THE IMPACT OF RISING OIL PRICES ON THE SOUTH AFRICAN ECONOMY

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ABSTRACT

Significant literature exists regarding the relationship between macroeconomic variables and stock market returns both locally and internationally. There is limited literature around oil prices and its impact on the South African (SA) economy. This research investigated the relationship between oil prices and macroeconomic variables in South Africa, like the United States Dollar / South African Rand (USD/ZAR) exchange rates, Inflation (CPI), Gross Domestic Product (GDP), and Interest rates. Monthly data was collected for all variables besides GDP (which was collected on a quarterly basis) from the period 1997 to June 2012. A quantitative research via regression analysis was carried out in order to determine if there was any significant relationship.

The findings were that there was a significant relationship between the USD/ZAR exchange rates at 1%, 5% and 10% significance levels as well as with GDP at the 5% and 10% significance levels. There seems to be no significant relationship between oil prices and inflation, as well as oil prices and interest rates at the 1%, 5% and 10% significance levels.

Keywords: GDP, CPI, Inflation, Interest rates, exchange rates, Brent Crude oil, Brent Crude oil futures, West Texas Instrument.

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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Chapter 1: Introduction to research problem

1.1 Introduction

The objective of this research is to try gain a greater understanding of the oil industry in South Africa and the impact that rising oil prices have had on the South African economy over the last 15 years. The time period of 15 years has been chosen as it represents three business cycles and also due to the large changes within the oil infrastructure industry during this time. International research has shown that crude oil prices are more likely to be affected by political and financial market movements, rather than the assumed supply and demand fundamentals. The volatility of these prices has led to uncertainty in world markets, whilst speculation regarding oil prices has led to prices trading higher than the true market value. Nkomo (2010) states that "High oil prices were associated with slow economic growth, increasing inflation, and rising unemployment." (p. 14).

As the world looks to the emerging market economies for growth, we find that there is a higher demand for oil coming out of the non – Organisation for Petroleum Exporting Countries (OPEC) which are affecting and disrupting the supply and demand of oil, thereby leading to higher prices (Triulzi, D'Ecclesia & Bencivenga, 2010). South Africa's energy is generated mainly from coal (65.7%) and oil (21.6%) of which coal is locally sourced via the large amounts of reserves available, whilst oil is mainly imported (Goyns, Maleka & Mashimbye, 2010).

South Africa continues to be the largest consumer of petroleum and energy products in Africa, and relies on importing about 95% of crude oil from overseas markets (Nkomo, 2006). Due to an uncompetitive and low-cost oil market, the cost of producing oil is as little as $2 in some countries (Middle East) with high barriers to entry (Amene, Maffei & Till, 2008). Given these cost structures, this industry is known for being highly lucrative with above average financial returns for oil producing companies and investors. Despite it being a lucrative industry, oil producing countries like Iran and some African countries still rely more on the word markets than the world markets rely on them for oil and gas (Amuzegar, 2008). Oil wealth should be used to increase and develop human capital as this is an important function of building an industry and economy.

We often read in the literature about the resource curse which is when countries fail to use their resources for national development and in some cases are harmed by having these resources due to the country's lack of effective administration (Shaxson, 2007). In most instances involving the Middle East, oil revenues have led to greater state power and increases in the size of the public sector at the expense of a shrinking private sector (Amuzegar, 2008). One of the biggest problems facing these countries is that there are a large number of individuals looking to exploit state assets for their personal benefit, with many of them getting away with it and avoiding detection.

Martin Wolf, a famous journalist with the Financial Times once said that, "In a society when everyone cheats and takes or pays bribes, there is little incentive not to join in." (Shaxson, 2007, p. 1126). Malaysia is a perfect example of a country rich in resources who have managed to grow a strong private sector, avoid political problems and decrease fiscal expenditure, and as a result of this they now have a diversified economy with a strong and growing private sector (Gurses, 2009).

Oil, gas and coal are the world's primary sources of energy supply. Oil is currently the most popular source of liquid fuels within the transport sector even though work is being done around changing that (Friedland, 1975). Approximately 40 – 45% of the world's crude oil is produced by what is known as OPEC (OPEC, 2011). Due to this oligopoly and highly politically motivated industry, oil producers are at liberty to change production and output as and when they deem necessary, in response to the changing global economic climate.

Ever since the 2000's, there has been a huge boom in the commodities sector internationally, which has been driven mainly by the accelerated economic growth in the East (Kilian, 2008). North America remains the largest consumer of oil at about 28% of the world's oil production (WOO, 2011). According to the Energy Information Administration (Energy Information Administration [EIA], 2009), "There is more trade internationally in oil than in anything else. This is true whether one measures trade by how much of a good is moved (volume), by its value, or by the carrying capacity needed to move it." (p. 15).

There are views that oil usage is set to peak in this decade, especially with the growth seen in emerging market economies, however, discoveries of new oil is lagging behind consumption (Frankel, 2006). Even though discoveries of new oil may not be as frequent as before, the alternative energy industry seems to be making headway and

providing another avenue to consumers without the environmental costs associated with oil and coal consumption (Goyns, Maleka & Mashimbye, 2010), 2010). Due to the growth prospects and a shift of buying power to the Asia-Pacific region, refining capacity is now being built in and around these areas as the purchasing power and demands of these countries increase (OPEC, 2011). Emerging markets economies are expected to account for about 50% of the world's GDP by 2050, whilst China and India are expected to account for about 42% of the increase in global oil demand over the next 30 year period (Basher, Haug & Sadorsky, 2010).

South Africa is highly reliant on overseas oil, especially for our petrol consumption. Table 1 provides an overview of the where SA's Crude oil is sourced from.

Table 1

Sources of crude oil for SAPIA Members: 1998 to 2011

Country of origin	Thousand tonnes													
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*	2008*	2009*	2010*	2011*
Algeria											66			0
Angola		389	48	382	138	116	654	404	1 144	3 054	3 598	3 817	3 409	1 948
Antigua and Barbuda														66
Argentina												516	297	0
Bermuda											115			0
Bolivia										36				0
Cameroon						271	106		53					0
Colombia										296				0
C te d'Ivoire													88	0
Cuba													9	0
Egypt			292			135					150			0
Ecuador										149				76
Equatorial Guinea													35	38
Gabon				373			191	270				90		0
Indonesia												232		0
Iran	6 757	5 824	7 414	5 718	6 239	7 012	8 166	8 008	6 054	6 092	4 637	5 604	5 528	4 874
Iraq	413	137		343				107	322	519		545	244	0
Israel												1		0
Kuwait	2 094	833	858	431	342									0
Liberia												395		0
Libyan Arab Jamahiriya										133				0
Mexico	633	244						84						0
Mozambique													44	0
Nigeria	287	1 286	842	1 246	3 615	3 450	1 313	2 472	2 935	3 386	2 517	3 963	3 594	3 755
North Sea / U.K.		18												0
Norway										76	35	74	37	0
Oman	313	71		610	8			330	16	712	178	141	72	862
Qatar	345		76	130				209	140		0			266
Russian Federation	305				267					971	89	839		0
Saudi Arabia	3 346	8 042	8 545	7 219	7 364	9 521	8 137	7 331	6 486	5 876	6 265	6 968	4 584	4 793
Singapore											267			0
South Africa	649	493	689	524	791	570	1 482	701	684	0	0			0
Spain													134	0
Switzerland												128	126	76
United Arab Emirates	897	300	758	734	70	106	109	779	514	332	855	553	1 018	598
United Kingdom												80		77
United States											282		36	262
Venezuela	787									153	424	277		0
Yemen	354		140	475	62	179	338	272	192	304	1 589	818		142
Total	**17 180**	**17 637**	**19 662**	**18 185**	**18 896**	**21 360**	**20 496**	**20 967**	**18 540**	**22 090**	**21 067**	**25 040**	**19 254**	**17 834**

*Source: South African Revenue Service.

(South African Petroleum Industry Association [SAPIA], 2012)

Despite this reliance, we have been very fortunate as a country in that we have one of the world's largest reserves of coal for our electricity consumption (Friedland, 1975). Oil accounts for approximately 6% of total country imports in South Africa, where 96% is sourced from Nigeria (16.6%), Iran (33.7%) and the majority from Saudi Arabia (45.8%) (ABSA, 2004). Oil consumption as a percentage of GDP in South Africa is 4.5% (HSBC, 2011). Even though oil reserves worldwide are depleting, Friedland (1975) suggests that there are ample amounts of oil still to be discovered through exploration. According to Adilov and Samavati (2009) petrol prices are in line with oligopolistic co-ordination theory, which states that when input costs in petroleum increase, the sellers of end products tend to immediately adjust their prices higher to ensure profits, however, when input prices come down there is a lag time in decreasing prices of end products until competitors start decreasing prices. Jones, Leiby and Paik (2003) confirms this by saying "Product prices rise more quickly in response to crude price increases than they decline in response to crude price reductions." (p. 6).

Based on the introduction above, this study aims to look at the structure and role of the oil industry, as well as those important factors that affect the price of oil. We then look at what has been discovered in the literature review, and try to find the relationship between variables affecting the oil price fluctuations in the SA economy, as well as spill over effects on inflation and company share price performance. We will identify the role that speculation plays in the oil markets and the extent to which this affects the price of oil. Once the regression and time series analysis has been carried out, we will interpret these results within the SA context and provide possible solutions and ways forward for the industry.

If we look at economics from a general perspective, as the price of oil increases, the price of petrol increases as well. When the price of petrol increases, the cost of transport and logistics will rise. This in turn affects the cost of goods sold and products become more expensive. This is where it stops from a costing perspective. However, as the cost of petrol increases, people tend to save less money as they have less disposable income, which in turn leads to a decrease in spending on luxuries. When people decrease spending, jobs are affected and unemployment becomes more prevalent. When oil prices spike, economic activity is curtailed as a result of consumers now spending more money on energy consumption rather than discretionary expenditures (Trung & Vinh, 2011)

1.2 Research Motivation

The reason for wanting to do a topic around the oil industry is both important for business today and a personal interest. If we look at the oil industry internationally, it affects every single sector in which one operates. From a business perspective, a higher oil price makes oil producers wealthier as the cost of production remains static, whilst the revenue they earn via the increased oil prices continues to make them profitable. As can be seen from Table 2, South African petroleum vendors have seen a steady increase in profits over time with only the 2008 financial crisis affecting them.

Table 2

Aggregate financial results of SAPIA members

Year ended 31 December

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Operating profit (R/m)	2 402	2 229	1 987	2 965	5 704	5 687	6 136	3 625	7 758	10 421	9 828	10 451	5 193	7 991	11 285
Interest paid (R/m)	(447)	(454)	(683)	(389)	(789)	(673)	(1 141)	(1 062)	(617)	2	(1 505)	(1 117)	(2 312)	(973)	(1 868)
Income tax (R/m)	(568)	(474)	(419)	(667)	(1 249)	(1 682)	(1 178)	(983)	(2 591)	(2 976)	(1 622)	(2 284)	(1 377)	(190)	(1 609)
Net income (R/m)	1 387	1 301	885	1 909	3 666	3 332	3 817	1 579	4 550	7 456	6 701	7 050	1 503	6 828	7 808
Total assets (R/m)	17 634	18 597	19 546	20 492	34 157	41 451	41 849	37 794	57 169	58 845	63 401	88 415	116 460	101 051	100 851
Capital expenditure (R/m)	1 377	1 455	1 511	1 542	1 763	2 627	2 877	1 812	2 555	3 154	4 494	4 958	6 070	5 573	5 091
Refinery shutdown														939	574
Other														4 634	4 518
After tax return on assets (%)	7.9	7.0	4.5	9.3	10.7	8.0	8.4	4.2	8.0	12.7	10.6	8.0	1.3	6.8	7.7
Sales volumes (bn litres)	29.4	33.8	31.0	26.6	26.7	26.9	31.4	30.2	30.6	29.2	32.0	32.3	35.3	28.7	21.5
Net income after tax (c/l)	4.7	3.8	2.9	7.2	13.7	12.4	12.2	5.2	14.9	25.5	20.9	21.8	4.3	23.8	36.3

Individual company financial data aggregated by Sizwe Ntsaluba Auditors.
2011 data not available at the time of publication.

(SAPIA, 2012)

Higher oil prices could have disastrous effects via rising inflation that is seen, higher electricity prices, increased petrol and transportation costs, and most of all, smaller profits as a result of the aforementioned. What we fail to realise is that when the oil prices do increase significantly, there are spill over effects that are not always immediately evident, but upon thorough inspection, became visible. For example, when oil prices increase, inflation tends to increase, which means that workers now demand a higher wage and trade unions therefore become more active. The importance of the oil trade and its potential impact on our economy should not be neglected. As an emerging market economy that does not have the buying capacity compared to the likes of the

United States of America (USA), and now Asia-Pacific, SA is vulnerable to the fluctuating oil prices.

South Africa has vast amounts of resources like platinum, coal and chrome. When these prices increase local miners are the beneficiaries as their cost of production stays relatively stable. Just like oil, commodities are generally priced in USD and so the strength of the Rand against the USD may affect business that we do internationally.

The literature around this topic was sourced from a wide range of academic articles as well as analyst research reports and government publications. A large portion of the material was also sourced via the EIA and OPEC publications.

1.3 Research Problem

This study will aim to give us a more detailed understanding of whether oil price increases have any effect on the South African economy. Given that our purchasing power is not as big as other emerging market economies, we are trying to identify if we are still susceptible to these increases locally.

The research will:

- Identify the relationship between oil prices and foreign exchange rates, with particular emphasis on the USD (against the Rand) being the purchasing currency.
- Aim to identify the inflationary effects that arise as a result of the fluctuating oil prices in South Africa via the Consumer Price Inflation (CPI) index.
- Identify the relationship between oil prices and the Gross Domestic Product (GDP) of SA
- Identify the relationship between oil prices and the interest rate (prime rate) in South Africa.
- Look at the role of OPEC and politics within the oil industry, and identify where South Africa fits in.

Chapter 2: Theory and Literature Review

2.1 Introduction

The primary usage of oil is for transport fuel, heating, energy and inputs into the petrochemical industries. Over the last decade we have seen a sudden rise in the demand for oil, especially from emerging market economies, which has driven the global prices of oil up (Feldstein, 2008). Despite a mismatch in equilibrium oil prices where demand was lower than supply in 2008, oil prices peaked at $150 a barrel, which clearly states that there are other important factors to consider in the pricing of oil, of which politics and the financial sector have a pivotal role to play (De Meo & Suni, 2009). According to Owen (2006), “Oil is King, and the revenues it generates become an essential part of the means of exercising political control.” (p. 4). Around 40% of the world’s oil is produced by OPEC and they have access to approximately 70% of the world’s reserves which could last in excess of a hundred years (Owen, 2006).

In order to provide some perspective to the thesis, it is important for one to differentiate between the two main types of oil, the West Texas Instrument (WTI) oil and Brent Crude oil. Until the mid-2000’s, WTI was known as the benchmark for pricing oil internationally, however, due to the limitations and the nature of sourcing this product, Brent Crude oil has now become the benchmark or reference point for the majority of oil traded internationally, including Africa (Castlestone, 2011).

Historically, the price of Brent Crude oil has been used as a benchmark for the European petroleum industry, whereas WTI crude oil has been used a benchmark for the U.S industry (Kliesen & Owyang, 2011). Koyama (2011) states that “WTI is traded not internationally but exclusively in a region in the United States.” (p. 1). Both these oils are sweet and light and have a low sulphur content which allows for ease of transport and logistics of these products (Castlestone, 2011). The WTI remains a higher quality and premium product to Brent Crude oil due to its characteristics and specifications.

Even though Brent Crude oil is mainly traded in Europe, this product is found in various locations internationally and has a far greater distribution reach (Koyama, 2011). As a result of this, the supply and demand environments are very different and therefore the prices trade at different levels. The discounts in the WTI oil price experienced over the

last few years has been as a result of three main factors: there is a weaker demand for this product internationally due to its location and channels of trading; there has been a huge increase in the production of WTI oil which has been situated in inventory in various locations around the US; and finally, there are massive infrastructure problems and bottlenecks as well as logistical constraints of getting the product to markets and refineries (Koyama, 2011). In order for the two prices to reach a near equilibrium again, a large amount of work is required in the Cushing region in America.

In SA, retail petrol prices are regulated by the government and are changed on the first Wednesday of every month (Sasol, 2008). South African refineries are price takers in that they do not have any direct control over the price of oil. The current method of pricing fuel in SA is via the Basic Fuel Price (BFP) formula. This formula replaced the previous In-Bond-Landed-Cost (IBLC) methodology in April 2003. There is a time lag between the period that oil prices change and the change in petrol prices in SA. This lag used to be six months in the 1970's, but is now closer to one month. The single buoy mooring facility in Isipingo (Durban) is the point where 80% of SA's crude oil is discharged, which is then sent on to various refineries to be housed. Table 3 gives one an indication of the Crude oil capacity of the various refineries in SA.

Table 3

Capacity of South African refineries

Capacity (bbl/day)

Refineries	1992	1997	2007	2009	2010	2011
Sapref	120 000	165 000	180 000	180 000	180 000	180 000
Enref	70 000	105 000	125 000	125 000	120 000	120 000
Chevref	100 000	100 000	100 000	100 000	100 000	100 000
Natref	78 000	86 000	108 000	108 000	108 000	108 000
Sasol	150 000*	150 000*	150 000	150 000	150 000	150 000
PetroSA	45 000*	45 000*	45 000	45 000	45 000	45 000
Total	**513 000**	**651 000**	**708 000**	**708 000**	**703 000**	**703 000**

* Crude equivalent.

(SAPIA, 2012)

When there are disruptions within the supply chain of getting this oil to its desired location, we find that SA runs out of its current spare inventory (21 days) which leads to

supply disruptions in the fuel market (Department of Energy [DOE], 2012). Additions to growing concerns are that the South African treasury has decided to introduce a carbon tax which could make many energy-intensive industries no longer viable. Fuel is also a large component of agricultural and logistics costs which, if increased, could lead to increases in the prices of daily necessities like bread, milk and meat.

An oil shock is regarded as any disruption to the existing supply and demand conditions within the industry, usually via price. Oil shocks are seen often and have an effect via labour and capital allocations. When there is an oil price shock, demand for various goods and services are lowered. This leaves idle both the capacity for labour and capital, which multiplies the overall effect of the impact on the economy as these resources are not being utilised (Hamilton, 2005). These fluctuations in prices can lead to investment expenditure falling up to 35%, which contributes to a weaker economy (Aguiar, Conraria & Wen, 2007).

As oil usage has increased over the last few decades, we have seen higher levels of pollution and damage to the atmosphere. The burning of fossil fuels has been regarded as one of the main causes of global warming, and this has led to the drive to develop renewable energy solutions (Atzori, 2011). As a result of this, we have seen a large amount of state intervention in the oil sector, with many experts indicating that if there is too much involvement by the state it could lead to the weakening of an effective private sector (Gurses, 2009).

Friedland (1975) believes that in the long run the demand curve for oil will shift to the left due to the large amount of research and money spent on finding substitutes for fuels, especially within the transport sector. Nkomo (2009) has a very different view in that SA is a net importer of oil and there are no substitutes that are readily available, or economical for that matter, to replace oil. The price of oil is not driven by pure supply and demand like other commodities. A perfect example is the September 11 attacks on the USA when, even though the demand and supply were not affected worldwide, oil prices sky rocketed (Nkomo, 2009). What we are seeing in the 2000's is a rise in the demand for oil purely as a result of the industrialisation of China, India and other emerging market economies. The Chinese economy has been growing at near 10% since 2007, and each year the demand for oil has increased as a result of growth in GDP and personal income (Nkomo, 2010).

Nkomo (2009) indicates “Demand for oil is demand inelastic in the medium term for reasons that there are no immediate substitutes for oil and consumers do not have flexibility to switch to other fuels.” (p. 21). South Africa’s strategic petroleum reserves are currently at 45 million barrels and are continuously being increased to cater for temporary supply disruptions (Nkomo, 2010). The depletion of oil pushes the supply curve to the left, whilst a growing knowledge about more oil pushes the curve to the right (Adelman, 1998). Adelman (1998) states that, “In a non-competitive market, the supply curve does not exist because producers do not equate marginal cost to price.” (p. 3).

Crude oil supply does not adjust immediately when there are changes in demand, as there are costs associated with altering supply, and often uncertainty about the sustainability of the increased demand (Kilian, 2008).

Higher oil prices on the demand side mean that consumers pay more to producing nations for imports, which leaves less income to be used locally for development and economic spend (Foote & Little, 2011).

2.2 The role of OPEC and politics within the oil industry internationally

The Organisation for Petroleum Exporting Countries (OPEC) consists of representation from 12 oil producing nations and was founded in 1960 (OPEC, 2011). Initially, OPEC was purely involved in oil production and pricing decisions, however, as time has evolved, they have been more actively involved in these areas as well as exploration and policy making due to the direct interest OPEC has in the price of oil in providing capital and foreign exchange flows (Nkomo, 2006). For a large number of these countries, exporting oil is a major source of their income, and so they emphasise the importance of looking after their interest via the oil price. The main objective for OPEC is to control the supply of oil and negotiate favourable prices for its members. As Hamilton (2008) puts it, “In the modern era, it is sovereign countries rather than private companies who would be calling the shots.” (p. 21).

According to Owen (2006), “Oil has been widely seen as a weapon, as it has served as a source of funds both for the financing of international terror and for the pursuit of eccentric and often nasty social experiments by dangerous governments.” (p. 2). Most

OPEC states have large amounts of oil but lack the technology and infrastructure needed to develop new and existing oil fields, as well as lacking in skills to ensure business optimisation. Many of these countries also do not want to get into long standing partnerships with the West at the risk of them being exploited for their resources. Despite the large amounts of oil available via OPEC, with time we have seen the emergence of sizable amounts of non-OPEC reserves being discovered, as well as other forms of energy, which could put pressure on OPEC in the future.

For OPEC to function effectively it is important for them to produce at a point where marginal revenues equal marginal costs. We know from microeconomics that the point where marginal revenue equals marginal costs is the point at which profits are maximised (Baye, 2010). However, due to OPEC being a group or a cartel of oil producing countries rather than an individual, there are always incentives for people within the group to cheat by often producing more than they should to benefit personally (Hamilton, 2008).

As mentioned earlier, private greed often drives the dishonest activity within the oil industry. In order to solve some problems around this greed and the resource curse faced by many countries, Shaxson (2007) advises that oil revenues should be distributed equally to all citizens in oil producing countries. This, he believes, should also lead to a more effective tax system in less developed economies like Iran. Gurses (2009) mentions "…surplus revenues enable the state to maintain the coercive capacity to repress any demands for democratic reforms and popular participation." (p. 509).

We often do not realise the role that politics play in the price of oil. Oil price hikes can be associated with political instability and so supply of oil is adjusted to take these interruptions into account (Nkomo, 2006). If we look at the 1990-1991 conflicts between Iraq and Saudi Arabia, we find that the US were called in to provide protection services to the Saudi Arabian's which came at a very large cost/expense (Owen, 2006). The Americans have also been known to get first choice of establishing very large stockpiles of oil which have been put in storage for protection during embargoes and cartel pricing (Friedland, 1975). The Western political influence has ensured that Western oil companies control the entire supply chain of the oil industry for their benefit, with host governments often getting royalties (Friedland, 1975)

The largest exporters of oil in the world is still the Middle Eastern region, which therefore places a large amount of dependence on these countries, even though large reserves

have recently been found in other OPEC countries (EIA, 2009). As the largest consumer of oil, the US has made great strides in cementing a good relationship with the Middle East to ensure continuous trade and view them as a partner for import growth (EIA, 2009). The Middle Eastern nations have been known to curtail production by millions of barrels a day just to achieve a political objective (Nkomo, 2010).

Oil revenues are seen as in important source of providing funds for the development of nations and the upliftment of local communities to allow them to compete internationally. If we look at Saudi Arabia prior to the discovery of oil, they had to rely on tax revenue via farming and small merchants in operation. Today, tax revenues are flooding in via oil and oil related industries which help with the growth of the country. The rich and wealthy oil producing states like the Middle East tend to leave large amounts of their cash and investments offshore in places like the US and Europe which allows these countries to utilize them for their own benefit (Owen, 2006).

The large amounts of money that are made in the Middle East should be invested wisely for effective future use. The paradox of thrift states that if these savings are not appropriately made in investment expenditure, then the increased spend in investments will not be equal to the decrease in consumption spending, which will result in a decrease in demand and eventually give rise to unemployment (Colander, 2010). One of the more successful state models was the Kuwaiti Model, which emphasised the use of oil revenues to pay and support the local communities, provide employment, housing, health care and education, and provide a sense of empowerment to the local people (Owen, 2006). Gurses (2009) states that “If resource-led growth does not lead to higher education levels and greater occupational specialisation, it should also fail to bring about democracy.” (p. 509).

This model has been replicated in recent years by the United Arab Emirates, with Dubai and Abu Dhabi being great practical examples of this. However, Ross (2001) has done research in the area of 113 states and concluded that oil exporting countries like the Middle East portray anti-democratic behaviour and is consistent with authoritarian rule. A country like Iran not only has large reserves of oil, but also has the second largest reserves of natural gas (Amuzegar, 2008). They are said to have about 11.6% of the world’s known petroleum reserves, or about 520 billion barrels of oil (Amuzegar, 2008). However, despite these assets, Iran has struggled to achieve full economic benefit as a result of old oil fields, reservoir damage, a lack of the latest technology and the highest fuel consumption rates in the world (Amuzegar, 2008). At this point, it is fair to make a

comparison with South Africa. As a country, we have vast amounts of resources, but the beneficiaries of the generated profits are a small handful of elites rather than the larger community, as is the case in the Middle East.

The reasons for high petrol prices in SA are also due to the fact that we have various other costs that are taken into account which make up the oil price. The price of petrol is different depending on whether you are at the coast or inland. There are also different prices for leaded and unleaded fuel, as well as diesel with different sulphur levels (Department of Energy, [DOE], 2012). The petrol market is regulated up to a retail level via the Department of Energy in South Africa; however diesel is only regulated up to wholesale prices. A comprehensive breakdown of how petrol prices are calculated can be found in Appendix B (Sasol, 2008). All these costs added together are incorporated into the price of petrol in SA and when the price of crude oil rises, this makes the petrol price increase further as all these costs are based on a percentage of the value of imported oil, which is the largest input into petrol prices.

The industrial modernisation of oil in the second half of the last decade has led to the emergence of trade unions and other sub-committees, both locally and internationally, to facilitate with the trade and flow of oil transactions. Oil has been the source of about 40% of the world's energy which emphasises its importance in business and politics today (OPEC, 2011). If we take these factors for granted, we could see drastic changes to the supply of oil in the future.

As mentioned earlier, SA imports about 30% of their oil from Iran. This means that when there are oil embargos for Iranian oil, it has an impact on our refineries via the refining process of substitute oil products from other countries, which come at an additional cost. With a high reliance on Iran's crude oil imports into SA, sanctions are becoming an obstacle for business continuity which drastically affects our local markets. Once again, we could see a shift of the aggregate supply curve to the left and prices start to rise.

2.3 The relationship between oil prices and exchange rates

Investments in oil has for many years been used as a hedge against the volatility of the USD and inflation (Jickling & Austin, 2011). The exchange rate has a huge role to play with regards to the rising oil prices. In order to help control the prices of oil more effectively as well as hedge against inflation, it is suggested that oil be priced using a basket of currencies rather than the USD alone (Triulzi et al., 2010). One would expect that when the price of oil goes up, we would see a depreciating or weakening exchange rate against the USD. Hence, if we have a weaker Rand against the USD, we should pay more for oil and as a result of this our petrol prices would increase as well. However, despite what we believe should happen, the literature states otherwise.

Grisse (2010) identified that there was a lack of literature with regards to the relationship between oil prices and the USD exchange rate against many of the major currencies. He carried out a structural Value at Risk (VAR) analysis which revealed that there was a significant negative relationship between the price of oil and the USD exchange rate over both the short and long terms (Grisse, 2010). This relationship has been stronger post 2002. During the financial crisis of 2008, Grisse (2010) observed an appreciation of the USD whilst the price of oil was very low; and post financial crisis saw the price of oil higher whilst the USD depreciated. A fair amount of research generally finds that there is a positive relationship with oil price increases as well as the USD appreciating; however there is no relationship between foreign currency and its role on the oil prices.

Golub (1983) suggests that as oil prices increase, the value of the USD depreciates. Basher et al.(2010) stated that this "…depends on the crucial assumption that the demand for oil in oil-importing countries is price inelastic and if the price elasticity is greater than one, an increase in oil prices will lower total expenditure on oil and the demand for US Dollars would fall." (p. 7).

Basher et al. (2010) took data regarding oil prices and the USD from 1988 to 2008 to identify if there was any significant relationship between these two variables. The structural vector autoregression (SVAR) methodology was used. These findings produced similar results to Grisse (2010) which stated that in the short term, as the price of oil increases, the value of the USD depreciates.

A higher oil price leads to a profit or loss in foreign exchange translations, which could make a profitable company report losses. If we look at South African Airways (South African Airways [SAA], 2011), we see that the higher crude oil prices affected their income statement (close to a billion Rand in 2010 and 200 million Rand in 2011) and they have therefore responded by saying that their biggest challenge is to tackle these rising prices. Table 4 clearly shows the amount of jet fuel that is consumed in SA, which in terms of petroleum products is the third largest after petrol and diesel.

Table 4

Consumption of petroleum products in South Africa

Year	Millions of litres					
	Petrol	Diesel	Paraffin	Jet Fuel	Fuel Oil	LPG
1988	7 995	5 409	641	784	524	406
1989	8 395	5 350	678	835	546	432
1990	8 612	5 273	723	866	576	434
1991	8 906	5 130	725	861	526	464
1992	9 171	4 950	743	1 009	549	465
1993	9 202	4 940	834	1 095	595	454
1994	9 630	5 110	875	1 193	633	485
1995	10 153	5 432	850	1 368	616	472
1996	10 566	5 759	917	1 601	704	450
1997	10 798	5 875	970	1 777	635	502
1998	10 883	5 959	1 052	1 877	574	523
1999	10 861	5 993	1 054	1 995	561	540
2000	10 396	6 254	857	2 020	555	567
2001	10 340	6 488	786	1 924	555	599
2002	10 335	6 831	745	1 967	536	586
2003	10 667	7 263	769	2 099	528	558
2004	10 985	7 679	797	2 076	569	563
2005	11 165	8 115	761	2 180	489	550
2006	11 279	8 708	738	2 260	476	605
2007	11 558	9 755	696	2 402	465	636
2008	11 069	9 762	532	2 376	555	613
2009*	11 321	9 437	551	2 349	724	554
2010*	11 874	9 298	456	2 319	724	629

* Source: Department of Energy, except in the case of paraffin and fuel oil which is based on a best estimate.

(SAPIA, 2012)

Feldstein (2008) suggests that the rising price of oil does impact the USD because the higher oil prices leads to a widening of the US trade deficit which weakens the currency. This is evident even in today's times as we saw the USA reach its cap on their trade deficit just last year (2011).

In order to keep inflation rates constant, a tighter monetary policy and an appreciation against the USD is required (Frankel, 2006). Suggestions have been made to peg the export price via the following method: the central bank will announce a daily exchange rate against the USD based on the movement of the oil and gold prices, which would bring more stability to commodity prices in their local currencies (Frankel, 2006). This is especially important for markets which have highly fluctuating foreign exchange prices against the USD, but could also decrease investment growth if investors are not happy with the manner in which this process is carried out. Due to South Africa's aging and weak infrastructure in the oil industry, a strong exchange rate against the high oil prices will not help much as petrol prices continue to escalate (Legge & Mulock Houwer, 2008).

When the price of oil is higher than the equilibrium price, what we observe are steps taken to find alternate and cheaper substitutes to oil, high usage of technology and innovation, and the sudden interest in new supplies and extraction methods (Nkomo, 2006). Based on the aforementioned, there is strong evidence that companies like Sasol are currently looking at alternate avenues of supplying power and energy via the gas to liquid industry, and should therefore continue to try develop domestic opportunities to safeguard themselves from the high prices. According to the World Oil Outlook (WOO) (2011), by the year 2035 coal and gas will overtake oil as the largest source of energy. When the oil price is high, companies like Sasol are the short term beneficiaries, considering that production costs have not changed much.

A weak currency has knock on effects that is evident in higher interest rates, which are used to combat inflation; a decrease in consumer expenditure and lower real income growth (Nkomo, 2004). ABSA (2004) has done research in the area only to find that when the exchange rate is R6.50 to the USD, a $1 rise in crude oil prices would lead to an R0.08 increase in petrol prices per litre. When the ZAR strengthens against the USD, the cost of importing oil becomes cheaper which shifts the aggregate demand curve to the right. This increases GDP locally, and so increases the price level of goods.

Fluctuations of the oil price results in large inflows of foreign exchange to oil producers which means that there is less money to be used in the purchasing countries economy (Nkomo, 2009). We often find the term 'Dutch disease' being mentioned by academics and economist which refers to the strengthening of the currency due to resource sales and the knock on negative effect it has on the competitive position of the other local industries (Shaxson, 2007). Gurses (2009) refers to this disease as being an increase in a state's real exchange rate and imports, as well as a reduction in the production of

agricultural and manufacturing goods (Gurses 2009). South Africa has seen an increase in the average Rand price per barrel over time due to the effect of foreign exchange and spot oil prices fluctuating (Refer to Table 5).

Table 5

Brent crude prices

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	Brent													
Average US$ price	12.7	17.9	28.4	24.5	24.7	28.8	38.2	54.4	65.1	72.5	97.0	61.5	97.5	111.28
Average rand price/barrel	69.90	109.37	197.76	208.02	258.60	218.05	246.85	347.52	422.61	511.49	548.53	520.79	715.56	810.16

(SAPIA, 2012)

The futures and speculative market around oil has been a blossoming industry in the last decade, especially with the use of derivatives, which has caused the prices of oil to increase way above the incremental or marginal cost of production (Triulzi et al., 2010). The Commodity Futures and Trading Commission have done studies which prove a positive correlation between speculators and the price of oil (Jickling & Austin, 2011). However, despite the evidence of speculation in the market, Krugman (2008) believes that it is not speculation that drives the price of commodities like oil higher, but rather it is due to the increasing demand for oil from the emerging and developing economies like China and India. Amene et al., (2008) also believe that it is due to the volatility of the USD that has led to the oil prices rapidly increasing, rather than speculation.

2.4 The relationship between oil prices and inflation

The CPI index is used as a proxy for determining the rate at which the general price of a basket of goods increases in SA each month/year. The level of inflation in a country determines the actions that monetary policy and government will take in order to achieve macroeconomic targets. From economics we see that when the Reserve Bank

applies monetary policies, it leads to an increase in oil prices and subsequently inflation. In order to combat this inflation, the interest rate is increased which has an impact on investment spending and growth (Colander, 2010). This therefore causes the economy to weaken. When the price of oil increases, inflation increases as a result of the reaction to changes in monetary policy (Reicher & Utlaut, 2010). Various academics have proven that there is a direct relationship between oil prices and inflation, which is usually filtered through the changes in the components in the basket that makes up the CPI (proxy for inflation).

Nkomo (2006) made mention that, “Oil price increases lead to transfer of income to the exporting country through a shift in the terms of trade, reduces real national income of the importing country, and constrains the ability of citizens to purchase other goods and services.” (p. 28). Regardless of which country’s perspective you see this from, the impact of changing/increasing oil prices would depend on the price elasticity of demand. Some of the knock on effects of these price increases can be seen via the increased inflation levels out of the 3-6% target range and higher petrol, diesel and transport costs (South African Reserve Bank [SARB], 2011). Despite oil prices leading to higher levels of inflation, Domac and Yucel (2005) state that inflation rates amongst emerging market economies have been decreasing over time as a result of more efficient economic policies and favourable external environments for trade (Domac & Yucel, 2005).

Trung and Vinh (2011) looked at the relationship between oil prices and inflation for a predominantly oil importing country, Vietnam. They carried out a vector autoregressive model, and concluded that higher oil prices led to inflation which hampered economic growth (Trung & Vinh, 2011). A study of six Asian countries was carried out regarding the aforementioned relationship by Cunado and de Gracia (2004) during the period 1975 to 2002. This was a test for bivariate co-integration between oil prices and CPI. The results showed that there was causality for all six countries, and that a significant relationship exists between oil prices and inflation in the short term when the local currency was used.

As oil prices tend to increase the impact that they have on inflation is only modest. Chinn and LeBlanc (2004) state that when the price of oil rises by $10, the inflationary impact is about 0.1 - 0.8% in the US (Chinn & LeBlanc, 2004). Unexpected inflation is seen to redistribute wealth, create uncertainty which lowers welfare and decreases growth (Wu, 2010). The price of gold and oil are regarded as good indicators of inflation

expectations in an economy as these prices move faster than the manufacturing and services sectors (Frankel, 2006).

When commodity prices in general increase, this could give rise to and concern for there being a loose monetary policy in place (Frankel, 2006). Akram (2009) states that "…high crude oil prices may have contributed to higher prices of other commodities through cost-push effects…" (p. 2). There are generally two types of inflation, cost-push and demand pull (Colander, 2010). The type referred to by Akram is in reference to inflation that occurs when the economy is below potential output (Akram, 2009). Raising commodity prices during this time is always risky as there is no certainty that the demand is available.

The optimal inflation rate should be between 0.7 and 1.4% for the overall benefit of the US public (Billi & Kahn, 2008). However, this does not hold true for SA as our interest rates are higher than that of the US, and because we are an emerging market economy. High energy and food prices have large negative impacts on CPI, however, when these two variables are omitted in order to calculate the core inflation numbers, they are much more of a reasonable indicator (Evans & Fisher, 2011). Contrary to what many economists and analysts say, excluding food and energy from CPI calculations will not give a better indication of inflation figures or expectations.

2.5 The relationship between oil prices and GDP

GDP is the total market value of all the final goods and services that are produced in an economy in any one year period and is calculated every quarter (Colander, 2010). GDP is by far the most commonly and widely used methodology for measuring economic activity within a country. Rotemberg and Woodford (1996) have stated that a 10% rise in oil prices will lead to a 2.5% decrease in output; however this will only occur after 6 months. These findings are consistent with the findings of Hamilton and Herrera (2004), which states that there is a correlation between high oil prices and a deteriorating economy. The Organisation for Economic Co-Operation and Development (OECD) go the extent of saying that a rise of $10 a barrel in oil prices will lead to a 3% decrease in GDP in Sub-Saharan Africa (OECD, 2006).

Abeysinghe (2001) carried out an analysis of increasing oil prices on GDP output. He proceeded with a structural VARX model to determine any relationship by increasing the price of oil up to 50% and plotting his results. His findings were that those countries that are oil importers are more negatively affected by higher oil prices, whilst net oil exporting countries have a positive relationship. However, despite this positive relationship that they may have, these exporting countries are affected negatively due to the contractionary effects that the higher oil prices have on their trade partners. He goes on to say that, “Although a rise in oil prices has a significant negative effect on growth, a fall in oil prices does not cause an economic expansion.” (Abeysinghe, 2001, p. 149). Due to this inverse relationship between oil prices and growth, companies are expected to earn less money during peak oil prices which transfer to lower cash flows and therefore to a weaker economy (Maghyereh, 2004). Various economists have, over the years, seen the impact of higher oil prices on the economy, and policy makers have to take this into account before making decisions.

Jones et al. (2003) summarised a paper by the US Department of Energy to understand the macroeconomic effects of higher oil prices on the economy. Jones et al. (2003) estimates that a 10% change in the price of oil will affect GDP by about 2.50% but only after five or six quarters. In order to mitigate ones risk, they suggest that a country have adequate amounts of oil in stockpile as a contingency plan due to supply interruptions. “An oil price shock causes sharp, simultaneous decreases in energy use and capital utilization. The decline in energy use works through the representative firms production function directly, reducing output and labours marginal product.” (Jones et al., 2003, p. 2). With regards to employment, their research shows that oil prices have an impact on employment levels in that opportunities for skilled workers increase when oil prices rise suggesting that skilled labour may be used as a substitute for energy in production.

Hamilton (2005) is regarded as one of the gurus within the oil and petroleum fields. He carried out research using ordinary least squares (OLS) regression analysis based on US quarterly GDP data and oil prices to determine whether there was any significant relationship between higher oil prices and GDP in the US. The results found that there was a significant inverse relationship between higher oil prices and GDP growth in the US after three to four quarters. There also seemed to be an indication that it is demand factors that have driven the price of oil up in recent years rather than supply disruptions. As oil prices rise, GDP growth is retarded (Trung & Vinh, 2011).

Nkomo (2009) states that a $10 change in the price of oil due to shocks in the industry will result in a 0.8% decrease in GDP and 1.2% increase in inflation. From his observations he found that, “The oil price increases reduce the national output, change the structure of spending and production and shifts the economy to a lower economic growth path.” (Nkomo, 2006, p. 10).

Nkomo (2006) mentions that economic growth and job creation is highly dependent on the price of energy and considering that technology is fixed in the short run, increases in the oil price will have a drastic effect on GDP and other economic variables indirectly. There is a strong correlation between energy consumption and economic growth especially within developing economies where the growth potential is high (Nkomo, 2006). This leads to an increase in demand for oil out of the region and has the capability of driving up the oil prices.

Cunado and de Gracia (2004) state that “…the oil price increase reduces aggregate supply since higher energy prices mean that firms purchase less energy; consequently, the productivity of any given amount of capital and labour declines and potential output falls.” (p. 3). There is the possibility that the high oil prices experienced in recent years could be as a result of the low US interest rates, which relates to a low opportunity cost of storing or holding additional crude oil stock (Kilian, 2008). Higher oil prices also tend to increase the uncertainty in world markets and leads to people putting money into risk free and less energy intensive assets (Foote & Little, 2011).

In order to boost an economy, the Federal Reserve Bank pumps large amounts of liquidity into the markets which shifts aggregate demand to the right and increases GDP (HSBC, 2011). It is debatable whether this provides short term growth and has inflationary consequences which are offset by higher interest rates. Oil revenues have the tendency to build or support industrialisation, as well as to eradicate poverty and increase human capital in both developed and under developed economies (Gurses, 2009).

If people expect the price of oil to rise in the future, there is an incentive for producers to leave a large portion of their reserves in the ground to capitalise on these higher prices, thereby leading to higher profits (Davidson, 2008). Oil producing countries with current account surpluses are the beneficiaries of higher oil exports and those countries that are importing will face the other side of the coin, which is a current account deficit. In SA, because we are a net importer of oil, when the price of oil increases, we witness a

widening of the current account deficit (HSBC, 2011). To give an indication of the balance between imports and exports of petroleum products in SA, Table 6 shows the breakdown per product.

Table 6

Petroleum products imports and exports

Thousand tonnes

Year	Imports				Exports			
	Petrol	Diesel	Jet Fuel	LPG	Petrol	Diesel	Jet Fuel	LPG
2011	1 815	3 153	199	19.68	176	452	126	3.20
2010	1 571	2 163	213	3.75	329	618	53	2.56
2009	1 484	1 943	85	0.04	333	717	40	1.44
2008	956	2 108	60	0.03	363	744	83	1.24
2007	1 272	2 343	229	0.01	296	728	64	1.09

Source: South African Revenue Service.

(SAPIA, 2012)

Some oil producing countries, like Iran for example, do not use their oil income effectively. These countries' aims are usually to increase GDP and reduce unemployment whilst keeping inflation steady (Amuzegar, 2008). However, most end up with higher levels of inflation, an ineffective tax system, higher levels of corruption and greed, and a gini coefficient which lies well above those of other oil producing countries.

The effect of an oil price shock may affect GDP as this leads to a decrease in supply of oil by producers, and a decrease in demand for buyers and end users, upsetting equilibrium in the market. The largest effects of oil shocks are only seen about three to four quarters after the shock and via GDP growth, yet recovery is only seen after years (Hamilton & Herrera 2004). Various studies have shown that oil shocks have a more lasting and influential role than monetary contractions. Keynes believed that oil shocks are a typical example of his theory which results in both inflation and unemployment and often occurs along with a weaker economy (Olson, 1988).

When there is a shock in the economy, there is a change in the consumption and spending by firms and consumers which in turn affects GDP (Hamilton, 2005). The impact on the oil industry is that the aggregate supply curve shifts to the left and prices increase. Depending on how severe the shock is will determine to what extent prices

increase. Aggregate demand could stay the same; however, if there is a rise in aggregate demand as well, there is a possibility of the price of oil reaching even higher levels of equilibrium. If the decrease in aggregate supply is offset by the increase in aggregate demand, then the output and GDP remain at constant levels, but would find the price escalating further (Colander, 2010).

The demand and supply of oil, is affected by price, the number of barrels held as spare production and inventory levels. When the price of oil is high, producers of oil want to ensure maximum profits, and vice versa when it is low. This results in a shift of the supply curve depending on the price. For example, if the price of oil is at $150 a barrel, oil producers will adjust their supply to capitalise on the profit taking since their production costs have not increased. This will shift the supply curve either to the right or left depending on demand requirements/levels. When there is a disruption to the industry, either via a shutdown or external shock, supply decreases which will also drive up oil prices temporarily. All these actions will ultimately affect the GDP of a country.

If we follow the law of comparative advantage, those producers who have a production advantage will extract and produce more oil and at a faster rate (Owen, 2006).

Recent research alludes to a changing oil price via a change in global demand and supply. Killian (2008) states that "…oil price shocks have been driven mainly by a combination of global aggregate demand shocks and precautionary demand shocks, rather than oil supply shocks, as is commonly believed." (p. 2).

Oil stockpiles are used as and when needed or on a discretionary basis to ensure that markets have just the right amount of oil for supply to meet demand (EIA, 2009). As a result of this, projected stocks are seen as a very good indicator of where the oil markets are heading, and as such, industry and consumers can position themselves accordingly based on these projections. If expectations of aggregate demand are that they will increase, the aggregate demand curve will shift to the right thereby increasing GDP and price (Colander, 2010).

2.6 The relationship between oil prices and interest rates

Reicher and Utlaut (2010) used OLS to determine whether there was any significant relationship between oil prices and interest rates in the US during the period 1955 to 2009 taking into account lag periods. They found that there was a strong relationship between these two variables, indicating that as oil prices increased, the nominal interest rate in the US increased by 0.53% per quarter and about 2.1% per annum (Reicher & Utlaut, 2010). Unemployment was decreasing during this period which could be due to industrialisation and the growth of the financial and industrial systems. Soytas and Dogrul (2010) looked at the relationship between oil prices and unemployment in emerging markets and found that there was a significant inverse relationship between oil prices and employment (Soytas & Dogrul 2010). As the price of oil increased, the levels of employment decreased. During recent times, inflation and interest rates have changed with a lot more stability as oil prices have changed with interest rate movements indicating the future/expectation for inflation within a particular country (Reicher & Utlaut, 2010). Despite this analysis being very sound and informative, it failed to take into account other countries, especially emerging market and net importing countries, to see if there were any similarities.

Wu (2010) looked at the potential relationship between oil prices, interest rates, the bond index and interest rate volatility in the US during the period between 1998 and 2005. The results were that the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) values were of no significance at a 5% level. The findings were that there was a positive relationship between oil price changes and the change in interest rates. Wu also identified a relationship between higher oil prices and bond returns, which in turn further affected interest rates (Wu, 2010).

Frankel (2006) explains the relationship between commodity prices and the economy via “The Overshooting Model” which states the following:

- A monetary contraction increases the real interest rate (either through a rise in the nominal rate or a decline in inflation).
- This leads to a decrease in real commodity prices until they are undervalued to such an extent that the only outlook for them is to go up and to offset higher interest rates.

- In the long run, price levels will adjust to any changes in money supply. This concludes that real interest rates, money supply and commodity prices will eventually return to equilibrium levels.
    - (Frankel, 2006)

The above is also consistent with Akram (2009), who states that lower real interest rates will lead to higher commodity prices. When interest rates are low, people tend to move money out of bonds and into commodities which increases its demand and drives prices up. Akram (2009) goes on to say that food and industrial prices respond more gradually to changes in interest rates, whilst oil and metal prices portray 'overshooting' behaviour consistent with Frankel (2006). This is why oil producers are faced with a dilemma.

When interest rates are high, the costs of investments are also high whilst the return on leaving money in the bank will be favourable. When interest rates are low, the investment cost is low but it may not be profitable to leave money in the bank, and investment expenditure becomes the best option. When interest rates are low, investment expenditures increase and so does aggregate demand which shifts to the right and therefore increases output and GDP (Colander, 2010). This is why the oil prices are important as the higher oil price could compensate suppliers and producers for the lower interest rates.

If we adapt economic theory to the overshooting model previously mentioned, we find that when interest rates increase, investment expenditure decreases, commodity prices then follow which leads to a decrease in wages and thereafter a declining economy (Colander, 2010). What we also find is that when the economy is in decline, production decreases and employees are laid off which revolves in a cycle as these employees consume and invest less which, in turn, decreases economic growth further.

Olson (1988) suggests that even though many economists believe that energy costs cannot, on its own, have such a high impact on an economy, the spill over and knock on effects should not be discarded, especially within emerging market economies.

2.7 The role of speculation on oil prices

In a recent report, it was stated that speculators in the US have spent billions of Dollars on the energy sector which has thus led to higher oil prices over the recent years (Davidson, 2008). It is said that as much as $20 to $25 in the oil prices are due to the doings and actions of the speculative market. Awhoti (2008) mentions that since 2007 oil prices and market fundamentals have not been aligned with each other, and speculation could be at the forefront. If we look at recent events in the world, the unrest in the East and Africa has caused excessive trading in the futures markets, as well as massive concerns over world demand and supply of oil which has led prices run to well above the $100 per barrel mark (Koyama, 2011). Fattouh, Kilian and Mahadeva (2012) confirm that the rise in the real price of oil in the last decade has been purely as a result of the 'financialisation' of the futures market for oil. The futures market has since been able to explain a large component of the spot price of oil.

To put the speculation of oil into perspective, a recent study by Davidson (2008) showed the following, "Oil futures prices had increased by 86% whilst the actual price of oil only increased by 2%." (p. 113). This goes to show that many investors, especially hedge funds, have created a market demand for oil and a commodity bubble which contributes through to increased food prices. Most speculators do not take physical delivery of oil but rather trade the financial instruments linked to it to try to make a profit using arbitrage opportunities (Jickling & Austin, 2011). According to Amene et al. (2008), in order for us to see drastic decreases in the price of oil, we would have to see a global recession like the one witnessed in 2008. To confirm this theory, the price of oil during the latter half of 2008 traded at $45 per barrel, and during 2009 the average price was $43 per barrel, from highs of $160 per barrel a few months earlier. Very high oil prices are generally seen just prior to a world recession and any predictions regarding the oil prices are said to be highly uncertain due to the dynamic changes of the world we live in (Foote & Little, 2011).

Approximately seven to eight billion barrels of oil are said to be held by government stocks via inventory and the OPEC industry at any given time (OPEC, 2011). Maghyereh (2004), states that that in emerging markets there is a weak relationship between the price of oil after price shocks and economic performance. Amongst the emerging market economies, though the effects are not big, oil shocks have the largest

impact in Europe and Asia due to their buying capacity (Maghyereh, 2004). When oil price shocks drive prices higher, importing countries find that the cost of doing business is expensive. This is also a reason why there has been an increasing use of derivatives in the commodity space to try to protect buyers and sellers from fluctuating prices.

South African Airways (2010) make various disclosures of their use of derivatives to try hedge against the oil price fluctuations, and have over recent times used risk management to ensure that they are 'in the money' for the derivatives and are making profits on the foreign exchange translations. Warren Buffet, regarded as one of the world's best investors, makes mention in his Annual General Meeting (AGM) with Berkshire Hathaway (2002) that derivatives are time bombs and one should try refrain from using them.

Chapter 3: Research hypotheses

3.1 Hypothesis 1

The first research objective is to determine the relationship between foreign exchange rates (USD/ZAR) and oil prices.

The Null hypothesis associated was: There is no correlation between foreign exchange rates and the oil price.

The alternative hypothesis associated with this objective was: There is a correlation between foreign exchange rates and the oil price.

Thus:

H1(0): r = 0

H1(A): r <> 0

3.2 Hypothesis 2

The second research objective was to determine the relationship between CPI (proxy for inflation) and oil prices

The Null hypothesis associated was: There is no correlation between CPI and the oil price.

The alternative hypothesis associated with this objective was: There is a correlation between CPI and oil price.

Thus:

H2(0): r = 0

H2(A): r <> 0

3.3 Hypothesis 3

The third research objective was to determine the relationship between the GDP of SA and the oil price.

The Null hypothesis associated was: There is no correlation between GDP and the oil price.

The alternative hypothesis associated with this objective was: There is a correlation between GDP and the oil price.

Thus:

H3(0): r = 0

H3(A): r <> 0

3.4 Hypothesis 4

The fourth research objective was to determine the relationship between interest rates and the spot price of oil.

The Null hypothesis associated was: There is no correlation between interest rates in SA and the oil price.

The alternative hypothesis associated with this objective was: There is a correlation between interest rates in SA and the oil price.

Thus:

H4(0): r = 0

H4(A): r <>0

Chapter 4: Research methodology

4.1 Overview

The aim of this study was to determine whether oil prices have any correlation or relationship with four main macroeconomic variables: USD/ZAR exchange rate, Inflation, GDP, and interest rates in SA. Based on my research analysis and literature review, vast amounts of work, both practically and academically has been done around identifying the relationship between macroeconomic variables and share prices. This study aims to investigate whether there is any positive or negative relationship between these four macroeconomic variables and the price of Brent Crude oil spot.

The study will be quantitative (causal) in nature. The quantitative methods will involve a regression analysis with the dependent and independent variables mentioned above. The causal study will provide more solid evidence in terms of correlations and relationships amongst variables, and whether there is a lag time between the oil price increases and changes in SA macroeconomic indicators.

Oil prices are generally derived via benchmarking pricing through the Brent Crude oil spot or West Texas Instrument. In SA, the price of Brent Crude oil is mainly used as the benchmarking pricing for oil, whilst the West Texas Instrument pricing methodology is used in other parts of the world, especially America.

The price of Brent Crude oil was used as the independent variable for the analyses carried out. The price of Brent Crude oil futures and the West Texas Instruments oil prices have also been included as a proxy price for analysis and discussion, especially given that the price of oil futures has such a large impact on macroeconomic variables and the price of oil spot. Four main dependent variables were used for the analysis, including USD/ZAR exchange rates, Inflation, GDP, and interest rates.

Also included in the analysis were other variables like the values of the All Bond Index, the JSE All Share Total Return Index, the Producer Price Inflation index (PPI) and the share price of Sasol. These were added for comparative purposes and will be used in discussion for Chapters 6 and 7 purely to add value and perspective to the results.

The exchange rate utilised for our analysis was the USD/ZAR. Internationally, oil is priced in USD, just like many other internationally traded commodities and metals. The USD is the most traded currency internationally on a daily and annual basis. The relationship between oil prices and exchange rates have been academically viewed in the literature review, however there is a lack of evidence identifying the relationship between oil prices and the USD/ZAR exchange rate.

Gross Domestic Product (GDP) is used as an effective measure of aggregate economic activity (or economic health) within a country. It is also the end market value of all finished services and goods within a particular country for a particular time period. Gross Domestic Product (GDP) numbers in SA and many other countries are reported on a quarterly basis. In order for one to calculate the growth in GDP, a quarter on quarter analysis is required based on the previous year's data. Real GDP is nominal GDP that has been adjusted for inflation. As mentioned earlier, the CPI is used as a proxy for measuring inflation or growth of inflation in SA. Consumer Price Inflation (CPI) figures are released on a monthly basis around the 20th of each month and are reported based on a one month lag.

The interest rate in SA is made of the prime lending rate which includes a spread over and above the repurchase (repo) rate. The repo rate in SA is the rate at which the South African Reserve Bank lends money to financial institutions that have different requirements based on tier ratings and credit/liquidity positions. This repo rate is then used as a benchmark and a spread is added to it in order to determine the prime lending rate in SA. This prime lending rate also serves as a benchmark for banks looking to provide loans and advancements. Depositors of money usually receive a rate closer to the repo rate rather than the prime rate. When the prime rate is high, the cost of investment becomes a lot higher, whilst the opportunity for people to earn higher income through deposits increases as well.

4.2 Research design

The research methodology utilised for my thesis was quantitative and causal. The relationship examined was between oil prices and four macroeconomic variables: USD/ZAR exchange rates, Inflation, GDP, and interest rates.

The research, collection of data and analysis was carried as follows:

1. Monthly values were collected for the independent variable, being the price of Brent Crude oil spot. Other independent variables used were Brent Crude oil futures and West Texas Instrument values. These two were collected and used purely for comparative and analytical purposes. The period of data collection was from 1997 to second quarter 2012.
2. Monthly figures were then collected for the four macroeconomic variables that will be presented as the dependent variables, besides GDP which is only available on a quarterly basis. Along with these four variables, data on the producer price inflation, Sasol share price, the All Bond Index and the All Share Total Return Index were also collected to provide a meaningful analysis. This data was also collected from 1997 to second quarter 2012.
3. Statistical/Regression analysis was carried out to determine the nature and extent of any relationship between the oil prices and the various macroeconomic variables.
4. The results were analysed with both descriptive and graphical outcomes that were used for interpretation.

4.3 Unit of analysis

The unit of analysis for my thesis was USD/ZAR exchange rates, Inflation, GDP, and interest rates. Blumberg, Cooper & Schindler (2008) describe the unit of analysis as being the level at which the research is performed and those variables that are researched.

4.4 Sampling method

Sampling methodologies may be probable or non-probable depending on the type of data one has and the kind of analysis that is required. For this analysis a probability

sampling methodology was not utilised given the nature of the data set. The sampling methodology adopted was purposive given that the criterion was that the variables had to be part of a specific macroeconomic group, namely: USD/ZAR exchange rates, inflation, GDP and interest rates.

4.5 Data Collection

The data required for this study was sourced from INet Bridge, StatsSA and the South African Reserve Bank website. I have access to INet Bridge via a username and password login through my company, whilst the data on the StatsSA and South African Reserve Bank website is publicly available. All closing monthly and quarterly data values for Brent Crude oil prices were collected from 1997 to second quarter 2012.

The dependent variable data was collected for GDP, CPI, interest rates and the USD/ZAR exchange rates on a monthly and quarterly basis for the same period mentioned above. All data was collected at the same time and compared across the different sources to ensure that they were accurate.

4.6 Data Analysis

Data analysis is the next key step in proceeding with the thesis once the literature review has been completed. The literature review is seen as setting the scene for what the data analysis may find. According to Zikmund (2003) "…the process of data analysis entails summarising large quantities of raw data so the results can be interpreted. The aim of data analysis is to reveal any consistent patterns in the data so the results may be studied and interpreted in a brief and meaningful manner." (p. 473).

The data collected for all five variables was time series data collected from the period 1997 to second quarter 2012. According to Albright, Winston and Zappe (2009), "… time series data involve one or more variables that are observed at several, usually equally spaced, points in time." (p. 573). They mention that this type of data comprises of four

different components, namely: trend, seasonal, cyclical and random (Albright et al., 2009). Based on the above definition, we have collected data at equally spaced time periods, being monthly for all variables besides GDP, which is quarterly.

In order to determine if there was any relationship between the oil prices and the dependent variables, we used a regression analysis as follows:

$$DV_t = \alpha + \beta IV_{t-k} + \varepsilon$$

Where

DV = dependent variable at time t

IV = independent variable at time t, lagged by k periods (months or quarters, depending on which DV is used)

α = intercept

β = coefficient of IV

ε = error term

The dependent variable is the variable being explained by the independent variable. We have chosen a simple regression including only one single explanatory variable.

Whenever one deals with time series data, there is a large possibility of there being autocorrelation present within the data set. “An autocorrelation is a type of correlation used to measure whether values of a time series are related to their own past values (Albright et al, 2009, p. 726).” Given the nature of the data set that we have used, it is certain that autocorrelation is evident. The current price of oil is dependent on the previous price just as inflation and GDP figures are. Detecting autocorrelation requires the use of the Durbin-Watson statistic. In order to combat or fix autocorrelation, one can fix the model with generalised least squares using a maximum likelihood estimation methodology.

4.7 Research Limitations

Due to a short time frame, as well as various other constraints, there will be limitations to my study. Some of these limitations include:

- The sample will only be looking at relationships over the last 15 years as the oil market has changed drastically. My intention is to identify the most recent findings, and 15 years indicates roughly three business cycles which should be sufficient to see a relationship.

- An analysis of how oil producing companies have performed given certain oil prices will be carried out. However, there are only two listed oil companies in SA which makes it difficult to see how share price performance has changed over time. For this reason, I will look at how the general index, being the All Share Index (ALsi), has changed whilst oil prices have fluctuated.

- My analysis is a direct analysis of the relationship between oil prices and macroeconomic variables. Much literature alludes to the fact that the impact or relationship is actually seen indirectly through business, industry, wages, employment or monetary policy. I have not looked at these indirect effects.

- The study was performed using regression analysis on the dependent and independent variables. Various scholars have indicated that with this type of research, a good approach to use would be a cross correlation test rather than a regression analysis as the cross correlation test takes lags into account more efficiently.

Chapter 5: Results

5.1 Overview

The aim of the study was to investigate the relationship between the oil price (and the price of oil futures) on various macroeconomic indicators. This section presents the findings of my quantitative research and analysis conducted based on the above. Various statistics and graphs were produced to provide a greater insight into a possible relationship.

5.2 Analysis

All data was provided on a monthly basis since January 1997 to June 2012, with the exception of GDP data which was provided on a quarterly basis. The number of observations was 186 (n = 186) for the monthly data, and 62 (n = 62) for the quarterly data where appropriate (GDP).

A 95% confidence interval was used throughout the analysis and testing, unless specified otherwise.

The dependent variables used were as follows:

- ECPI Consumer price inflation (CPI)
- EPPI Producer price inflation (PPI)
- ALBI All Bond Index
- J203T Total return on the All Share Index
- SOL Sasol share price (ZAR)

- USDZAR US Dollar/ZAR exchange rate
- RPOR Prime interest rate
- GDP Gross domestic product of South Africa (indexed) (NGDP)
- BRFUT Price of Brent Crude oil futures
- CNYF Price of West Texas Instrument oil

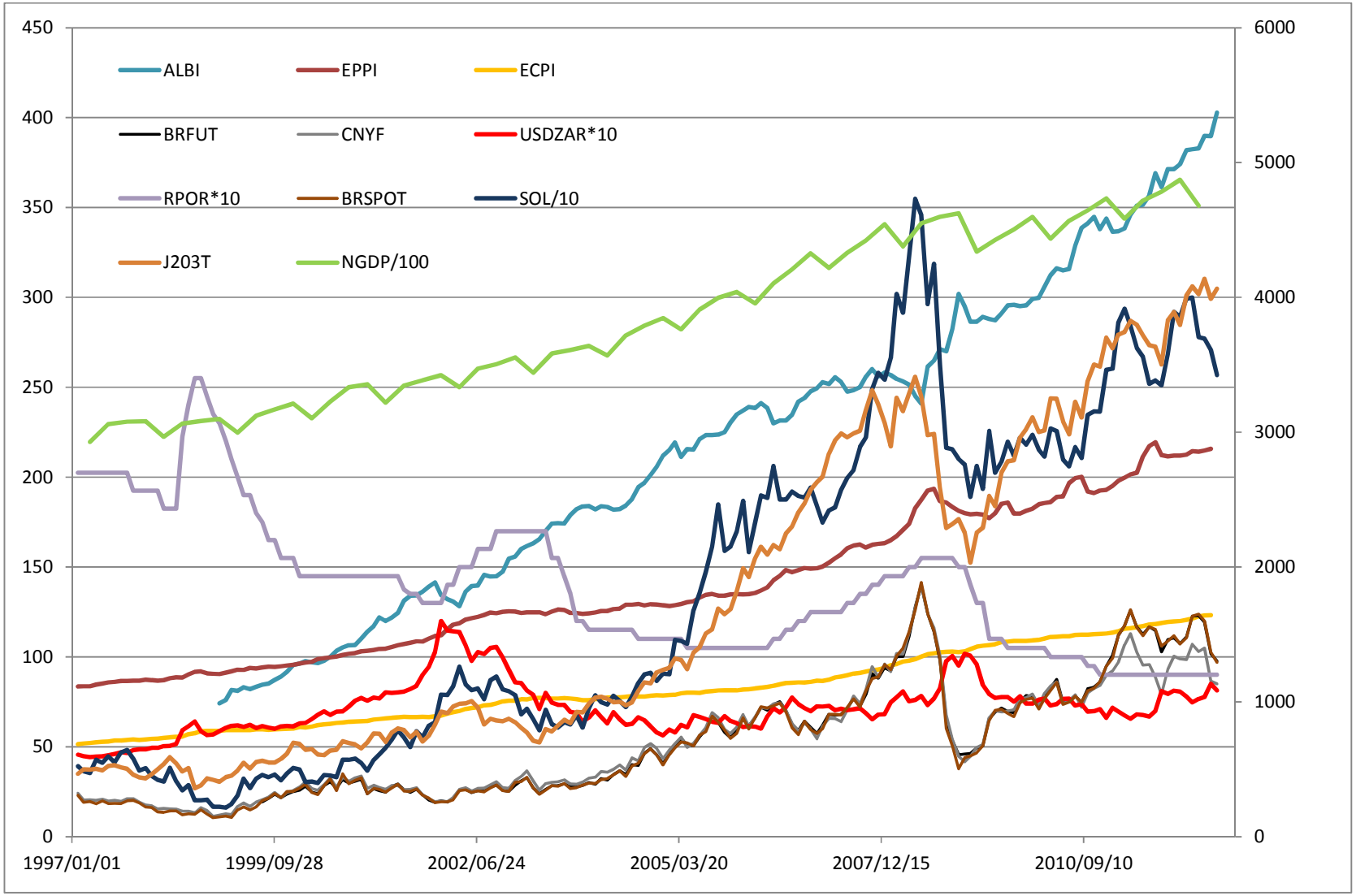
The independent variables used include the following:

- BRSPOT The spot price of Brent Crude oil
- BRFUT Price of Brent Crude oil futures

5.2 Univariate Analysis

Plots of the independent and dependent variables in the data set with respect to time are produced below (Graph 1) since inception of the data set:

Graph 1



Based on Graph 1, it is clear that the data series appear to be autocorrelated. “Autocorrelation refers to the correlation of a time series with its own past and future values” (GEOS, 2011, p. 1).” One would expect to see a large amount of autocorrelation present in this data set as the variables presented contain values which are very much based on, or associated with, the past values. For example, CPI figures which are used as a proxy for inflation will have autocorrelation due to the upward trend in this type of series.

At the outset, we can see that the large changes in all three of the oil price series appear to be mirrored by changes in the All Share Index (J203T), Producer price inflation (EPPI) and the Sasol share price (SOL). However, even though the graph above shows potential relationships between the different variables, further analysis will be carried out to determine if there is a statistically significant relationship between them.

As far as oil price shocks are concerned, an initial parameter of a 10% change was used to determine these shocks. However, such a low threshold in such a volatile series proved to show too many shocks for no good reason on a monthly data series. One cannot determine whether a change in the price is as a result of a shock or just a gradual increase/decrease in the price over a short period of time.

The Univariate statistics for the variables used in the models are given in the table below (Table 7). Significant values for skewness and kurtosis statistics at the 99% confidence level are marked in red.

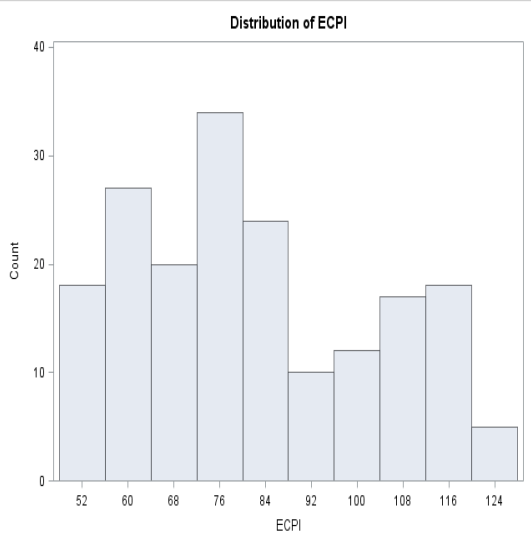
Table 7

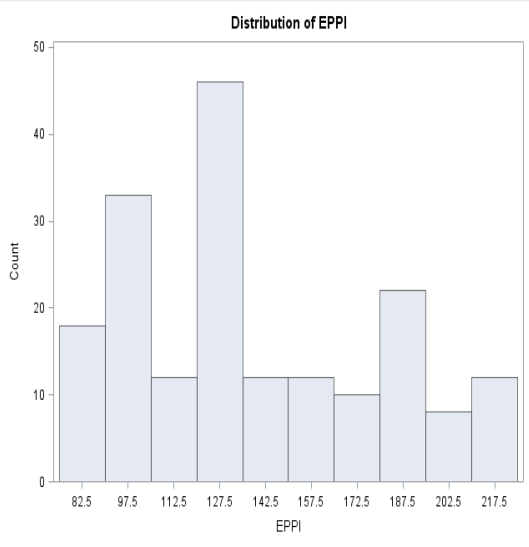
Variable	N	Mean	Median	Minimum	Maximum	Std Dev	Skewness	Kurtosis	z(skewness)	z(kurtosis)
BRSPOT	186	51.7	40.4	10.6	141.4	33.4	0.74	-0.58	4.09	-1.62
BRFUT	156	58.8	55.4	19.2	139.8	32.0	0.58	-0.78	2.93	-2.00
CNYF	186	51.3	43.6	11.3	140.0	30.3	0.61	-0.68	3.39	-1.88
ECPI	185	82.2	78.1	51.5	123.2	20.7	0.39	-1.03	2.16	-2.86
EPPI	185	138.4	128.8	83.5	219.4	40.0	0.41	-1.06	2.29	-2.95
ALBI	163	218.7	223.6	74.2	402.8	87.9	0.15	-0.97	0.78	-2.52
RPOR	186	13.88	13.50	9.00	25.50	3.85	0.84	0.23	4.65	0.65
J203T	186	1737	1141	360	4138	1193	0.52	-1.26	2.91	-3.52
SOL	186	17941	12050	2140	47300	12553	0.42	-1.24	2.32	-3.44
USDZAR	186	7.18	7.03	4.42	12.00	1.46	0.77	1.09	4.29	3.04
GDP	62	3.17	3.20	-6.30	7.40	2.43	-1.14	2.91	-3.68	4.67

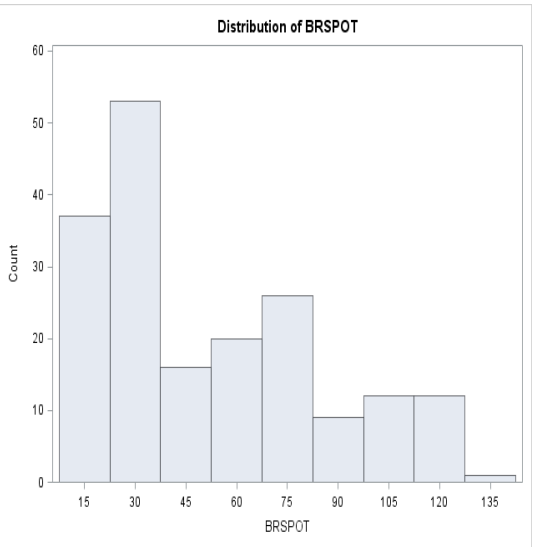
The above statistics indicate some interesting results. The average or mean price of Brent Crude oil is $51.70 which is about half of what the current price is in August 2012, similarly for Brent futures and West Texas Instrument oil. The mean interest rate of this period was 13.88% which is significantly higher than the current rate of 8.5% in August 2012. The average USD/ZAR exchange rate is about R1 below current levels (August 2012), and the average price of Sasol shares are about half current spot prices.

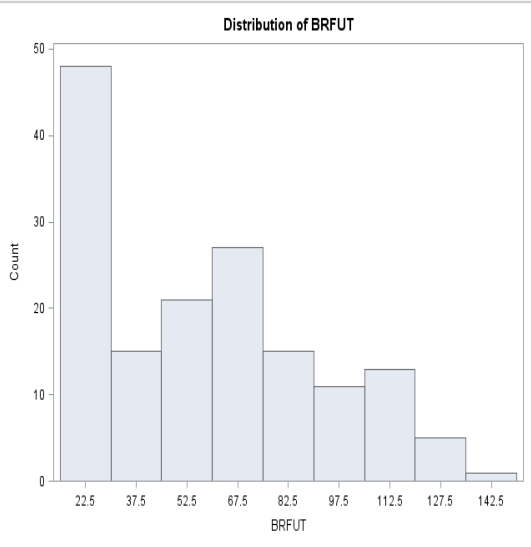
5.3 Frequency Distribution

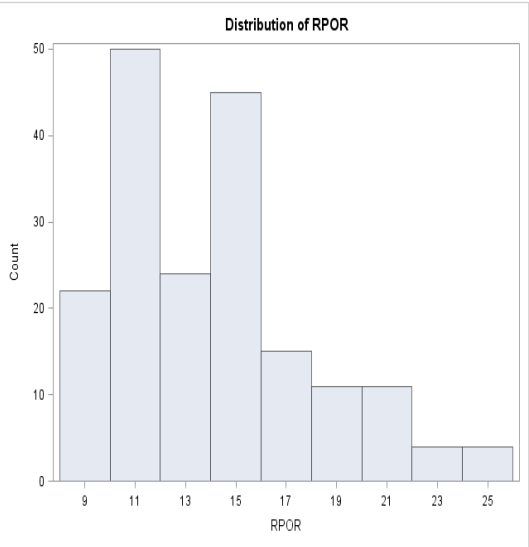
After looking at the univariate analysis, I carried out an analysis of frequency distributions on all the variables. Frequency distributions take large data sets and compress them by grouping the data into classes depending on how many of those points fall within a particular class. These distributions are very helpful to allow readers to easily understand what the commonality amongst values in a data set is. Often, frequency distributions are displayed using graphs and tables which summarise data sets. Frequency distribution graphs for my data set are displayed below:

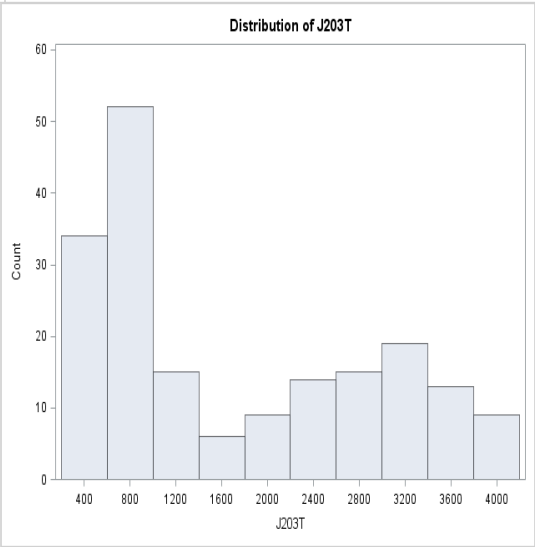


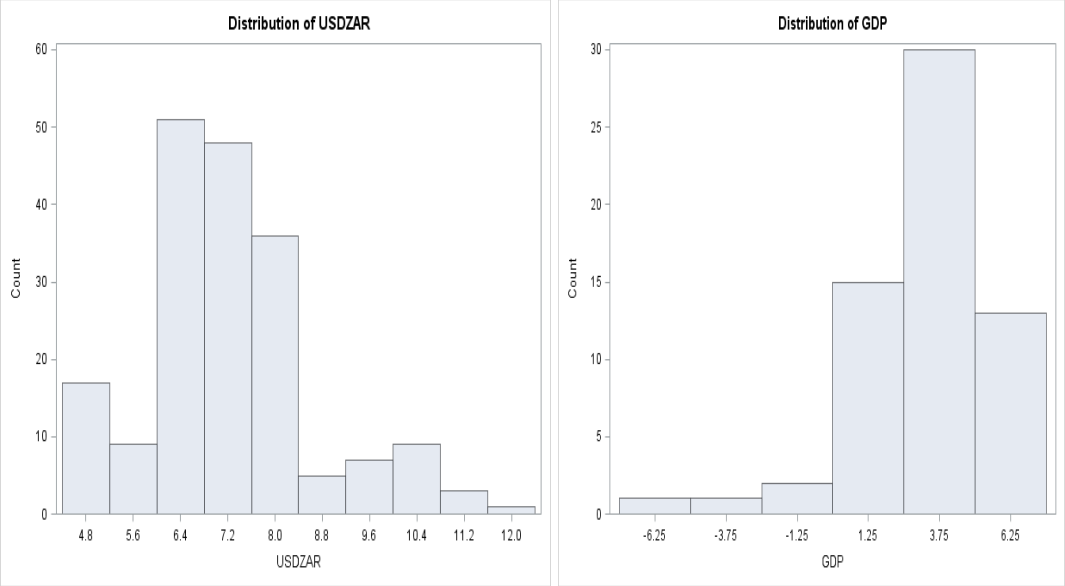












The frequency distribution of all three oil series (BRSPOT, BRFUT and CNYF), as well as the prime interest rates (RPOR), All Share Index (J203T) and USDZAR series were positive skewed. The data from the CPI (ECPI), PPI (EPPI), ALSI (J203T) and Sasol (SOL) series all exhibited platykurtic or very flat frequency distributions with many observations at the extremes of the range covered by the data. Platykurtic refers to those distributions that are a lot flatter than the 'normal' bell shaped curve. The USD/ZAR series had a leptokurtic or peaked distribution, with leptokurtic indicating the opposite of platykurtic having much more peaked distributions. The GDP series appeared to be negatively skewed.

5.4 Autoregression

All variables within the data set were tested for autocorrelation by examining the plots of the autocorrelation function (ACF) and the partial autocorrelation function (PACF); and then by carrying out the auto correlation check for White Noise. The Augmented Dickey-

Fuller (ADF) (up to lag length 4) and Phillips-Perron (PP) (truncated at lag 5) unit root tests for stationarity were also carried out. The results are summarised in Table 8 below:

Table 8

Variable	ACF	PACF	White Noise Test	ADF Test	PP Test
BRSPOT	decays v. slowly	lag 1-3 significant	all significant	non-stationary	non-stationary
BRFUT	decays v. slowly	lags 1-2 significant	all significant	non-stationary	non-stationary
CNYF	decays v. slowly	lag 1-3 significant	all significant	non-stationary	non-stationary
ECPI	decays v. slowly	lag 1 significant	all significant	non-stationary	non-stationary
EPPI	decays v. slowly	lag 1 significant	all significant	non-stationary	non-stationary
ALBI	decays v. slowly	lag 1 significant	all significant	non-stationary	non-stationary
RPOR	decays v. slowly	lag 1-3 significant	all significant	non-stationary	non-stationary
J203T	decays v. slowly	lag 1 significant	all significant	non-stationary	non-stationary
SOL	decays v. slowly	lag 1 significant	all significant	non-stationary	non-stationary
USDZAR	decays v. slowly	lag 1 significant	all significant	non-stationary	non-stationary
GDP	decays rapidly	lag 1 significant	all significant	non-stationary	non-stationary

All the variables, as may be expected, were characterised by a slowly decaying ACF, indicating non-stationarity of the series. The PACF indicated a significant autocorrelation at lag 1 (and further lags for BRSPOT, BRFUT and RPOR). The White Noise check, as well as the ADF and PP unit root tests also indicated that the series were not stationary.

These results suggest, as is typical for economic data, that the regression models are likely to require autoregressive error correction.

5.5 Regression Analysis

Models of the following form were considered:

$DV_t = \alpha + \beta IV_{t-k} + \varepsilon$

Where

DV = dependent variable at time t

IV = independent variable at time t, lagged by k periods (months or quarters, depending on which dependent variable is used)

α = intercept

β = coefficient of independent variable

ε = error term

In addition, suitable autoregressive and/or moving average model terms were added to the model to ensure stationarity of the model residuals.

Prior to fitting the above model, the optimal lag for the IV was determined as follows: The IV was modelled with a univariate ARMA (Autoregressive moving average) model (in this case an AR(2) model was found to be suitable for the monthly data and an AR(3) model for the quarterly data). The same model was fitted to the DV to 'pre-whiten' both series before computing the cross-correlations up to 24 lags. The first significant cross-correlation was then used for the regression model. Where there was no significant cross-correlation, the regression was done with the IV at lag 0.

Next, the regression model was fitted without any autoregressive error correction using Ordinary Least Squares (OLS). The Durbin-Watson statistic for autocorrelation of the residuals was then examined to determine whether an autoregressive term should be added to the model. The model containing an autoregressive term was then fitted by Generalised Least Squares (GLS) using Maximum Likelihood (ML) estimation. For all models an autoregressive term of order 1 (AR(1)) was added, while for some models an AR(2) term was also required.

Once autocorrelation of the residuals had been addressed, the heteroscedasticity of the residuals was evaluated by means of the Q-test and the Lagrange multiplier test. Heteroscedasticity occurs when there are no constant error terms amongst the variances in an OLS regression (Long & Ervin, 1998). The OLS estimators will continue to remain unbiased; however they become unreliable and inefficient. In all cases, there was not sufficient evidence of heteroscedasticity at the $p<0.001$ level of confidence to warrant the inclusion of an ARCH or GARCH component in the model.

The corrected standard errors and p-values, based on the inclusion of the appropriate autoregressive terms in the model, are reported.

The constant term was significant for some models and not for others, however this was irrelevant for the analysis.

Before interpreting the results, it is important for one to understand the importance of the R squared (without autocorrelation) statistic presented above. The R squared function is a measure of fit and identifies to what extent the independent variable can explain the results of the dependent variables. The higher the R squared value, the better the fit values lie between 0 and 1.

The results of the regressions are summarised in the tables below. Significant model coefficients and p values are highlighted. The hypotheses that are to be tested are stated below Table 9, and tested in detail in Chapter 6.

Table 9

DV	Prewhitening AR(n)	Lag	α (intercept)			β (IV coefficient)			AR(1)			AR(2)			DW	R^2	
			Parameter estimate	SE	p-value	Parameter estimate	SE	p-value	Parameter estimate	SE	p-value	Parameter estimate	SE	p-value		without auto-correlation	Total
IV = BRSPOT																	
BRFUT	2	0	0.485	0.272	0.077	0.995	0.00407	**<0.0001**	-0.229	0.0789	0.0043	none			2.13	0.997	0.998
CNYF	2	0	4.38	1.83	**0.019**	0.900	0.0223	**<0.0001**	-0.718	0.0733	<0.0001	-0.174	0.0745	0.021	1.95	0.899	0.995
ECPI	2	0	86.8	34.3	**0.012**	0.000536	0.00490	0.92	-1.68	0.0644	<0.0001	0.676	0.0652	<0.0001	2.25	0.0001	0.999
ECPI	2	6	88.0	33.0	**0.0083**	0.00105	0.00510	0.84	-1.68	0.0649	<0.0001	0.679	0.0657	<0.0001	2.24	0.0002	0.999
ECPI	2	9	88.5	32.5	**0.0071**	0.000580	0.00520	0.91	-1.68	0.0652	<0.0001	0.680	0.0661	<0.0001	2.23	0.0001	0.999
EPPI	2	0	146	58.4	**0.013**	0.0374	0.0242	0.12	-1.40	0.0702	<0.0001	0.406	0.0710	<0.0001	1.86	0.013	0.998
ALBI	2	0	245	166	0.14	-0.139	0.0596	**0.021**	-1.00	0.00358	<0.0001	none			1.09	0.033	0.997
RPOR	2	0	14.3	2.70	**<0.0001**	-0.00244	0.00670	0.72	-1.34	0.0695	<0.0001	0.352	0.0698	<0.0001	2.00	0.0007	0.982
J203T	2	0	1682	1261	0.180	8.29	1.13	**<0.0001**	-0.998	0.00694	<0.0001	none			1.54	0.229	0.994
SOL	2	0	10086	5286	0.0580	156	17.2	**<0.0001**	-0.985	0.0127	<0.0001	none			2.25	0.309	0.988
USDZAR	2	0	7.91	1.19	**<0.0001**	-0.0188	0.00453	**<0.0001**	-0.982	0.0138	<0.0001	none			1.65	0.086	0.939
USDZAR	2	3	7.36	0.940	**<0.0001**	-0.00702	0.00483	**<0.0001**	-0.973	0.0165	<0.0001	none			1.57	0.012	0.930
GDP	3	0	1.30	1.10	0.25	0.0346	0.0146	**0.0213**	-0.735	0.0878	<0.0001	none			1.82	0.086	0.525

5.6 Hypothesis

Hypothesis 1: The null hypothesis was that there is no correlation between the USD/ZAR exchange rate and the price of oil. The alternative hypothesis was that there is a correlation between the USD/ZAR exchange rate and the price of oil.

Hypothesis 2: The null hypothesis was that there is no correlation between CPI and the price of oil. The alternative hypothesis was that there is a correlation between the CPI and the price of oil.

Hypothesis 3: The null hypothesis was that there is no correlation between GDP and the price of oil. The alternative hypothesis was that there is a correlation between the GDP of South Africa and the price of oil.

Hypothesis 4: The null hypothesis was that there is no correlation between interest rates and the price of oil. The alternative hypothesis was that there is a correlation between interest rates and the price of oil.

5.7 Results

The results for the regression analysis, with Brent Crude spot being the independent variable are as follows:

IV = BRSPOT

- DV = BRFUT, CNYF: The coefficients for BRSPOT (at lag 0) were significant and positive. BRSPOT explained in excess of 90% of the variation in BRFUT and CNYF (R^2 = 0.98 and 0.90 respectively). This is to be expected, since the three oil price series track each other very closely.

- DV = J203T, SOL: The coefficients for BRSPOT (at lag 0) were significant and positive. BRSPOT explained about 20 - 30% of the variation in J203T and SOL (R^2 = 0.22 and 0.31 respectively).

- DV = USDZAR: The coefficients for BRSPOT (at lag 0 (not significant) and at lag 3 (marginally significant)) were significant and negative. BRSPOT explained about 9% and 1% of the variation in USDZAR at lags 0 and 3 respectively (R^2 = 0.086 and 0.012 respectively).

- DV = ALBI: The coefficient for BRSPOT (at lag 0 – although no lags is significant in cross-correlation calculation) was significant and negative. BRSPOT explained about 3% of the variation in ALBI (R^2 = 0.033).

- DV = GDP: The coefficient for BRSPOT (at lag 0) was significant and positive. BRSPOT explained about 9% of the variation in GDP (R^2 = 0.08).

- DV = ECPI, EPPI, RPOR: The coefficients for BRSPOT (lag 0) were not significant, indicating that BRSPOT was not correlated significantly with any of these DV's.

The results for the regression analysis with Brent Crude Futures being the independent variable are as follows:

Table 10

DV	Prewhitening AR(n)	Lag	α (intercept)			β (IV coefficient)			AR(1)			AR(2)			DW	R^2	
			Parameter estimate	SE	p-value	Parameter estimate	SE	p-value	Parameter estimate	SE	p-value	Parameter estimate	SE	p-value		without auto-correlation	Total
IV = BRFUT																	
BRSPOT	2	0	-0.336	0.273	0.22	1.00	0.00400	<0.0001	-0.224	0.0788	0.0051	none			2.12	0.998	0.998
CNYF	2	0	-0.121	2.69	0.96	0.973	0.0237	<0.0001	-0.942	0.0294	<0.0001	none			1.84	0.917	0.996
ECPI	2	1	90.0	29.5	0.0027	0.0156	0.00554	0.0055	-1.68	0.070	<0.0001	0.684	0.0707	<0.0001	2.26	0.050	0.999
EPPI	2	2	150	50.8	0.0036	0.0620	0.0295	0.038	-1.39	0.079	<0.0001	0.386	0.0798	<0.0001	1.83	0.029	0.997
ALBI	2	2	257	160	0.11	-0.171	0.0687	0.014	-1.23	0.086	<0.0001	0.229	0.0874	0.0098	1.56	0.040	0.997
RPOR	2	6	11.3	2.38	<0.0001	0.0128	0.00525	0.016	-0.992	0.0115	<0.0001	none			1.57	0.039	0.976
J203T	2	0	1667	1138	0.15	10.0	1.23	<.0001	-0.997	0.00828	<0.0001	none			1.43	0.301	0.994
SOL	2	0	9672	4548	0.035	178	19.1	<.0001	-0.979	0.0160	<0.0001	none			2.17	0.363	0.959
USDZAR	2	0	8.65	0.769	<0.0001	-0.0203	0.00504	<.0001	-0.962	0.0216	<0.0001	none			1.75	0.096	0.911
NGDP	3	0	394599	60615	<0.0001	-4.98	122.2	0.97	-0.986	0.0257	<0.0001	none			1.75	0.0001	0.957

IV = BRFUT

- DV = BRSPOT, CNYF: The coefficients for BRFUT (at lag 0) were significant and positive. BRFUT explained in excess of 90% of the variation in BRSPOT and CNYF (R^2 = 0.998 and 0.92 respectively). This is to be expected, since the three oil price series track each other very closely.

- DV = J203T, SOL: The coefficients for BRFUT (at lag 0) were significant and positive. BRFUT explained about 30 - 36% of the variation in J203T and SOL (R^2 = 0.30 and 0.36 respectively).

- DV = USDZAR: The coefficient for BRFUT (at lag 0) was significant and negative. BRFUT explained about 10% of the variation in USDZAR (R^2 = 0.096).

- DV = ALBI: The coefficient for BRFUT (at lag 2: different to results for BRSPOT) was significant and negative. BRFUT explained about 4% of the variation in ALBI (R^2 = 0.040).

- DV = ECPI: The coefficient for BRFUT (at lag 1: different to results for BRSPOT) was significant (also different to result for BRSPOT) and positive. BRFUT explained about 5% of the variation in ECPI (R^2 = 0.050).

- DV = EPPI: The coefficient for BRFUT (at lag 2: different to results for BRSPOT) was significant (also different to result for BRSPOT) and positive. BRFUT explained about 3% of the variation in EPPI (R^2 = 0.029).

- DV = RPOR: The coefficient for BRFUT (at lag 6: different to results for BRSPOT) was significant (also different to result for BRSPOT) and positive. BRFUT explained about 4% of the variation in RPOR (R^2 = 0.039).

- DV = NGDP: The coefficient for BRFUT (lag 0, although no lags significant in the cross-correlation calculation) was not significant, indicating that BRFUT was not correlated significantly with NGDP.

Chapter 6: Discussion of results

6.1 Overview

A conclusion of the literature has been presented around my topic in Chapter 2, as well as an analysis of the data in Chapter 5. We can safely say that, based on the results in the previous chapter (5), there are few significantly strong relationships that really stand out between the independent and dependent variables, even after taking autocorrelation and heteroscedasticity into account.

6.2 Hypothesis

6.2.1 Exchange Rate

Hypothesis 1: The null hypothesis was that there is no correlation between the USD/ZAR exchange rate and the price of oil. The alternative hypothesis was that there is a correlation between the USD/ZAR exchange rate and price of oil.

Based on the results table presented in Chapter 5, the p-value is less than 0.0001 (even with a 3 month lag) which means that we may reject the null hypothesis and conclude that there is a correlation between exchange rates in SA and the spot price of oil at the 1%, 5% and 10% significance levels.

The research analysed in Chapter 2 makes mention of the relationship between USD/ZAR being negative against the price of oil. Our results agree with the literature, with the parameter estimate being negative but the BRSPOT only being able to explain between 1 - 9% of the variation in USD/ZAR via the R squared value. As the price of oil increases, fewer USD are required to purchase the oil and therefore the USD weakens against the Rand. When the Rand becomes stronger, we see the USD/ZAR value decrease which tells us that there is a negative correlation between the spot price of oil and the USD/ZAR exchange rate.

An increase in the price of oil by $10 leads to an R 0.188 decrease in the USD/ZAR exchange rate. That figure may not look very big from the outset, but if oil prices continue to increase steadily for a long period of time, we could see a devaluation of the Rand.

The aforementioned relationship is in line with the findings of Grisse (2010) and Golub (1983) who carried out similar analysis using a structural VAR analysis. Both found there to be a negative relationship between oil prices and the strength of the USD (Grisse, 2010; Golub, 1983). Although these studies were done by looking at major currencies against the USD, the Rand has also proven to have a similar relationship when it strengthens against the USD as oil prices increase.

This study did not look at the impact in the short and long term; however Basher et al. (2010) also found a negative correlation between oil prices and the strength of the USD between the years 1988 and 2008 using a vector autoregression. As the price of oil increases, the US trade deficit increases and the USD weakens. According to Feldstein (2008), these are the steps of how the USD is actually weakened when oil prices rise.

Based on the above discussions, it is evident and clear that the relationship between oil prices and the USD are negative, even when looked at with the USD against the Rand. The Rand strengthens against the USD as the price of oil increases, and even though there may not be large increases, the movements are more than significant in foreign exchange terms.

6.2.2 CPI (Inflation)

Hypothesis 2: The null hypothesis was that there is no correlation between CPI and the price of oil. The alternative hypothesis was that there is a correlation between the CPI and price of oil.

Based on the results table presented in Chapter 5, the p-value is 0.84 (lag of 6 months) and 0.91 (lag of 9 months), which means that we may not reject the null hypothesis and conclude that there is a no correlation between CPI (inflation) in SA and the spot price of oil at the 1%, 5% and 10% significance levels.

There is no clear cut or direct relationship between higher oil prices and inflation in South Africa. The South African Reserve Bank indicates that they employ inflation targeting tactics which look to place inflation within the 3 - 6% target range. Even though there is no evidence of a strong relationship between CPI and the price of oil, the actual effects of inflation is perhaps seen via industry through the increase in petrol prices. A future study that looks at the relationship between inflation and petrol prices could provide some interesting results.

Yucel (2005) has potentially provided us with a better understanding of the relationship between these two variables through research that suggests that emerging markets inflation rates are decreasing due to better and more efficient economic policies. However, some economists believe that with the increase in 'financialisation' and 'industrialisation' of emerging market economies, we should see an increase in inflation levels. As a measure of complimentary analyses, we find that the EPPI figures had the same/similar results as ECPI.

In a study of six Asian countries by Cunado and de Garcia (2004) during 1975 and 2002, there was a positive correlation between oil price increases and inflation rates. This was contrary to what our findings were due to the Asian economies being much larger with a far greater buying power, and growth rates exceeding that of South Africa. The above relationship was also witnessed by Trung and Vinh (2011).

Chinn and LeBlanc (2004), in their study of the US market, found that as the price of oil increased by $10, the inflationary impact was between 0.1% and 0.8%. This was not seen for the SA market. The South African Reserve Bank has a policy of ensuring that the inflation levels in this country fall between the 3% – 6% target range. Based on the data analysed, we find no relationship between the price of oil and the level of inflation in the country, even after using a cross-correlation graph. Reicher and Utlaut (2010) mention that the inflation increases are not as a direct result of oil price increases, but rather an effect of the monetary policy execution that is seen when oil prices are increasing. Due to this, there are two areas for potential investigation: the lag effects, and the secondary or indirect effects of oil prices on inflation.

When using the price of oil futures as the independent variable, what we see is a rejection of the null hypothesis and a correlation between CPI and the price of futures at the 1%, 5%, and 10% significance levels (Refer to Table 10). This is interesting and perhaps points to the idea that inflation is priced into the future price of oil. Consumer

Price Inflation figures are usually calculated with a lag in SA and it seems that the oil price futures capture the effect of inflation (via CPI) to a much greater degree than the spot price of oil. We also find that the increased oil prices which lead to increased petrol prices are usually lagged and this too could be an important determinant of oil price futures. The value of EPPI also changes when compared to the price of oil futures. We now reject the null hypothesis and can say with confidence that there is a correlation at the 5% and 10% significance levels.

6.2.3 GDP

Hypothesis 3: The null hypothesis was that there is no correlation between GDP and the price of oil. The alternative hypothesis was that there is a correlation between the GDP of South Africa and the price of oil.

Based on the results table presented in Chapter 5, the p-value is 0.0213, which means that we may reject the null hypothesis and conclude that there is a correlation between the GDP in SA and the spot price of oil at the 5% and 10% significance levels.

There is a relationship between GDP growth and the price of oil. Despite literature stating that we should see a decrease in GDP after increases in oil prices (Rotemberg & Woodford, 1996), this is not evident in the data and results presented to us. South Africa is a net importer of oil, with the majority of imports being used for transportation. Imports of oil only make up about 6% of the total GDP spend and as a result the impact and effects on GDP may not be as large as expected. The parameter estimates are positive for GDP which indicate a positive relationship with oil prices. A $10 increase in the price of oil, will lead to a 0.3% increase in annual GDP growth.

Other emerging markets are using oil as a source of energy as well as for logistical purposes and are therefore importing a lot more oil which could affect the GDP of the country. South Africa relies on coal as a major source of input into the production of electricity and has abundant amounts of coal available. Hamilton and Herrera (2004) and Rotemberg and Woodford (1996) both made mention that there was a negative correlation between GDP and oil prices in their literature which does not show in our

results. This could be due to the fact that previous studies have been on either oil exporting countries, or major importers like the USA and Europe.

Abeysinghe (2001), Maghyereh (2004), Jones et al. (2003) and Hamilton (2005) all confirmed via regression analysis that there was an inverse relationship between oil prices and GDP growth (mainly in the USA). Gurses (2009) believes that the higher oil prices allow companies to make higher profits which are used to build economies.

Nkomo (2009) seemed to be the only person in SA who studied the impact of oil prices on GDP. He looked at oil shocks rather than a movement in oil prices and found that oil prices are negatively correlated with GDP in SA. He mentions that a $10 increase in the price of oil due to shocks would result in a 0.8% decrease in GDP. The regression analysis over the last 15 years does not indicate such relationship, and in fact shows a positive relationship.

It should be noted that the prices of oil are in nominal terms. This could potentially have an impact on the results. However, despite all the literature around GDP and its correlation with oil prices being negative, based on our research we can safely say that there seems to be a positive relationship with GDP growth rates in SA and the price of Brent Crude oil spot.

6.2.4 Interest Rates

Hypothesis 4: The null hypothesis was that there is no correlation between interest rates and the price of oil. The alternative hypothesis was that there is a correlation between interest rates and the price of oil.

Based on the results table presented in Chapter 5, the p-value is 0.72 which means that we may not reject the null hypothesis and conclude that there is no correlation between interest rates in SA and the spot price of oil at the 1%, 5% and 10% significance levels.

The results presented above are inconsistent with Reichter (2010) and Wu (2010) who both found a correlation between oil prices and interest rates. Both studies looked at the US market and failed to capture the impact of emerging markets. This could be due to

the fact that interest rates in SA are decisions made as a result of monetary policy, inflation targeting and the condition or strength of the current and capital accounts. The impact of oil prices on interest rates are therefore seen indirectly.

There is also evidence of no such relationship between higher oil prices and a lower interest rate as mentioned by Frankel (2006) and Akram (2009). However, what is interesting is that at the 5% and 10% significance levels, there is a negative relationship between oil prices and the All Bond Total Return Index. This could be explained by the fact that when oil prices are rising, people invest more money into commodity stocks or physical delivery of commodities like oil in order to make profits, and as a result the bond markets weaken.

When we run the price of oil futures as the independent variable (Refer to Table 10), it seems to explain a large component of the results for the interest rates, as well as the All Bond Total Return Index. Similar results were seen for the CPI above. This is interesting as it tells us that the oil futures market is a good indicator of interest and bond rates in SA as they are both forward looking. People are pricing the impact of interest rates and bond yields into the futures prices of oil rather than the spot price of oil. At the 5% and 10% significance levels we find that there is a relationship between oil price futures and the All Bond Total Return Index as well as the spot interest rates in SA.

6.2.5 Other Variables

When carrying out my quantitative analysis, I decided to have a look at some additional variables impact on oil prices and oil price futures to get an indication of what other variables impact the oil price, and where potential future research could be focussed. Interesting results were seen when the independent variable was the spot price of oil in that there was no significant relationship with the interest rates in SA. However, there was a correlation with spot prices of oil and the price of Sasol shares, which explained some 31%, as well as with the price of West Texas Oil, the All Bond Index and the All Share Index.

The All Share Total Return Index actually increases by 8.29 points for every $1 increase in the price of oil. If one had to look from the outset, we would have expect that there would be a relationship between the All Share Index and the price of oil considering that there is a relationship with the GDP of SA. We have often seen people use the stock market as a proxy for GDP which does provide some authenticity. Similarly, we found that there was a significant correlation with the price of oil and the Share price of Sasol. The price of Sasol shares increased by R1.56 when the price of oil spot increased by $1. This is as a direct result of Sasol being the only listed oil producing, manufacturing and refining company in SA, and when the oil price increases, Sasol benefits to some extent from this.

When we took oil price futures as the independent variable, all dependent variables were shown to be significant at some level besides GDP, which seems to have no impact or correlation with the price of oil. Interesting to see is that the oil price futures have a much larger and stronger correlation with the variables than the price of oil spot. The price of oil futures is dependent to an extent on the current spot price of oil and the expectations about oil prices in the future. Depending on what people expect the price of oil to do in the future, they will either buy or sell futures. As a result of the aforementioned relationship, we can say with certainty that there is a direct correlation and relationship between the spot price of oil and the price of oil futures.

An analysis was also carried out using the West Texas Instrument oil spot prices, to see whether there were any significant results that could be different to what was seen with the Brent Crude oil. The results of the West Texas oil are displayed below in Table 11.

Table 11

DV	Prewhitening AR(n)	Lag	α (intercept)			β (IV coefficient)			AR(1)			AR(2)			DW	R^2	
			Parameter estimate	SE	p-value	Parameter estimate	SE	p-value	Parameter estimate	SE	p-value	Parameter estimate	SE	p-value		without auto-correlation	Total
IV = CNYF																	
BRSPOT	2	0	2.77	2.74	0.31	0.966	0.0282	**<0.0001**	-0.932	0.0289	<0.0001	none			2.29	0.865	0.995
BRFUT	2	0	6.91	4.11	0.095	0.913	0.0236	**<0.0001**	-1.14	0.0818	<0.0001	0.177	0.0832	0.035	1.95	0.908	0.997
ECPI	2	0	86.8	34.3	**0.012**	0.000599	0.00494	0.90	-1.68	0.0643	<0.0001	0.676	0.0652	<0.0001	2.25	0.0001	0.999
EPPI	2	0	147.4	58.8	**0.013**	0.0228	0.0245	0.35	-1.42	0.0695	<0.0001	0.418	0.0703	<0.0001	1.88	0.0048	0.998
ALBI	2	0	244	164	0.14	-0.118	0.0615	0.056	-1.00	0.00362	<0.0001	none			1.10	0.023	0.997
RPOR	2	0	14.3	2.72	**<0.0001**	-0.00204	0.00678	0.76	-1.34	0.0695	<0.0001	0.352	0.0698	<0.0001	2.00	0.0005	0.982
J203T	2	0	1652	1295	0.20	9.88	1.09	**<0.0001**	-0.998	0.00675	<0.0001	none			1.48	0.309	0.995
SOL	2	0	9546	6488	0.14	180	14.8	**<0.0001**	-0.711	0.0727	<0.0001	-0.280	0.0732	0.0002	1.76	0.450	0.990
USDZAR	2	0	7.98	1.17	**<0.0001**	-0.0204	0.00463	**<0.0001**	-0.981	0.0137	<0.0001	none			1.63	0.097	0.939
USDZAR	2	5	6.16	0.736	**<0.0001**	0.0168	0.00491	**0.0008**	-0.965	0.0186	<0.0001	none			1.77	0.062	0.930
NGDP	3	0	380313	70823	**<0.0001**	15.0	115	0.90	-0.990	0.0202	<0.0001	none			1.81	0.0003	0.968

Based on the above table (used for comparative purposes only), we see that the results using of the price of WTI as the independent variable produces almost the same results as BRSPOT and BRFUT. What is interesting to see is that the price of WTI is explained more or less by 99% in the price of BRSPOT and BRFUT, yet the parameter estimates are slightly less than when BRSPOT or BRFUT is the independent variable.

Chapter 7: Conclusion

7.1 Introduction

The results produced through this study were, in some cases, expected; however others may be surprising or inconclusive and could require further investigation. Despite what the literature said or what people believe to be true, the evidence in some cases showed otherwise.

It is evident based on the literature around the oil industry that politics has a very significant role to play in the price of oil and its impact on economies. Various studies show that it is not supply and demand but rather politics that drive the price of oil around the world, especially those countries that are representing OPEC.

7.2 Review of research background and objectives

This study was aimed at identifying whether there was an impact of rising oil prices on the South African economy. Various studies have been done looking at the impact of rising oil prices on macroeconomic indicators around the world, however little or no literature seems to exist looking at the South African market in particular.

The study focused on addressing the following objectives:

- Identify the relationship between oil prices and foreign exchange rates, with particular emphasis on the USD (against the Rand) being the purchasing currency.
- Aim to identify the inflationary effects that arise as a result of the fluctuating oil prices in South Africa via the Consumer Price Inflation (CPI) index.
- Identify the relationship between oil prices and the Gross Domestic Product (GDP) of SA
- Identify the relationship between oil prices and the interest rate in South Africa.

7.3 Research findings

The results were able to show the impact of rising oil prices on all four macroeconomic variables in South Africa: USD/ZAR, Inflation, GDP and interest rates. This research was carried out using time series data and using a regression analysis to identify if a significant relationship exists.

The results indicated that there was a negative correlation between the oil price and the USD/ZAR exchange rate in SA at the 1%, 5% and 10% significance levels. As the price of oil increased, the USD/ZAR exchange rate weakened, indicating that the USD became weaker against the Rand.

The results indicated that there was no significant relationship between the oil price and inflation in South Africa. However further analysis indicated that there was a correlation between the price of Brent Crude oil futures and the inflation rates in SA.

The results indicated that there was a positive correlation between the price of oil and the GDP in SA at the 5% and 10% significance levels. This was contrary to what a lot of the literature stated and proved that when oil prices increase we should see a rise in the GDP levels in SA.

The results indicated that there was no relationship between oil prices and interest rates in SA. However, further complimentary analysis showed that there was a relationship between oil price futures and interest rates; as well as oil price futures and the All Bond Index.

As a means of comparison, the price of Brent Crude oil futures was used as a independent variable to identify if it could explain any relationships which may not have been explained via the spot price of oil. Interesting to note was that those variables that did not have a correlation with spot oil prices had a strong correlation with oil price futures. This means that the price of oil futures is a good indicator of some macroeconomic relationships.

7.4 Recommendations for future research

After having completed this thesis, it is clear that there are gaps that require future research. If there is someone who has an interest in the oil field like I do, a suggestion is that they look at the following studies for the future:

- The role that politics has to play on the price of oil via a study of political events over time against the price of oil. One would find very useful and interesting results from this study as it is widely believed that politics drives the price of oil, and not market factors. If we look at the degree in variation explained by oil prices, it is not as large as we may have expected. The cause may be more due to the role of politics than supply and demand.

- An analysis of how the price of oil affects the price of petrol, and as a result, the impact on economic indicators through the rising petrol prices.

- A study to determine the impact of rising oil prices through expert interviews as well as a case for unregulated oil prices

- A study of the relationship between the stock market index and the macroeconomic variables used in this thesis. Despite there being large amounts of literature available on this topic internationally, there is limited research available locally, especially within emerging markets. There is also much research from a practical viewpoint arising out analysts' reports; however there is a lack of sound academic literature.

It is mentioned in the introduction that there is an effect that higher oil prices have on cost of goods, savings and employment. As the price of oil increases, the price of petrol increases as well. When the price of petrol increases, the cost of transport and logistics will rise as well. This in turn affects the cost of goods sold and products become more expensive to purchase. This is where it stops from a costing perspective. However, as the cost of petrol increases, people tend to save less money as they have less disposable income which in turn leads to a decrease in spending on luxuries. When people decrease spending, jobs are affected and unemployment becomes more prevalent.

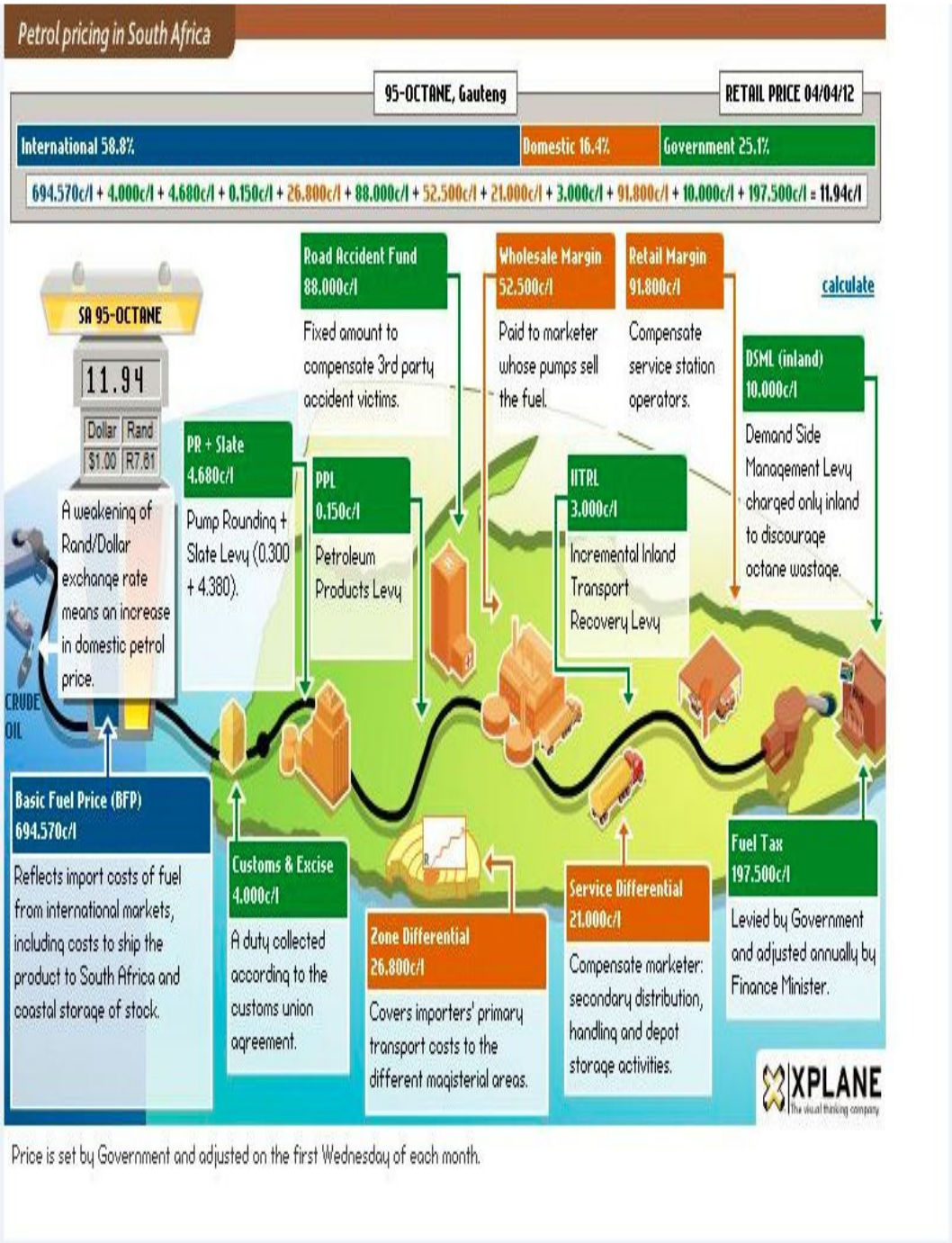
An interesting study for the future would be to look at the extent that higher petrol prices (via oil prices) would have on the savings and unemployment rates in SA. Once we gain an understanding of the potential impact, as a country we can look to see what can be done to improve the situation through hedging strategies and employment programmes.

7.5 The way forward

If we look at the spending and usage of oil in SA, it is mainly used in the transport and logistics industry. Given that oil has an impact on some macroeconomic variables in SA, we can say with certainty that the way in which it impacts our economy is via the petrol price given that the petrol price moves more or less in line with the oil price. As a country, we have to find a way to combat and overcome this problem of the fluctuating oil price and its potential harm on the economy. In order to combat the problem of higher oil prices and its impact on the SA economy, we have presented a few potential solutions:

- South Africa should increase the usage of the Gautrain as a means of transportation; make it more affordable by getting the government to subsidise a portion of it and in so doing, try to make South Africa's public transport infrastructure like that of a developed economy. It is not impossible; it can be done with the correct management, strategic thinking and collaboration between the public and private sectors. Creating this infrastructure will eliminate our reliance on oil as well as decrease the green house and emissions effect that driving on the roads has. Another potential benefit will be via lower numbers of traffic disasters and accidents (potentially).
- Develop more cars that run off electric motors that can provide the full range of features and benefits that current petrol cars have, at an affordable price. This will have similar effects as the aforementioned benefits.

Appendix A



Appendix B

FOB Price	Equal to 50% of the Singapore spot price and 50% of the Mediterranean spot price
Freight Costs	Costs are calculated using the average freight rate assessment of the London Tanker Brokers Panel
Insurance	Insurance is calculated at 0.15% of the FOB + Freight costs
Ocean Loss Allowance	A 'normal' loss to the buyer of 0.3% of the FOB + Insurance + Freight cost
Cargo Dues	Cargo tariffs are paid according to the product
Coastal Storage	Costs of handling and facilities at terminals
Stock Financing Costs	Finance charge of 25 days stock at a rate prime less 2% from Standard Bank SA
Transport and Delivery Costs	Cost of getting the product to the various depots based on a zoning system, as well as to the end user at the station
Wholesale Margin	A mark-up paid to the oil company for marketing and branding, set by government and equal to 15% of depreciated book value of assets.
Retail Margin	Fixed by the government and regulator based on the costs involved in distribution petrol
Fuel, Customs and Excise tax	All indirect taxed paid to the government
Road Accident Fund	A fixed value used to provide funding for any injuries through accidents

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