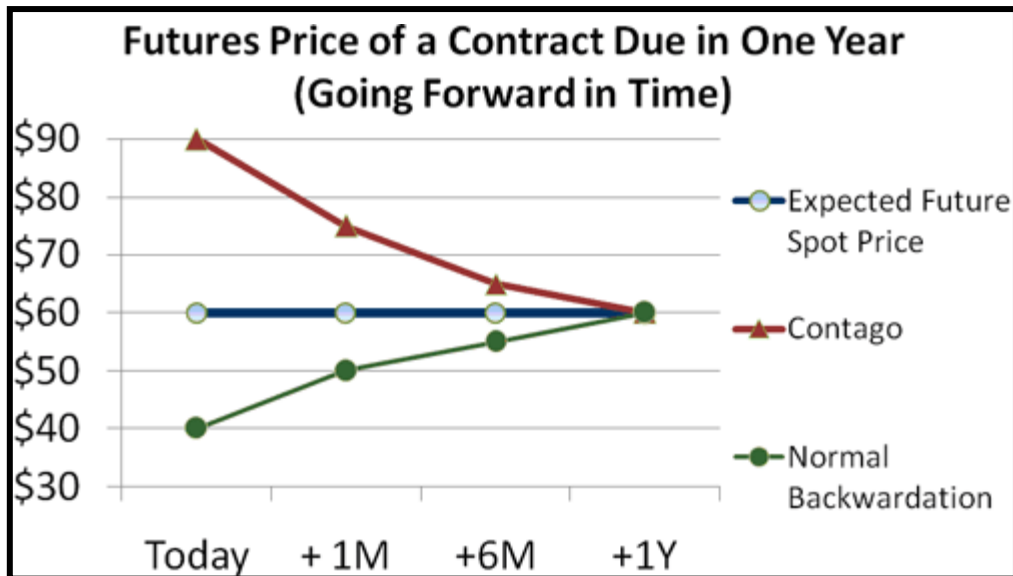
Figure 2-1: Futures Price of contract due in one year.

Source: www.investopidia.com

2.3 Models for Forecasting Oil Price Volatility

Volatility is one of the most important concepts in management finance. In order for investors to manage the risk of the assets, they need to understand their risk exposure presented by the asset. Few methods of forecasting volatility (risk) are available (Belaifa and Morimune, 2006):

2.3.1 Constant Volatility Models

Constant volatility models are used in pricing derivatives, using the popular Black and Scholes formula that gives explicitly the option price (see Section 2.4). These models are determined by the following equation:

$$R_t = \mu + \sigma \varepsilon_t$$

Equation 2-1

Where R_t is the price return and ε_t is the white noise.

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2.3.2 Historical/Rolling Window Moving Average Models

This approach consists of computing the standard deviation of returns over some historical period. This deviation becomes the volatility forecast for all future periods. This estimation method is used among practitioners as a benchmark for comparing forecasts from advanced time varying volatility models

It is based on equally weighted squared returns and is calculated as follows:

$$\sigma_t^2 = \frac{1}{M} \sum_{i=1}^{M} (R_{t-i} - \bar{R})^2$$

Equation 2-2

Where M is the number of days over which returns (R_t) are observed.

2.3.3 Implied Volatility Models

These models are the market's forecast of the volatility of the underlying asset returns over the life of the corresponding option as described in Black and Scholes model. Once the options parameters are identified, the volatility forecast may be implied using for example the Newton Raphson algorithm.

2.3.4 Exponentially Weighted Moving Average

This method describes the volatility on the basis of geometrically declining weights

$$h_t = \lambda h_{t-1} + (1 - \lambda)(R_{t-1} - \bar{R})^2$$

Equation 2-3

where h_t is the time varying variance; λ is the decay factor , generally taken equal to 0.94 for daily data and 0.97 for monthly data

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2.3.5 Autoregressive Volatility Models

These models are based on the time series of observations on some volatility proxy. The standard Box Jenkins type procedure for estimating autoregressive models can then be applied to this series. Examples of these models are ARCH, GARCH etc. Auto regressive volatility models play a prominent role in many financial theories (Li and Thomson, 2010; Manera *et al.*, 2006; Schwartz, 2000). These models are more appropriate for forcasting and describing returns and volatility:

ARCH (1)

$$R_t = \mu + \varepsilon_t$$

$$\varepsilon_t = z_t \sqrt{h_t}$$

$$h_t = \bar{\omega} + \alpha_t \varepsilon_{-1t}^2$$

Equation 2-4

The structure of ARCH (1) expresses the fact that the conditional variance of a time series is an increasing function of the squared shocks that occurred one period before:

GARCH (1)

$$R_t = \mu + \varepsilon_t$$

$$\varepsilon_t = z_t \sqrt{h_t}$$

$$h_t = \bar{\omega} + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$$

$$\bar{\omega} > 0, \alpha_1 > 0, \beta_1 \geq 0$$

Equation 2-5

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Equation 2-5 shows that the conditional variance of the shocks at time t, depends on the mean, ω, the news about the volatility from the previous period (ε_{t-1}^2) and also on the last period's forecast of conditional variance(h_{t-1}).

2.4 Effect of Oil Price Volatility on Economic Performance

Volatility affects prices, production and inventories in two principal ways. Firstly, it directly affects the marginal value of storage i.e. the flow of benefits from an extra unit of inventory. When prices and hence production and demand are more volatile, there is a greater demand for inventories, which are needed to smooth production and deliveries and reduce marketing costs by facilitating production and delivery scheduling and avoiding stock outs. Thus an increase in volatility can lead to inventory build ups and raise prices in the short run. Figure 2-2 shows the relationship between volatility and supply capacity. The essence of this figure is the V-shape relationship between volatility of the spot price and the level of inventory (Leonid *et al.,* 2009).

Second, for a depletable resource like oil, volatility affects the total marginal cost of production via the option premium. Producers hold operating options, with an exercise price equal to direct marginal production cost and a payoff equal to the spot price. Total marginal cost equal to the direct marginal cost plus the opportunity cost of exercising the incremental operating option. An increase in price volatility raises the value of this option and the associated opportunity cost, and can thus result in

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decrease in production (Pindyck, 2004). This statement can be represented mathematically by the Black and Scholes option pricing model (Equation 2-6).
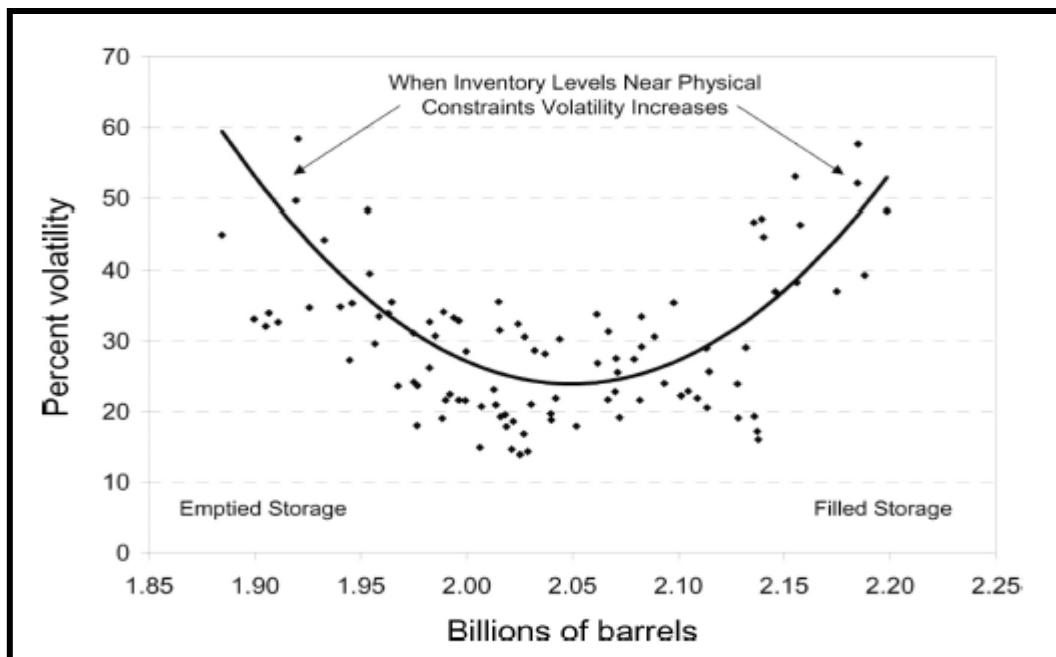
Figure 2-2: Volatility and Supply capacity constraints. *Source:* **(Leonid** *et al.,* **2009)**

$$V = P[N(d_1)] - Xe^{-r_{RF}t}[N(d_2)]$$

$$d_1 = \frac{\ln(P/X) + \left[r_{RF} + \left(\frac{\sigma^2}{2}\right)\right]t}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

Equation 2-6

P = Spot price

X = exercise price

$\sigma\sqrt{t}$ = Volatility

Brent crude oil is traded in dollars; therefore, the currency exchange rate plays a vital role in economies of non U.S. dollar denominated countries such as South Africa.

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The next section discusses currency exchange, in particular the Rand /dollar exchange rate.

2.5 Currency Exchange Volatility (R/$)

Currency exchange has fundamental implications to both the oil importing and oil exporting countries. This point was discussed extensively in Section 2.2. In this section an attempt was made to explain some determinants of the real exchange rate. However the author appreciates the complexity of the subject. Real rand dollar exchange rate can be calculated using Equation 2-7 (Frankel, 2007)

$$\overline{Q} = SP^* / P$$

Equation 2-7

where S is the spot exchange rate in rand per dollar

P* is the (here US) price level

P is South African price level (PPI or GDP)

2.5.1 Determinants of South African Exchange rate

2.5.1.1 Rates of Return

In developing countries such as South Africa interest rates are relatively high compared to developed countries such as the USA. This suggests that the real interest differential should have a positive effect on the perceived rate of return to holding rand assets and therefore on the value of the rand. However, these high interest rates are usually attributed to the expected high inflation, default risk and devaluation risk rather than high expected returns (*ibid*). In most cases this interest

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rate differential between developed and developing countries promotes "carry trading" whereby investors borrow in low interests countries (developed markets) and invest in high interest countries (emerging market).

2.5.1.2 Country Risk Premium

The country's risk premium is associated with the risk of defaulting or the risk of future imposition of capital controls. The preferred measure of a country risk premium is the spread between the interest rate at which the country (RSA) borrows when borrowing in dollars and a foreign dollar interest rate of the same maturity. Figure 2-3 shows the downward trend of the spread for borrowing for the South African government in dollars from 1996 to 2006. The downward trend indicates the perceived risk of South African debt. The figure also illustrates the effect of agency rating on South Africa. The improved rating has positive effects on the rate at which the South African government borrows.
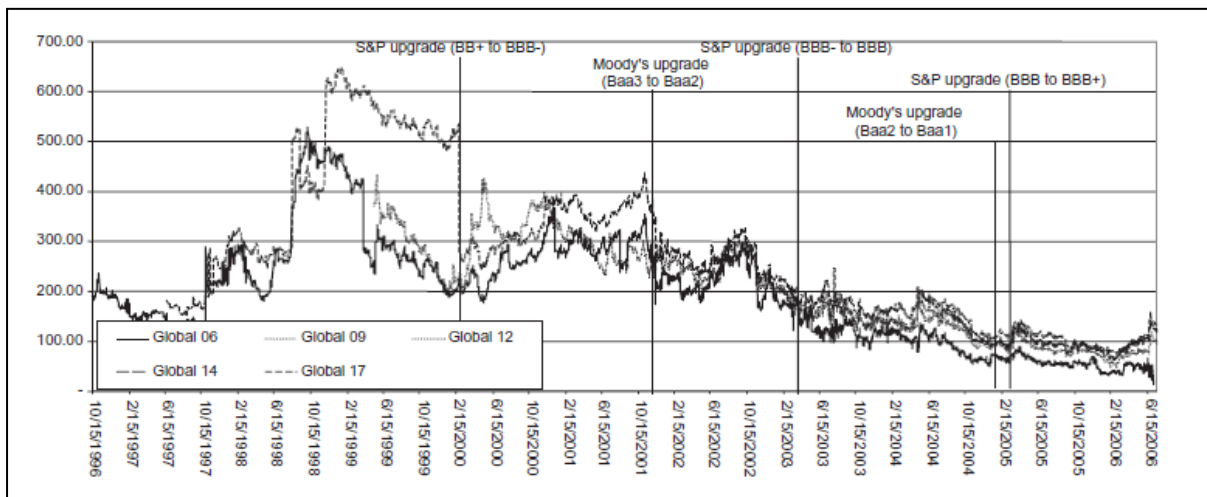
Figure 2-3: Spread for borrowing by the South African government in Dollars

Figure 2-4 presents South African spread compared to aggregate of emerging market bond. The broad spread observed in the early 2000 suggests that investors

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have far more confidence in South Africa than in other emerging countries. However this gap is narrowing.
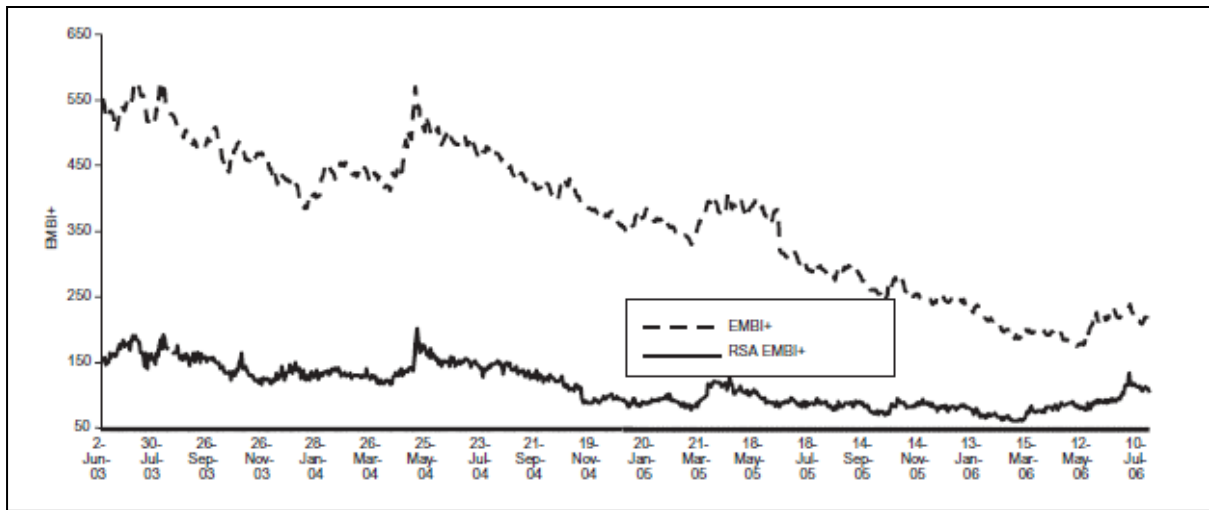
Figure 2-4: South African spread *vs.* aggregate of emerging market bonds

When investing in foreign countries, the country risk premium needs to be considered. This consideration results in a modified capital asset pricing model (CAPM). This is a model used to estimate the expected rate of return. The modified CAPM thus become:

$$R_e = R_f + \beta(R_m - R_f + CRP)$$

Equation 2-8

Equation 2-8 suggests that the higher the country's risk, the higher the expected rate of return from foreign investors. This can have deleterious effects on the projects that require foreign direct investments.

The currency exchange does not only affect foreign direct investment but it also affects the balance of trade. In the case of this study, the researcher is concerned about the effect on currency exchange on the cost of imported Brent crude oil and

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subsequently the value of oil and gas companies stocks. The next section looks at oil and gas companies' stocks.

2.6 Oil and Gas Companies Stocks

The value of the companies' stock is a measure of its worth. Two types of measures of the stocks exist, namely, market value and the intrinsic value. The market value of companies stock is often influence by the market forces and the perception that the investors place on that stock or company. This means that it depends on exogenous factors. However the intrinsic value of the stock is dependent on the microeconomic factors of the company. These factors include among others the dividend policy of the company and the growth of the company. The intrinsic value of the company's stock can be calculated using the Gordon's model:

$$P = \frac{D_1}{r_s - g}$$

$$= \frac{D_0(1 + g)}{r_s - g}$$

Equation 2-9

where D_1 is future dividends; D_0 is paid dividends, r_s is the expected rate of return and g is the growth rate.

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2.7 Summary

This chapter laid the foundation for the study of "the effect of oil price and currency exchange volatility on stock price of oil and gas companies' stocks. The factors that influence both oil price and currency exchange volatility were discussed. The next chapter presents a literature review. Three main areas are covered in the literature review:

- Oil price volatility

- Its effect on the currency and

- Also on the economy and in particular the oil and gas companies stocks.

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CHAPTER 3: LITERATURE REVIEW

3.1 Oil Price Volatility

Investors in the oil and gas companies closely follow oil price fluctuations because corporate managers and investors care about the exposure firms have to interest rates, exchange rates and commodity prices (oil price). The values of the companies change with the oil price because oil price volatility directly affects revenue, profits, investments and cash flows (Tufano, 1998; Boyer and Filion, 2007).

Oil price volatility not only affects oil and gas companies but it also affects the economy in general. This is so because oil is an input for almost all goods and services. Increase in oil price creates price pressures on the economy, setting the discount rate soaring and reducing the present value of cash flows. Volatility also affects prices, production and inventories in two principle ways. Firstly, it affects the marginal value of storage. An increase in volatility can lead to inventory build ups and raises prices in the short run. Secondly, volatility affects the total marginal cost of production via the option premium. Producers hold operating options, with an exercise price equals to the direct marginal production costs and a payoff equal the spot price. An increase in oil price volatility raises the value of the option and the associated opportunity costs and can result in a decrease in production (Yang *et al.*, 2002; Guo and Kliesen, 2005; Pindyck, 2004; Tang *et al.*, 2010). Tang *et al.* (2010) summarised the transmission of oil price shocks through the economy in Figure 3-1. They found that in China the stickiness and hysteresis of the inflationary shock transmission cut the profit rate of producers which cause the reduction in both short

term and long term outputs. Compared with developed countries, the baffled price transmission mechanism in China makes the adverse impact of inflationary shocks more serious and permanent.
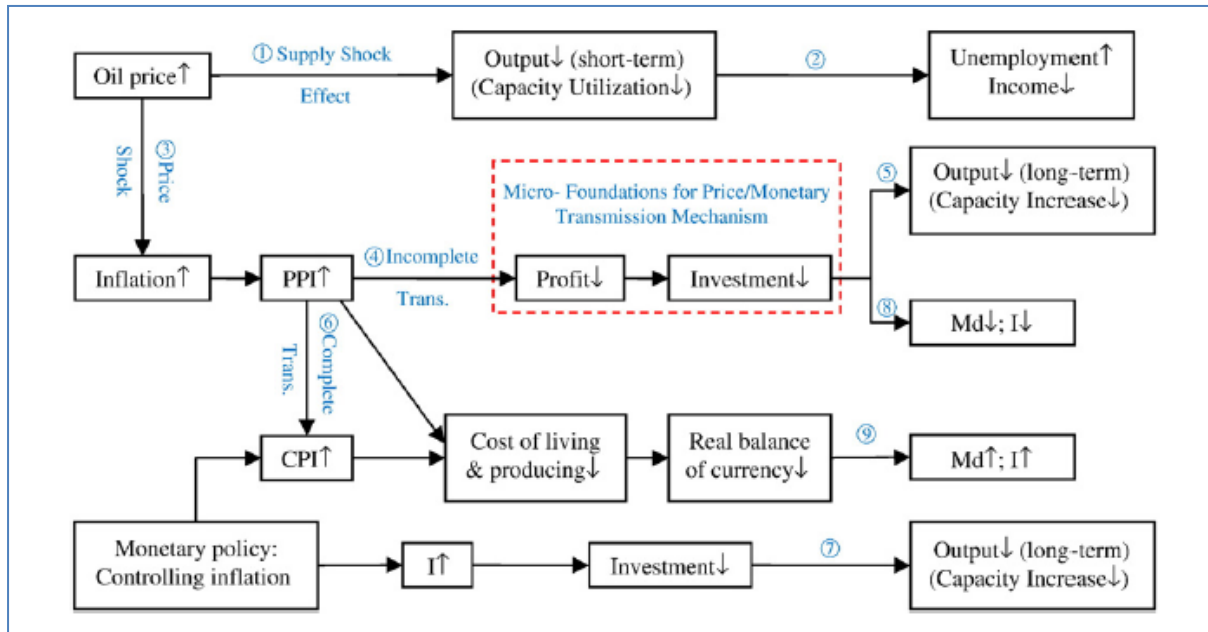
Figure 3-1: Transmission of oil price shock

According to Figure 3-1 as the oil price increases, the economy is affected in two fundamental ways. Firstly, through the supply shock which then leads to a decrease in output and consequently a reduction in the utilisation of production capacity. This results in the increase in unemployment and consequently a reduction in income. Secondly, through the price shock as all the manufacturers pass on the price increase to the consumers. This leads to an increase in inflation which in turn results in reduced disposable income and investment. The government can then adjust its monetary policies to try and curb the deleterious effect of high inflation rate.

The effect of oil price volatility on the economy can also be exacerbated by the exchange rate in non dollar denominated countries such as South Africa. The next paragraph looks at the relationship between oil price and currency exchange.

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3.2 Oil Price vs. Currency

The relationship between oil price and the currency is important for both oil importing and oil exporting countries. Since oil is traded in U.S. dollars, it is important to study the relationship between U.S. dollar and the local currency, rand. In particular, the effect of the oil price on the currency exchange rate. Lizardo and Mollick (2010) showed that an increase in real oil price lead to significant depreciation of the U.S. dollar in net oil exporter countries such as Canada, Mexico and Russia. On the other hand the currency of the oil importers suffer a depreciation relative to the U.S. dollar when the real oil price goes up. Ghosh (2011) showed that an increase in the oil price return leads to the depreciation of the Indian currency against the US dollar. India is a net importer of crude oil. In addition, the value of the U.S. dollar relative to the currencies of countries that are neither net exporters nor importers such as the U.K tends to go down.

3.3 Oil Price Volatility and the Macroeconomy

Extensive literature on oil price volatility and stock markets focused on the effect of oil price volatility on the overall stock market of individual countries. Although the outcomes of the studies are valid, "the devil lies in the details". Studies that look at the effect of the oil price volatility on specific sectors of the market realised that this sectors are affected differently. This study looks at the effect of oil price volatility on oil and gas stocks.

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When oil price volatility was studied against the general stock market, the empirical evidence showed that an oil price shock has a negative and statistically significant initial impact on the stock return (Sardorsky, 1999; Masih *et al.*, 2011; Nandha and Faff, 2007; Tang *et al.*, 2010; Filis, 2010). If oil price changes affect the economic activity, as measured by either industrial production or GDP, then it will affect the earnings of companies for which oil is an input cost to production. This negative relationship is brought about by the fact that oil is an input in production and its price increase has a deleterious effect on production output resulting in the decline in earnings. If the stock market is efficient, then an increase in oil price will cause an immediate decline in stock prices. If the stock market is not efficient then an increase in oil price will bring about a lagged decline in the stock market.

The pioneering work by Hamilton (1983) on the effect of oil price shocks on US macroeconomy has shown that oil price increases were partly responsible for every post World War II US recession except the one in 1960. Since then, Hamilton's basic findings have been tested using alternative data and estimation procedures.

Sardorsky (1999) used vector autoregresssion on monthly oil prices from 1947 to 1996 and showed that there is a negative relationship between oil price shocks and the real stock return for the US economy. His study extends to demonstrate this ripple effect on the economy by demonstrating the negative impact of shocks to real stock returns on interest rates and industrial production. More recently Masih (2011) did a similar study on South Korea.

Ji and Fan (2012) used bivariate EGARCH model with time varying correlation construction to study oil price volatility spillover on other non energy commodities

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and found that the impact of crude oil market on other commodity markets was greater when crude oil prices were high than when they were low.

Zhu *et al.* (2011) used a panel threshold cointegration approach to study the crude oil shocks and stock markets of OECD and non-OECD between 1995 and 2009. The study concluded that there is a positive relationship between the oil price increase and stock. This is contrary to the theoretical expectations. This contradiction can be attributed to the Granger causality method used to test the hypothesis. The inherent limitation of the method is that it is not sufficient to imply true causality and may produce misleading results when the true relationship involves three or more variables. Apergis and Miller (2009) also used Granger causality method to study the effect of oil shocks on the stocks return in Germany, Italy, United Kingdom, Australia, Canada, France, Japan and the united states and concluded that oil price has low or no effect on stock returns.

The effect of the oil Price volatility on the macro economy is generally negative, however, the extent of the impact depends on the level of dependency on the specific sector. The next section looks at the effect of oil price volatility on the oil and gas sector of the economy, particularly, the performance of oil and gas companies' stocks.

3.4 Oil Price Volatility and Oil and Gas companies stocks

Although oil price volatility has a negative relationship with the performance of the economy, studies that looked at the effect of oil price on oil and gas companies

stocks agree that there is a positive relationship between the increase in oil price and these stocks' prices (Sadorsky, 2001; El-Sharif *et al.*, 2005; Ramos and Veiga, 2011; Boyer and Fillion, 2007). Sadorsky (2001) and Boyer and Fillion (2007) conducted their studies on Canada, an oil exporting country. Their results show that oil and gas companies' stocks in Canada are positively affected by the increase in oil price but negatively affected by the increase in exchange rate between the US dollar and the Canadian dollar. They also concluded that the oil and gas sector is less risky than the market and moves pro-cyclically. Oil price volatility affects the oil and gas companies stock in a positive way. This is evident from the literature.

3.5 Summary

This chapter reviewed the literature on three fundamental area underpining this study, namely oil price volatility, its impact on the currency exchange, the general economy and oil and gas companies' stocks. The next chapter presents the methodology that was followed in the study.

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CHAPTER 4: RESEARCH METHODOLOGY

4.1 Problem Statement

Oil price volatility has as significant influence on the value of the stock of oil and gas companies. This can be exacerbated by the fluctuation in the currency exchange in non dollar denominated countries. This study is undertaken to impart more understanding into the influence of oil price and currency volatility on the value of oil and gas companies' stocks. Thus the problem statement is:

"Investors in oil and gas stocks require knowledge about the factors that contribute to the value of these stocks in order to time their investment correctly"

4.1.1 Sub-Problems

Oil price movements are underpinned by fundamental economic principles such as demand and supply of this commodity. These fundamentals are in turn influenced by the macroeconomic environment where Political, Economical, Social, Technological, Legal and environmental (PESTLE Model) issues play a critical role. It is against this background that the following sub-problems were formulated:

1. To determine the economic environmental factors contributing to the oil price and currency exchange volatility

2. To establish the correlation between oil price, currency exchange volatility and the stock price of oil and gas companies stocks.

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4.2 Methodology

Quantitative research methodology was used in this study. This type of research involves identifying the characteristics of oil price volatility and rand dollar exchange. The extent to which both oil price volatility and rand dollar exchange affect the oil and gas companies' stocks listed on the Johannesburg stock exchange was also studied.

Secondary data on the oil price, rand dollar exchange and the price of oil and gas companies as published in reputable sources were used to impart some understanding on how this factors interplay each other in the market.

Volatility was estimated using the sample standard deviations of adjusted daily log changes in spot prices. This approach has the advantage that it does not require a parametric model of evolution of volatility. Weekly estimates of volatility were calculated using the method that was used by (Pindyck, 2004). This method accounts for non-trading days. To do this the daily price data was sorted by intervals according to the number of days since the last trading day. For example, with no holidays, prices for Tuesday through Friday would be assigned interval of one day, but Monday would be assigned interval of three days because of the two day weekend. With holidays, some prices could be assigned to intervals of two, four or even five days. For each interval set, the sample standard deviation of log price changes for the entire studied period was calculated. The effective daily log price change for each trading day was then calculated as:

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$$r_\tau = \frac{\log P_\tau - \log P_{\tau-n}}{\widehat{S_n}\Big/\widehat{S_1}}$$

Equation 4-1

where $\hat{S}_n$ is the sample standard deviation for an interval of n days.

For each week a sample variance and corresponding sample standard deviation were calculated using the above daily log price changes for that week and the preceding four weeks

$$\hat{\sigma}_t = \sqrt{\frac{1}{N-1}\sum_{\tau-1}^{N}(r_{t\tau} - \bar{r}_t)^2}$$

Equation 4-2

where N is the number of effective days in a five week interval.

Equation 4-2 gives the sample standard deviation of daily percentage price change. To put it in weekly terms Equation 4-2 was multiplied by $\sqrt{30/4}$ and the resulting weekly series is the measure of volatility.

Correlation between Brent crude oil price and rand dollar exchange rate was performed. The same analysis was done between Brent crude oil price and oil and gas company's stock.

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4.3 Data

The data consists of daily closing price of the Brent crude oil on the London Stock Exchange and the closing Rand/Dollar exchange. The period studied is from 03/01/2005 to 24/08/2011. This period was chosen in order to cover the two major economic phenomena characterised by the economic boom of 2007 followed by the market crash of 2008. The data was corrected for non trading days.

The limited number of companies namely, Sasol limited (biggest player), Sacoil holdings limited and Oando PLC listed in the Johannesburg Securities Exchange under the oil and gas category was the biggest limitation for obtaining a representative sample. As a result of this only Sasol was used in the study for evaluating the performance of oil and gas companies.

4.4 Summary

Quantitative research methodology was used in the study. This method involved applying statistical calculations to clean the data with regard to non trading days. The data were also processed to look at the correlation between the Brent crude oil price and the rand dollar exchange rate and also the correlation between the Brent crude oil price and the oil and gas companies stock. Results are presented and discussed in the next chapter.

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CHAPTER 5: RESEARCH RESULTS AND DISCUSSION

5.1 Oil Price

The results of oil price from 2005 to 2011 are presented in Equation 5-1. The oil price experience an unprecedented increase from US$40 to US$80 in the period between Jan 2005 and June 2006. This was followed by about 38% decrease between July 2006 and Dec 2007. The start of the economic boom in 2007 also translated to the recovery in the price. During the period of Jan 2007 to July 2008 the oil price increased by approximately 170 % reaching a high of US$143 from a low of US$53. In the six months period of July 2008 to Dec 2008 the world experienced the economic "bubble burst" and this translated to the sharp decline in the oil price. The oil price lost about 76% by moving from a high position of US$143 to a low position of US$34. The graph shows that the oil price is being recovering some of the value it lost between July 2008 and Dec 2008. In the recent past the oil price touched a high level of US$126. Results also show that the oil price is mean reverting. That is although there is some degree of volatility, the price turn to revert to some average price (Joseph *et al.,* 2011).

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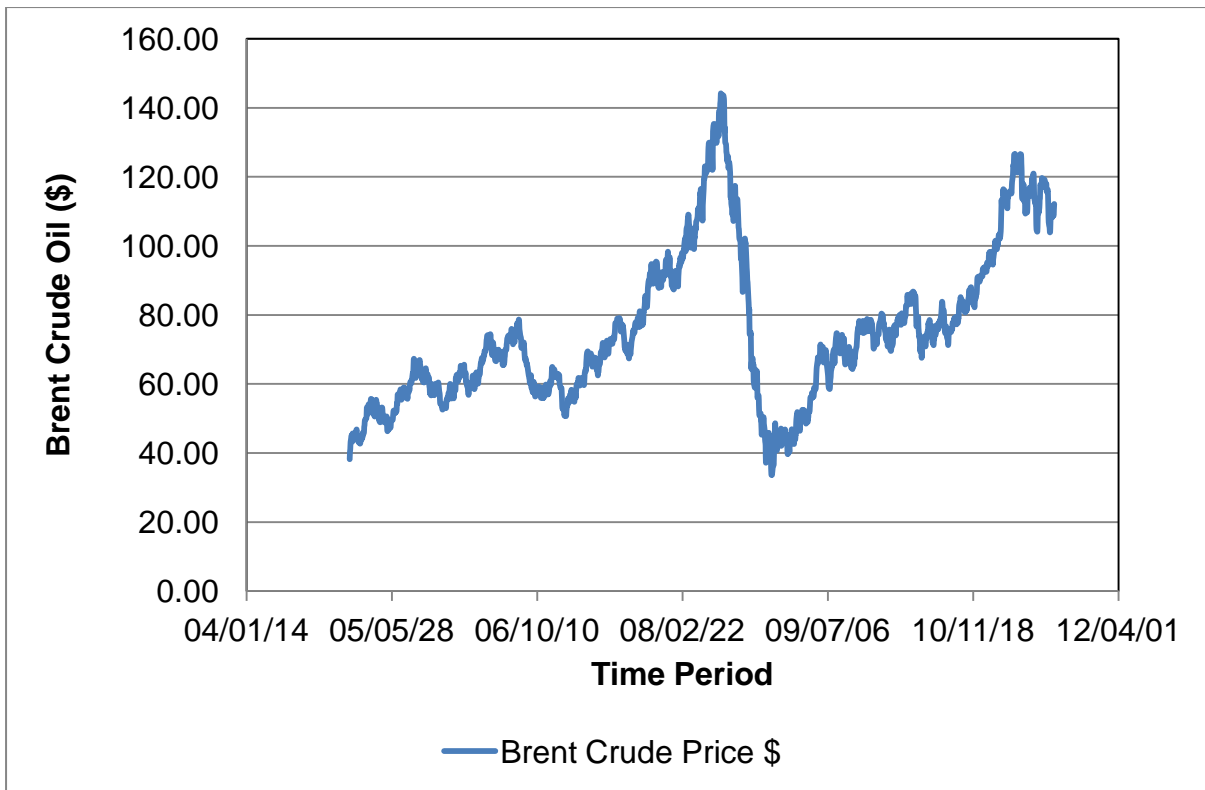
Figure 5-1: Oil Price between 2005 and 2011

5.1.1 Oil Price Return

The oil Price returns were calculated as the natural logarithm of the closing oil price of a given day less the natural logarithm of the closing oil price of the previous day.

That is:

$$R_t = \ln P_t - \ln P_{t-1}$$

Equation 5-1

The results of the oil price returns are graphically presented in Figure 5-2. Results show that the oil price returns are not evenly distributed around the mean. There exist a period of relative tranquillity followed by an "out burst". This time varying behaviour is referred to as heteroscedasticity or volatility clustering.

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Figure 5-2: Daily Brent Crude Oil Price Change

5.2 OIL Price Volatility

Oil price volatility was measured as the weekly variance in the oil price. Figure 5-3 presents the results of oil price volatility as measured by the variance in the weekly prices. The results show a similar trend as that observed with the daily returns in the oil price (Section 5.1) above.
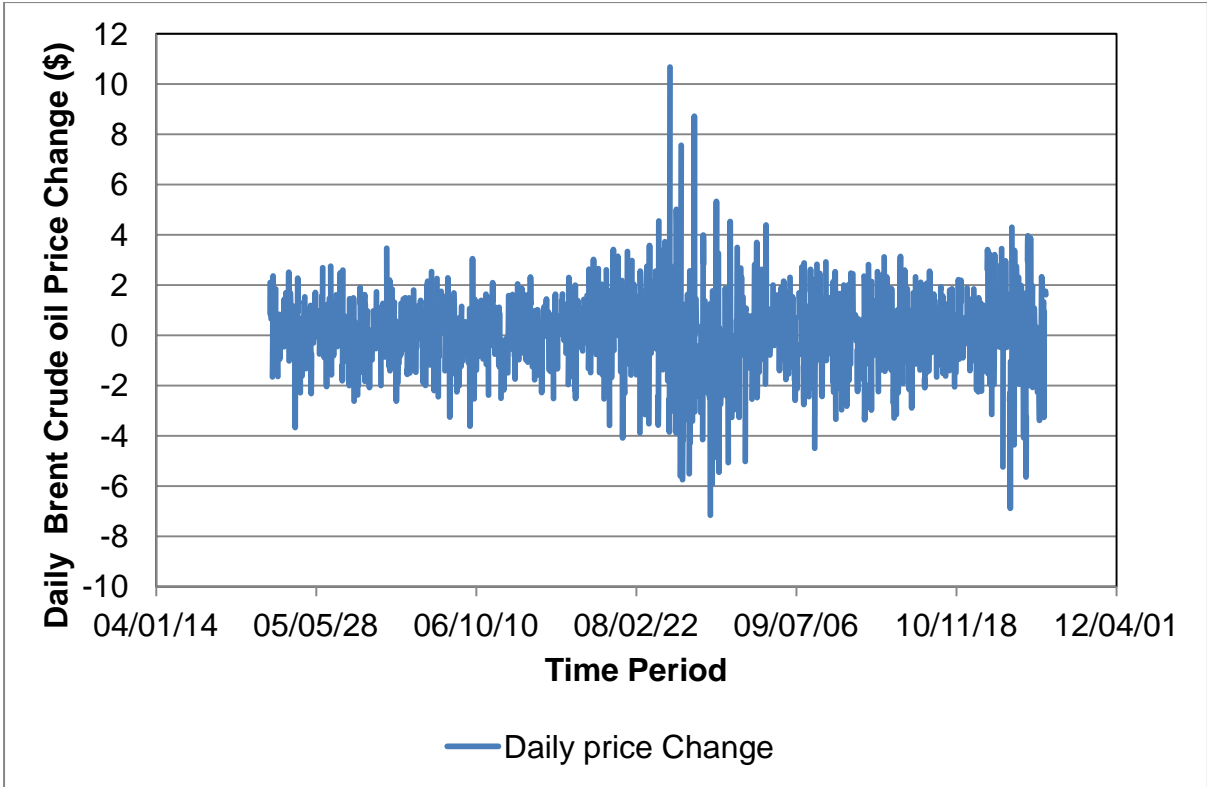
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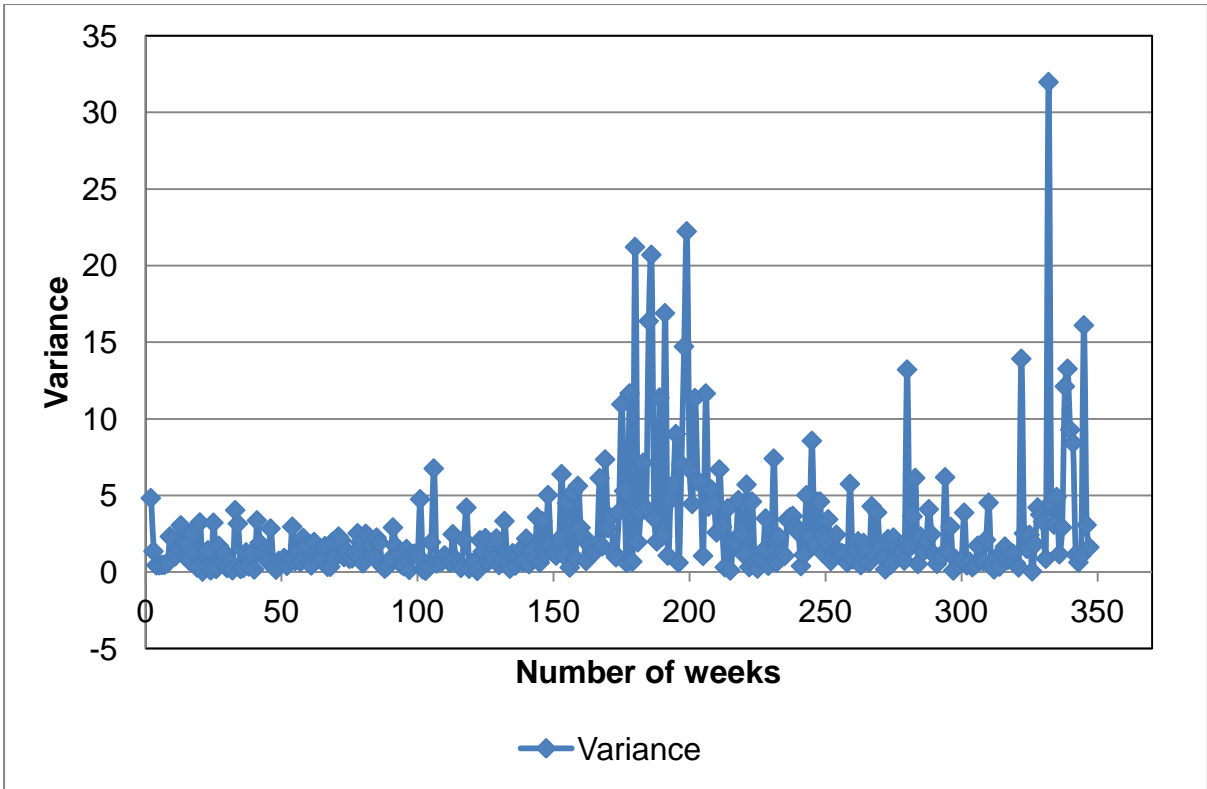
Figure 5-3: Volatility of the oil price as measured by the variance (weekly)

5.3 Rand Dollar Exchange

Figure 5-4 presents the rand dollar exchange from 03 January 2005 to 30 December 2010. The results show that the rand dollar exchange is mean reverting. Between Jan 2005 and August 2008 the rand value against the dollar was relatively stable and only varying between R6 and R8. Between September 2008 and May 2009 the rand experienced excessive weakening and touched the lowest levels of around R11.50 per dollar. These excessive losses can be attributed to a late response of the rand to the economic boom experienced in the late 2007 and early 2008. Beyond May 2009 the rand returned to the previously experienced territory ranging between R6 and R8 per dollar. This return can also be attributed to the economic crash experienced between July 2008 and December 2008.

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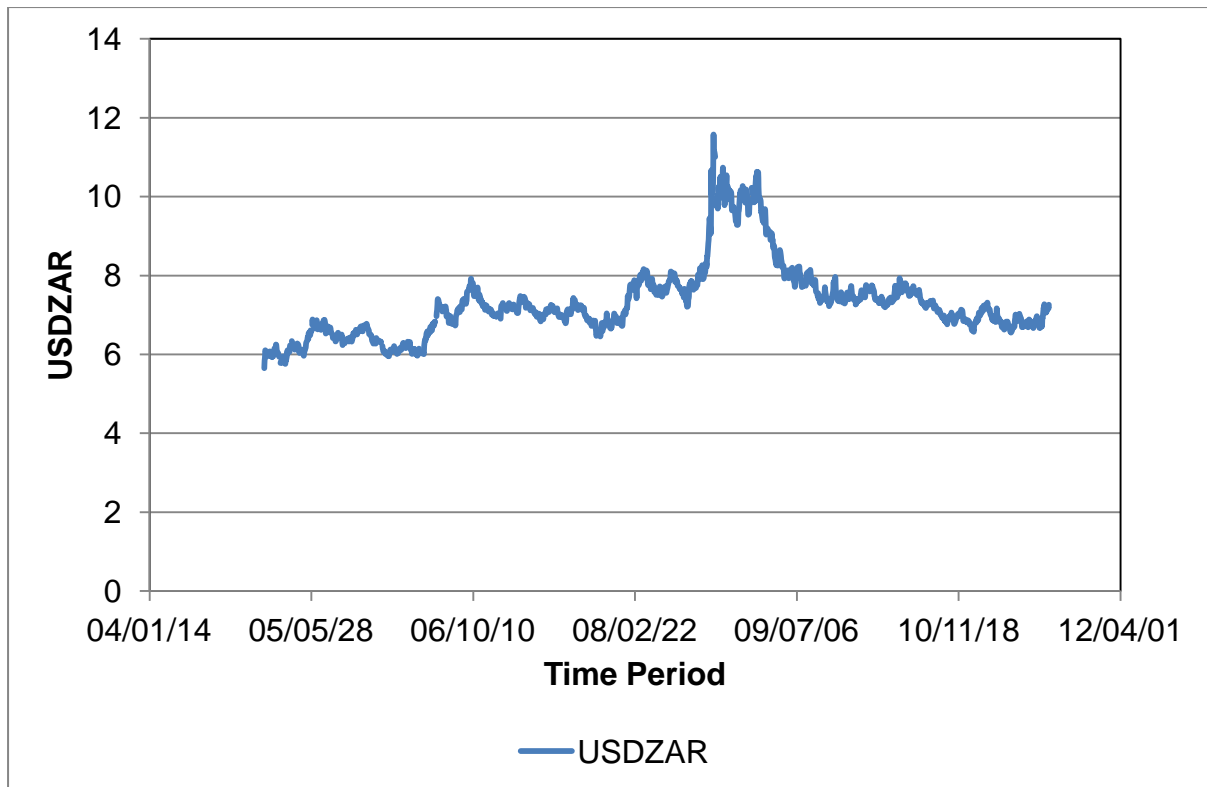
Figure 5-4: Rand /Dollar exchange from 2005-2010

South Africa is a net importer of oil and gas products that are dollar priced. Therefore, an understanding of the oil price movement relative to the rand dollar exchange is critical. This knowledge can be used in formulating the hedging strategy for Sasol. Discussion of hedging strategies is beyond the scope of this study and it was not discussed further.

5.4 Rand Dollar Exchange and Oil Price

Figure 5-5 present an overlay of the rand dollar exchange and the oil price within the period studied. The results show that a cross sectional view of the oil price and the rand dollar suggest that this assets' prices are inversely proportional to each other. This means that when the oil price weakens the dollar appreciates in value against

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the dollar. This is a desired behaviour for oil importing countries like South Africa because the negative impact of high oil price on the economy is minimised by the high value of the rand. Therefore, the translational gains associated with the high value of the rand soften the costs of importing crude oil. This behaviour is important when trading at spot prices however hedged transaction can translate into gains or losses depending on the perceived behaviour at the time of hedging. If the transaction is hedged at lower oil price with a perceived view that the oil price is going to increase and subsequently the oil price increases, this will translate into gains and vice versa. Therefore it is important to have other market indicators such as the rand dollar exchange to evaluate the probability of certain scenarios playing out as perceived.

These results are consistent with the results of Lizardo and Mollick (2010) that the currency of oil importing countries suffer a long run depreciation relative to the U.S dollar when the real oil price goes up.

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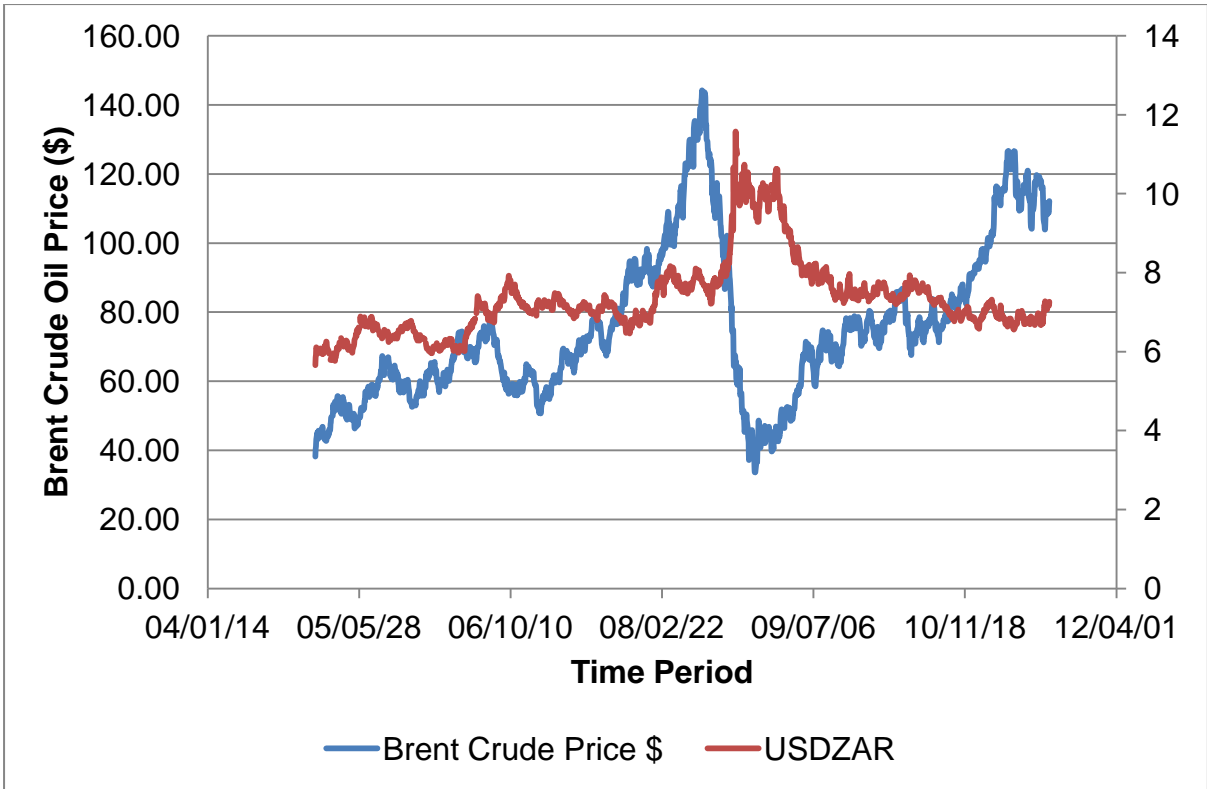
Figure 5-5: Comparison of rand dollar exchange and Oil Price

Table 5-1: Descriptive Statistics of both Oil Price and Rand dollar price

Year	Variable	Mean	STDEV	Variance	Min	Max
	Oil Price ($)	54.50	6.257263	39.15334	38.21	67.33
2005	Dollar Price (R)	6.36	0.281362	0.079165	5.65	6.89
	Oil Price ($)	65.14	5.843814	34.15017	55.89	78.69
2006	Dollar Price (R)	6.77	0.559716	0.313282	5.96	7.92
	Oil Price ($)	72.54	11.91424	141.9492	50.68	96.02
2007	Dollar Price (R)	7.04	0.21679	0.046998	6.46	7.48
	Oil Price ($)	96.90	28.97009	839.2663	33.66	144.22
2008	Dollar Price (R)	8.25	1.062212	1.128293	6.73	11.58
	Oil Price ($)	61.60	12.39318	153.5909	36.55	78.86
2009	Dollar Price (R)	8.39	0.981844	0.964017	7.23	10.63
	Oil Price ($)	79.60	5.804589	33.69325	67.58	94.00
2010	Dollar Price (R)	7.30	0.300306	0.090183	6.61	7.94

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Table 5-1 presents descriptive statistics results of both the oil price and the rand dollar price. Analysis of these results suggests that the oil price volatility as measured by the variance has a normal distribution over the period studied (Figure 5-6). The height of the oil price volatility was experienced in 2008.
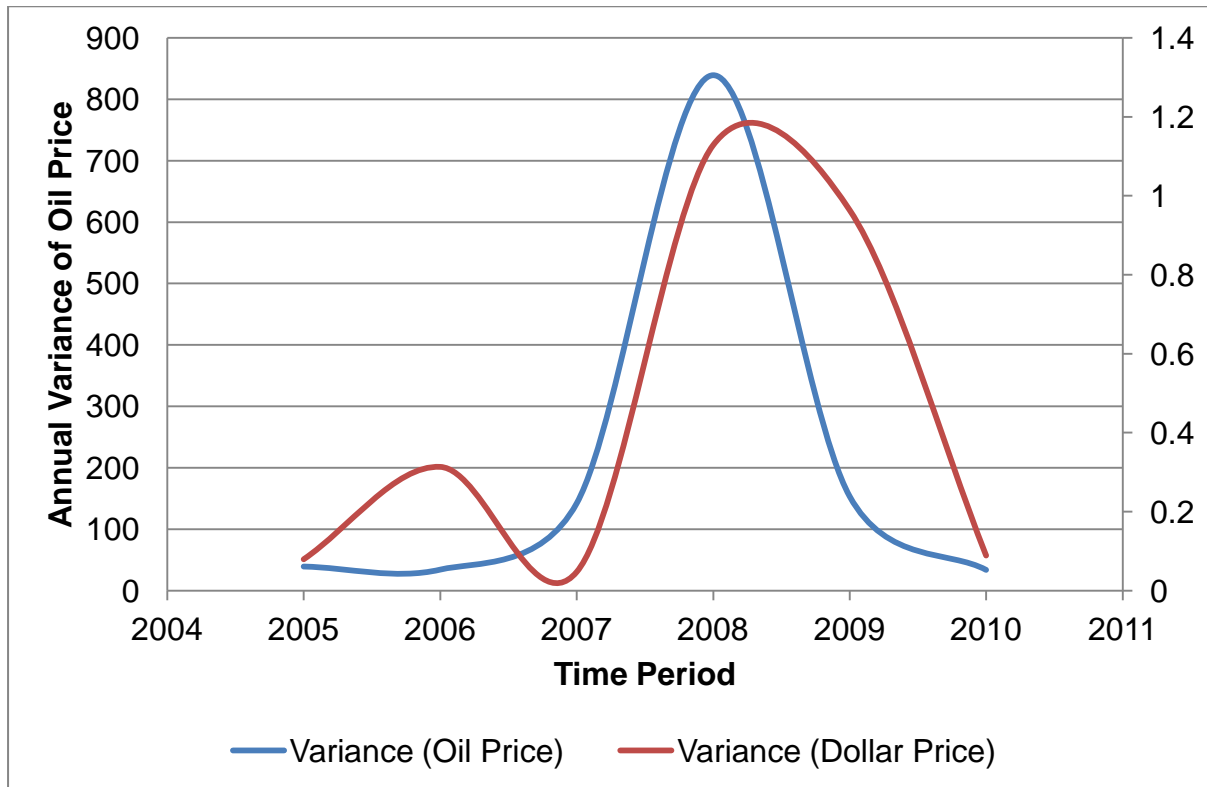
Figure 5-6: Annualised oil and dollar price volatility as measured by the variance.

Table 5-2 presents annual bivariate correlation results between oil price and the rand dollar exchange. The results show that except for 2005 which shows a positive correlation, there exists a fairly strong negative correlation between the oil price and the US dollar rand value. In order to determine whether the correlation is real, a significance test was conducted. T-test was use for the significance test.

The Null Hypothesis: There is no correlation between oil price and rand dollar price (i.e. $\rho = 0$)

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Alternative: There exists a correlation (either positive or negative) between oil price and rand dollar price (i.e. $\rho \neq 0$)

Significance level was chosen to be 0.05 and the one tailed method was used to test the hypothesis for all the five years studied. One tailed method was chosen over two tailed method because the results already indicate a negative correlation and this implies that there is already a direction. For one tailed test at 257 degrees of freedom (df) and 0.05 significance level, critical value of t = 1.651 was used.

The critical value results in Table 5-2 show that the calculated critical values for each year studied is greater than the critical value at 0.05 significance level from the t-table and therefore, the null hypothesis can be rejected. The alternative that states that there exists a correlation between oil price and the rand dollar exchange was accepted. The negative sign implies negative correlation. Although it is easy to achieve significance with large data, it is important to consider the strength of the correlation before reaching conclusion. The results also show that the correlation between Brent crude oil and the rand dollar exchange is strong.

Table 5-2: Annual Correlation of Oil Price and Rand/Dollar exchange

Period	Correlation	Critical values (t-Test)
2005	0.49	8.96
2006	-0.20	-3.31
2007	-0.75	-18.23
2008	-0.79	-20.41
2009	-0.93	-40.84
2010	-0.80	-21.13

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5.5 Oil and Gas Companies

The share price of Sasol, the only major player in the oil and gas sector in the JSE was analysed against the oil price and the rand dollar exchange. Brent crude Oil price was converted to rands by multiplying the dollar oil price by the closing dollar rand value. This was to ensure that a similar denomination was used for these assets. Figure 5-7 presents an overlay of the Sasol share price and the price of Brent crude oil. It is observed that Sasol share price almost always follow the oil price. This result suggests that the major contributing factor to the price of Sasol share is the Brent crude oil price.

Table 5-3 presents the annual correlation coefficients of Brent crude oil and Sasol share price. The significance of these correlation coefficient were calculated using one tailed t-test method at 5 percent significance level (p = 0.05) and 257 degree of freedom (df). The following hypothesis was tested:

The Null Hypothesis: There is no correlation between Brent crude oil price and Sasol Share price (i.e. $\rho = 0$)

Alternative: There exists a correlation (either positive or negative) between Brent crude oil price and rand dollar price (i.e. $\rho \neq 0$)

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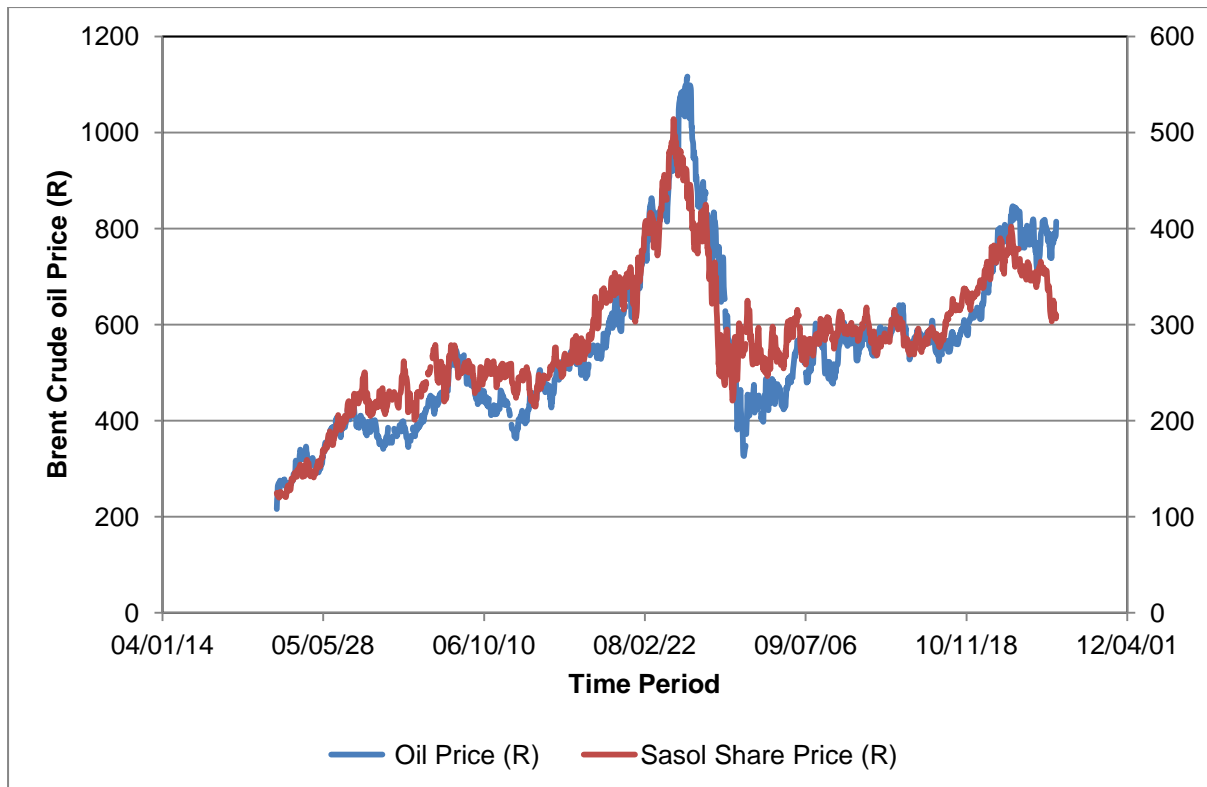
Figure 5-7: Sasol Share price vs. Brent Crude Oil Price

For 257 df and one tailed test, infinite critical value was used (t=1.651). From Table 5-3 it was observed that the calculated critical values for each year studied are greater than 1.651 therefore the null hypothesis was rejected. Since it is easy to achieve significance with large sample size, the strength of the correlation was also observed. Both the significance and the strength of the correlation were observed and therefore the researcher can confidently conclude that there exist a positive correlation between the Brent crude oil price and Sasol share price.

This high value of the correlation coefficient coupled with the high significance suggest that Sasol's share price is highly dependent on the oil price and that the other factors such as market speculations have little effect. Alternatively the effects

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of market forces can be considered to be embedded in the oil price thus being less pronounced in the movement of the Sasol share price.

Table 5-3: Annual Correlation coefficient of the Brent crude oil price and Sasol Share price

Period	Correlation	Critical values (t-Test)
2005	0.87	28.77
2006	0.65	13.77
2007	0.87	28.13
2008	0.86	26.87
2009	0.53	9.95
2010	0.54	10.18

Table 5-4 presents the results of the dividends declared by Sasol and the Brent crude oil price. The results show that there is a positive relationship between the oil price and the dividends declared to shareholders. These results are relevant to investors as they give an indication of the companies' performance towards building shareholder value.

Table 5-4: Sasol's Dividends and Brent Crude Oil Price

Period	Declared Dividends (cents)	Percentage Growth (%)	Average Oil Price (USD)
2005	540		46.17
2006	710	31.48	62.45
2007	900	26.76	63.95
2008	1300	44.44	95.51
2009	850	-34.62	68.14
2010	1050	23.53	74.37

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5.6 Summary

The results have shown that the Brent crude oil price is highly volatile. When the daily oil price returns were calculated, it was evident that the Brent crude oil prices are mean reverting and show periods of tranquillity and outbursts. This is a characteristic of heteroscedastic behaviour. Comparison of the Brent crude oil price with the rand dollar exchanges showed that there is a negative correlation between the oil price and the rand dollar value. The significance of the correlation was tested. These results are consistent with the literature on the relationship between the oil price and the currency exchange for net oil importing countries such as South Africa. On the oil and gas stocks vs. the Brent crude oil price it was observed that there is a strong positive correlation between the oil and gas company stocks and the Brent crude oil price. This was also evident in the dividends declared by Sasol. The significance of this correlation was also tested using the t-test at 0.05 significance level.

The next chapter presents the conclusion of the study and the recommendation to the investors on how best to use the observations of the study in order to make informed decisions when investing on oil and gas companies' stocks.

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CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

This study has shown that oil and rand dollar exchange have true characteristics of commodities as described by (Bryan *et al.*, 2000; Leonid *et al.*, 2009). This characteristics include among others

- Mean reverting behaviour

- Pronounced seasonality in both price level and volatility

- Strong heteroscedastic prices

- Backwardation

The mean reverting behaviour simply means that the average of the oil price turn to revolve around a certain average. This was emphasised by observing the daily oil price return. Results show that the daily oil price return averages around zero by and large. The daily price return also demonstrates the heteroscedastic behaviour of the oil price. This heteroscedastic behaviour is characterised by a period of relative tranquillity followed by an "outburst". Between 2005 and early 2007 the oil price movement was relatively calm. An outburst of the oil price was observed between 2007 and early 2009. Similarly, the rand dollar exchange also followed the same type of behaviour at some lagged time period. This behaviour of the oil price and the rand dollar exchange also confirms the seasonality characteristic of commodities. A strong negative correlation between the Brent crude oil and the rand dollar exchange rate was confirmed with the t-test method at $p = 0.05$.

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When looking at the absolute oil price over the periods 2005 to mid 2008 and from early 2009 to early 2011, one can conclude that if the future price of oil was set at some high value the overall behaviour would exhibit a strong backwardation. This means that immediate ownership of the commodity entails some benefits or convenience yield via a long forward position.

The price of Sasol shares almost always followed the movement of the oil price. Therefore it can be concluded that there is a strong correlation between the Sasol share price and the oil price. This correlation was confirmed with the t-test at 0.05 significance level. One is tempted to conclude that the market forces such as investor sentiments play little or no role in the movement of Sasol shares. The effect of the oil price on the value of the Sasol's stock also translated to the dividends declared. It was observed that the dividends also follow the price of the Brent crude oil. This observation is critical for investors who would like to invest in the oil and gas sector of the JSE particularly, on Sasol.

This study has shown that investors can use the oil price to determine the behaviour of oil and gas companies. There is a strong positive correlation between the oil price and the oil and gas companies' share price. However, the timing of the investment remains a critical factor. On the other hand the behaviour of the oil price can be used to make some inferences in terms of the behaviour of the rand relative to the dollar. This is critical information that can be used to decide the oil hedging strategy for companies such as Sasol.

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This study only looked at the oil and gas companies and it is recommended that further studies be conducted on the effect of oil price and currency exchange rate on the South African economy. Similar studies were conducted on countries such as India (Ghosh, 2011); South Korea (Masih *et al.*, 2011) and Canada (Boyer and Filion, 2007). Therefore a replica study can be done on South Africa.

6.1 Summary

This study has shown the time series behaviour of the Brent crude oil and illustrated the high oil volatility coupled with the oil shocks. Within the time period studied (i.e. 2005 and 2011) there was a major oil price shock observed in 2008. This was attributed to the speculative economic bubble and the burst of this bubble. The study has reconfirmed the general characteristics of commodities which are underpinned by heteroscedastic behaviour of the return, mean reversion, and strong backwardation.

The results on effect of the oil price on the rand dollar exchange rate have shown that the rand suffer from latent depreciation when the oil price increases. This is an inherent behaviour of the currency of the oil importing country. A strong positive correlation between the oil price and oil and gas companies (Sasol) stock was observed. This behaviour is contrary to the general stock market that shows a negative correlation to the oil price. This is so because as the oil price increases the cost of the factors of production also increases and this has a negative consequence to the general economy of the oil importing countries.

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