MANAGING PRICE RISK USING FUTURES: CASE OF OIL COMPANIES IN KENYA

BY:

NZUKI VUNGA GIDEON

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DECLARATION

This research project is my original work and has not been presented in any other university for academic or any other purpose.

Signature ______________________ Date 12th March 2009.

GIDEON VUNGA NZUKI

D53/13213/05

This project report has been submitted to the school of business with my approval as supervisor.

Signature ______________________ Date 8-04-09.

Ms. FARIDA ABDUL

Department of Accounting and Finance

This project report has been submitted to the school of business with my approval has Chairman Department of Accounting and Finance

KENYATTA UNIVERSITY DEPARTMENT OF ACCOUNTING AND FINANCE P.O. BOX 43844 - 00100, NAIROBI 14 APR 2009

Signature ______________________ Date 14-4-09.

MR. James Muturi

Chairman, Department of Accounting and Finance

ABSTRACT

Disruptions and supply insecurity in the world oil markets as a result of growth in demand, shrinking buffers, speculation and underinvestment in exploration and refining have important implications in the use of financial tools in the management of oil price risk in Kenya. The study surveyed the use of futures contracts as means to mitigate price volatility by oil companies registered in Kenya. Daily data on the WTI crude oil futures and spot prices were used to work out the hedge ratios and the measures of hedging effectiveness resulting from using the six-month contract for the period 1997-2006. The study also sought to establish the derivatives used by Kenyan registered oil companies and the extent to which the oil companies in Kenya apply Futures to hedge price volatility and the ratio they hedge when they use the futures as a return balancing portfolio.

Exploratory survey design involving both descriptive qualitative and quantitative analysis was adopted in conducting the study. The target population for this study was all the 364 registered oil companies in Kenya. A representative sample of 36 cases was selected using systematic sampling method. Semi-structured questionnaires were utilized to collect primary data while secondary data was sourced from the U.S. official energy website. The descriptive and OLS methods were used to analyses the data. Statistical data analysis was done using excel, SPSS and STATA.

The results show that oil companies in Kenya seem to give due consideration to crude oil price volatility and as a consequence, they use a hybrid of derivatives, mainly futures market and forward contracts. Further, oil spot and futures prices don't seem to vary significantly as the two prices move together. The results also indicate that majority of the oil companies in Kenya hedge about thirty one to sixty percent of their oil volumes using futures market and this compares unfavorably to the optimal hedge ratio of 93%. The results imply that oil companies in Kenya are currently under-hedging their futures markets and are therefore exposed to high price risks resulting from the underlying price volatility. The companies are therefore recommended to scale up the value of the hedged oil volumes in line with optimal hedge ratio. Majority of the oil companies indicated that

their use of futures contracts impacted positively on their profit margins. However, the oil firms indicated that they usually review their petrol pump prices whenever international crude oil prices go up. This implies that that even as the oil companies sustain their earnings as a result of hedging, they continue to pass the prices hikes to their customers.

The findings of this study suggest that in terms of risk reduction, the MV method is an appropriate method for estimating optimal hedge ratio. The empirical results in this paper reveal that NYMEX crude oil futures contract is an effective tool for hedging risk. In conclusion, under the assumption that the hedger's objective is to minimize risk regardless of the risk-reduction trade off, that is the hedger is highly risk-averse, an OHR of 93% for Oil is recommended. By applying the optimal hedge ratio, a company may reduce their risk exposure up to 81.03% compared to an unhedged position. This means that the optimal proportion of future contracts that oil companies in Kenya should hold to offset the spot prices position is 93%. This implies that futures contract deserves consideration as a possible hedging instrument for international oil market price risks by oil firms in the country.

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DEDICATION

Special dedication goes to my late mother Mrs. Monica Nduku for her love, moral and spiritual support.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller Test.
ANOVA	Analysis of Variance
ARCH	Autoregressive Conditional Heteroscedasticity.
CAPM	Capital Asset Pricing Model.
CSF	Critical Success Factors
F_c	F-Distribution Critical Value.
GARCH	Generalized Autoregression Conditional Heteroscedasticity
GQ	Goldfeld-Quandt test.
MV	Minimum Variance.
NYMEX	New York Mercantile Exchange.
OHR	Optimal Hedge ratio.
OLS	Ordinary Least Square.
SSE	Sum of Squared errors.
WTI	West Texas Intermediate

DEFINITIONS OF TERMS

Arbitrageurs- Investors (speculators) who earn guaranteed profits by buying from the cheap markets and selling in the expensive markets.

ARCH/ GARCH Models: an autoregressive conditional heteroscedasticity (ARCH, Engle (1982)) model considers the variance of the current error term to be a function of the variances of the previous time period's error terms. ARCH relates the error variance to the square of a previous period's error. It is employed commonly in modeling financial time series that exhibit time-varying volatility clustering, that is, periods of swings followed by periods of relative calm. If an ARMA model is assumed for the error variance, the model is a generalized autoregressive conditional heteroskedasticity (GARCH, Bollerslev (1986)) model.

Basis Risk- This is the current spot market price of commodity minus the price of the futures contract on that Commodity.

Backwardation-Refers to positive basis which occurs when the spot price is greater than the futures price

Black Shole – This is a derivative valuation model

Contango – used in the futures markets to describe an *upward* sloping forward curve. It is the situation where, and the amount by which, the price of a commodity for future delivery is higher than the spot, or a far future delivery price higher than a nearer future delivery. The opposite market condition to contango is known as backwardation.

Derivatives- financial instruments or arrangements that derive their value from some underlying stock, bond, commodity or other asset. Futures, swaps, forward contracts etc are the commonly used derivates.

Futures - This involves buying or selling in advance with an aim of locking in prices.

Hedging/Hedger- hedging entails the reduction of risk by taking an opposite position in the futures market from the traders spot market position a trader taking this position is known as the hedger.

Long Hedge- position taken by a trader who knows that he will buy an asset in future. he will buy futures contracts to lock in price in order to avoid loss if prices went up.

Optimal Hedge Ratio- This gives the amount of Futures contracts to buy/sell in relation To the Spot market.

Commodity Oil – crude oil is referred to as oil commodity in this study.

Oil Firms- The companies registered to deal in oil products.

Naive Hedge- This refers to a trader who hedges fully (100% hedge).

Price Risk- This refers to uncertain price volatility either upwards or downward.

Risk - Occurs when one cannot predict the future and that future is uncertain.

Short Hedge- This position taken by a trader who knows that he will sell an asset in future. The trader buys futures to lock in prices incase they come down.

Spot Price – Market prevailing price of a commodity.

Unhedged position- Open position taken by a trader.

CHAPTER ONE

1.0 INTRODUCTION AND BACKGROUND INFORMATION

1.1 Background of the Study

Price risk management is a crucial function in the overall success of many different types of business. The field of oil businesses is no exception. Firms trading in oil products, all realize that the market prices of the commodity they deal with in their businesses will fluctuate. The risk associated with this price volatility is one of the most obvious and well-studied aspects of price risk management (Hawes, 2003).

Surging oil commodity prices will be painful for companies that use oil in their production process or merchandise for trade. This occurs when the cost of raw materials rapidly increases and profit margins are narrowed. Increasing raw materials costs and decreasing profit margins may drive a company out of business (Haglund, 2005). This calls for companies to constantly monitor and review their price risk management strategies and hedge appropriately. For example the year 2006 was a difficult year for the petroleum sector as a result of soaring world crude oil prices especially in the first half, prices however stabilized in the second half of the year, resulting in decline in gross profits by Kshs 1.1 billion for Kenol/Kobil oil company, the market leaders in the petroleum sector in Kenya (Nairobi Analyst report, 2007).

Naturally, companies that are dependent on a number of commodities either as an input or trade merchandise are exposed to a number of risks when the commodity prices move in an undesired direction e.g. increased and unpredictable raw materials costs, reduced profit margins and falling share prices (Leuthold, 1990; Cameron, 2002; Hawes, 2003;Uptigrove, 2004). These substantial price fluctuations affects not only single companies but also industries and even countries, since some countries are heavily dependent on its commodity exports or imports (Satyanayan et al., 1994; Haglund, 2005).

The market price of commodity changes according to the demand and supply in the same way as prices of shares (Haglund, 2005). Commodities are traded in contracts and differ in amount and time from one commodity to another. The same is true for the futures contracts.

Futures contracts are firm commitments to make or accept delivery of a specified quantity and quality of a commodity during a specific month in the future at a price agreed upon at the time the commitment is made. The buyer, known as the long, agrees to take delivery of the underlying commodity. The seller known as the short agrees to make delivery. Only a small number of contracts traded each year results in delivery of the underlying commodity. Instead, traders generally offset (a buyer will liquidate by selling the contract, the seller will liquidate by buying back the contract) their futures positions before their contracts mature. The difference between the initial purchase or sale price and the price of the offsetting transaction represents the realized profits or loss.

The futures can be used both for speculation and hedging (Siegel, 1990). Hedging reduces exposure to price risk to those with opposite risk profiles or to investors (speculators) who are willing to accept the risk in exchange for profit opportunity.

To properly hedge, it is vital for a firm to determine the amount to hedge i.e. the optimal hedge ratio (Ederington, 1979; Baillie, 1991; Hawes, 2003; Haglund, 2005). In a study by Bystrom (2000) the hedging performance of electricity futures on the Nordic power exchange (Nord pool) were examined. Bystrom (2000) presents empirical results that indicated gains from hedging. Baillie (1991) conducted a study where six commodity contracts were examined over two futures contracts periods. The authors calculated the optimal hedge ratio in the six commodities. The results in this study indicated that different hedge ratios should be applied to different commodities.

Researchers have attempted to address the subject of price risk management and hedging in the past (Hawes, 2003). To be able to explain how hedging is actually performed we need to introduce a statistical term called variance, which is basically the difference between a set of data points around their mean value. The futures contract is purchased with the objective to minimize the variance between the futures and spot price (Haglund, 2005). When the future is minimizing the variance at the most, one is said to have an optimal hedge ratio (Siegel, 1990; Hawes, 2003)

The literature contains a significant number of hedging studies from the perspective of statistical mathematics that only show the optimal hedge ratio (i.e. The amount of futures to hold in respect to the spot position) but with very little application to business perspective (Haglund, 2005). The results from these studies can be used to research on how best one can apply OHR on a business perspective.

This study explored the extent to which oil companies in Kenya use oil futures to hedge against price volatility and find if whether the application of the optimal hedge ratio is likely to enhance companies' planned profit margins. The study also sought to determine methods used by oil companies in Kenya to mitigate oil price volatilities.

1.2 Statement of the Problem.

Firms dealing with oil commodity either as inputs for production or as merchandise for trade are vulnerable to price changes. The price changes can be expressed as volatility and higher volatility results in higher risk (Hawes, 2003). Hedging the commodity contracts with futures can offset this risk (Schneeweis, 2002). The amount of futures to buy or sell in relation to the spot position to be held, that is, optimal hedge ratio (OHR) is well documented but with very little business application (Haglund, 2005). The past studies have mainly focused on statistical mathematics. The main aim has been to show how many futures contracts should one purchase in relation to the spot position in order to maintain a required variation in expected returns.

Fuel price changes in Kenya have been unpredictable since the abolishment of price controls by the government. Any world price changes have been passed over to the consumers. In cases where the oil companies have made firm commitments with their corporate clients, and unplanned price change happens, the companies have been forced to contend with eroded profits This study aimed to investigate if oil companies could maintain their anticipated profit margins without passing on any unexpected price hikes to the fuel consumers using futures contracts normally traded in the main commodity exchanges in the world. The futures contracts in this study were assumed to be held for hedging purposes only and did not result into the actual delivery of the commodity.

1.3 Study Objectives

1.3.1 General Objective:

The objective of this study was to conduct an analysis of the variance in oil commodity contracts and provide evidence of the optimal hedge ratio. Also the study sought to establish whether companies hedging using futures can still maintain their profit margins without passing on the price hikes to the consumers.

1.3.2 Specific Objectives:

i. Identify methods oil companies in Kenya use to hedge price risk.
ii. Identify the variance in oil spot and futures prices.
iii. Establish the optimal hedge ratio to minimize the variance in oil commodity.
iv. Identify the risk reduction, when the optimal hedge ratio is applied in oil commodity
v. Find out if companies using oil futures to hedge price risk can maintain their profit margins incase world prices change unexpectedly without transferring to the consumers.

1.4 Research Questions.

i. Which methods do oil companies in Kenya use to hedge price risk?
ii. What is the variance in oil spot and futures prices?
iii. What is the optimal hedge ratio to minimize the variance in oil commodity?
iv. What is the risk reduction, when the optimal hedge ratio is applied in Oil commodity?
v. Can oil companies using Futures to hedge maintain their profit margins without passing prices hikes to the consumers?

1.5 Significance of the Study.

In particular, the following groups of interests are likely to derive benefits from the outcome of the study:

i. This optimal hedge ratio can be applied by companies dealing with oil commodities as inputs or merchandise for trade.

ii. Also policy makers in the government will use this study in advising business community involved in export or import of oil facing commodity risk exposure.

iii. The Nairobi stock exchange may use this research in trying to diversify from just dealing with stocks only, but also include commodity futures in the market. Academicians can use this study for further research.

iv. In general, while the focus of this study will zero in the oil companies, the benefits will not be limited to this sector only. Many of the price risk variables that must be considered for petroleum firms also affect companies in other sectors of the economy. Therefore, various firms with complex procurement and hedging needs can apply the results of this study to their own individual situation.

1.6 Scope of the Study.

This study was limited to the analysis of futures contracts in oil commodity, excluding forward and option contracts. The futures are the most common methods to hedge against commodity risk exposure on the different commodity exchanges (Schneeweis, 2002; Haglund, 2005). The size of this study can be too big if all the different derivative contracts were to be analyzed.

Risk management involves several perspectives; including, commodity price exposure, foreign exchange exposure, financial exposures and economic exposure. This study focused mainly on commodity price volatility risk. Therefore readers should keep in mind that this limitation results in an incomplete picture within risk management.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction to Literature Review

When the term, risk, is used in a statistical sense, it refers to any deviation from the expected value, whether positive or negative (Hawes, 2003). For this reason, risk is most commonly quantitatively measured in terms of standard deviation from the expected returns. Risk is an inherent reality for all businesses and individuals. As Jorison (2001) points out, the goal of these various entities is not the minimization of risk. Instead, the goal is to monitor and manage risk in order to achieve the best possible balance of risk versus expected returns. Risk comes in many different forms. Some risks must be assumed in order for a business to operate, and others can be diversified away (Hawes, 2003). The type of risk that is focused on in this proposal is price volatility. Firms that deal with oil commodity can be especially vulnerable to price risk. The constant changes in the prices of these commodities, whether inputs or merchandise for a specific firm, can have very significant effects on profitability. Therefore, risk management proves to be a critical function for these businesses.

Hedging instruments have evolved immensely from their relatively simple beginning but presently vary drastically in their complexity. Forwards, futures and options are the most common and traditional hedging tools. However, other tools have emerged e.g. swaps, and credit derivatives. It is important to note that the traditional futures and options are traded around the world electronically through the Internet (Hawes, 2003). This study opts to use futures contracts because they are essentially "costless" and they can be used to speculate on the future prices of a Commodity.

2.1.1 Futures Markets

Futures contracts are traded on exchanges and cannot be bought or sold over-the-counter (Hull, 2000). They are highly standardized agreements that specify exact quantity, quality, delivery periods, and delivery location for an asset (Hawes, 2003). By standardizing most of the factors that must be negotiated in forward contracts, the only aspect of the futures contracts to be negotiated is the price (Burns, 1979). This allows for very methodical purchases and sale agreements on exchange floors and eliminates the terms of forward contracts (Hawes, 2003; Hull, 2003). The futures markets offers investors a number of investment opportunities, from reducing or eliminating risk to speculating on price movements in the spot market or to diversify their portfolios (Haglund, 2005).

Futures have a number of useful applications. First, they can be used to hedge risk in the spot or cash market. By taking a position opposite to that held in the spot market, it is possible to reduce or even eliminate risk. Second, because futures are essentially costless, they can be used to speculate on the futures prices of a commodity (Haglund, 2005). Third, because the futures contract is based on delivery of some asset or Commodity in the spot market, there should be a relationship between the two prices .If these prices get out of line, an opportunity to arbitrage the difference between the two prices will exist. And finally, futures can be used to adjust the risk of a portfolio (Moy, 2000;Hull 2003).

2.1.2 Basis Risk

Basis is an important concept in understanding the pricing and risk of using futures contracts. Basis is the current spot market price of Commodity minus the price of the futures contract on that Commodity. The basis can be either positive or negative. When the basis is positive, price in spot market are higher than the futures prices, also called backwardation (Haglund, 2005). When the basis is negative, price in the cash market are lower than the futures prices, also called contango (Siegel , 1990).

During the life of futures contract, the basis will change. As the contract gets closer to expiration, the basis becomes smaller. At expiration, the basis of a contract will be zero because the futures price at expiration must equal the spot market price. Although the basis of a contract will equal zero at expiration, it can fluctuate during the life of the contract. The basis of a contract can widen or narrow. This type of risk is referred to as basis risk, which basically relates to the imperfect relationship between the future price and spot price at expiration. However, this is mostly an issue when cross hedging is used.

Cross hedging is a term to describe a hedge situation where an asset is hedged with the closest security that exists. Fortunately, there are futures contracts that exactly match most commodities today (oil inclusive), which means that the commodity that is supposed to be hedged has high correlation with the futures contract and practically no basis risk needs to be accounted for (Siegel, 1990; Moy, 2000; Hawes, 2003; Hull, 2003).

2.1.3 Futures Contract Pricing

The value of a futures contract is determined by the underlying commodity and the principle of arbitrage. Arbitrage occurs when it is possible for investor to earn guaranteed profit without using any of their money. This opportunity arises when the relationship between cash and futures prices gets out of line in principle, the cost of carrying the commodity. These costs include interest, storage, and insurance costs. When the price of the two markets gets out offline, arbitrageurs will drive the prices back to equilibrium state by purchasing in the market where the price is too low and simultaneously selling in the market where the price is too high (Moy, 2000;Hull, 2003;Haglund, 2005).

Four basis categories of futures contracts can be traded. The underlying asset or commodity can be a physical commodity, a foreign currency, an asset earning interest, or an index (Moy, 2000; Hull, 2003). This study will discuss futures contracts with an underlying physical commodity (oil).

2.2 Theoretical Framework

2.2.1 Hedging and Optimal Hedge Ratio

Hedging entails the reduction of risk by taking an opposite position in the futures market from the traders spot market position. There are different types of hedging strategies but all with the same intention, to reduce risk. Basically there are two ways to use futures contracts for hedging. A company that knows that it is due to sell an assets at a particular time in the future can hedge by taking a short futures position in order to protect against decline in commodity price. This is referred to as short hedge. If the price of the asset goes down, the company makes a loss on the sale of the asset but makes again on the short futures position (Haglund, 2005). If the price of the asset goes up, the company gains from the sale of the asset but takes a loss on the futures position. Similarly, a company that knows that it is due to buy an asset in the future can hedge by taking a long futures position, known as a long hedge. This is trying to protect against rising commodity prices. If the price of the asset rises, the futures position will profit and offset the company's loss due to higher costs (Siegel, 1990; Hull, 2003; Haglund, 2005).

The most common hedge does not make or take delivery, which means that the futures will not be executed. Instead, the seller (buyer) of the futures contract cancels his delivery commitment by buying (selling) a contract of the same futures prior to delivery. The purpose for a commodity contract that does not anticipate physical delivery can be speculation, arbitrage, or hedging price risk management (Ederington, 1979).

The hedge ratio is the ratio of the size of the position taken in futures contracts to the size of the exposure. Several types of hedge ratios can be produced depending on the type of risk that the hedger is concerned with. However, the following factors are usually important determinants of the position.

i) Size of the spot or cash market position.

ii) Size of the futures contracts.

iii) Sensitivity of spot price and futures price relative to some external factor.

The first two factors are quite obvious. The larger the size of the spot market position relative to the size of the futures contracts, the greater the number of contracts necessary to hedge the risk. The third factor adjusts the number of contracts for the different sensitivities of spot prices and futures prices. If the spot price changes 50% more when the futures price changes, the hedge ratio needs to be adjusted with that difference. More specifically, the hedge ratio needs to be 1:50,to reduce the risk. The hedger would thereby have to offset the risk with 1:50 futures contracts (Siegel, 1990; Hawes, 2003)

2.3 Empirical Literature

2.3.1 Optimal Hedge Ratio in Commodity Contracts

In this section, the study will present the academic research in the field of deriving an optimal hedge ratio in commodity contracts. The statistical model used in the different articles will be presented since this is vital for comparison to this study. In brief, the GARCH and the ordinary least square regression model are the two most common statistical methods used (Hawes, 2003; Haglund, 2005). More importantly, the implication of the hedge ratio for the oil commodity contracts for ten years will be presented and the reduction in risk that this implies.

Risk evaluation has long been a focus for all financial institutions. Such evaluation cannot be done without measuring the volatility for asset return. Engle (1982) developed enhanced methods for conducting these kinds of evaluation. He discovered that the concept of Autoregressive Conditional Heteroskedasticity (ARCH) accurately captures the properties of many time-series and developed methods for statistical modeling for time-varying volatility. Engle's model has become an important tool for both researchers and financial analysts (Haglund et al., 2005; Baillie, 1991; Bollerslev, 1986). Together with widely known CAPM and Black Sholes, ARCH and its variety models are today used on a frequent basis when pricing derivatives and handling financial risks (Ekonomipriset, 2003; Haglund, 2005; Hawes, 2003).

It is crucial to understand the distribution of commodity cash and futures markets, when constructing optimal hedging strategies on the commodity markets. Baillie (1991) presented a study, which investigated the distribution of commodity cash and futures prices of beef, coffee, corn, gold and soybeans. They applied the results to estimate the optimal futures hedge. An early study by Mandelbrot (1963) and Fama (1965) states that commodity prices changes appear to be non-normal distribution with volatile periods where variance changes over time (Haglund, 2005).

In the study by Baillie (1991), the authors used a Generalized Autoregressive conditional Heteroscedastic (GARCH) model, which was originally constructed by Engle (1982) and enhanced by Bollerslev (1986). The advantage of a GARCH model is that convenient assumptions about the conditional density of commodity price changes can lead to a robust model that allows for time-dependent variances (Haglund, 2005). The study concluded that the GARCH model was effective in describing the distribution of commodity cash and futures prices, and that it resulted in a natural description of time-varying optimal hedge ratios on commodity futures markets (Baillie, 1991; Haglund, 2005). However it important to note that long contracts where used, up to two years (1985-1987) and it seems reasonable that longer-term contracts also experience differences in variance, which would make a GARCH model suitable. Baillie (1991) also used an ordinary least square (OLS) A regression model (the OLS assumes a constant variance over time) when calculating the optimal hedge ratio (Haglund, 2005). The OLS optimal hedge ratio for the different commodities was the following: beef (7%), coffee (25%), corn (61%), cotton (38%), Gold (50%) and soybeans (76%). The optimal hedge ratio using GARCH framework was similar for all the commodities except for corn and cotton that experienced large volatility over time. Leuthold,(1990) also examined soybeans commodities with an optimal hedge ratio for all contracts around 90%.

In the study by Bystrom (2000) on electricity futures on Nord pool, the most interesting results where that the entire dynamic hedge ratios i.e. GARCH perform worse than the static ones (e.g. the OLS). There do not seem to be any major gains from modeling spot and futures returns on Nord pool with time-varying volatilities, which means that, although all models reduce the variance, the Naive and OLS perform better than the GARCH models on the unconditional variance. The findings that the Naive hedge performs equally well as (or even slightly better than) the OLS hedge was also found in the US stock index market by Park (1995), which is an example of how simpler models sometimes work better than more elaborate ones. Despite the weak performance by GARCH model on unconditional variance, the models perform well on the conditional variance. Although, there seems to be some gains from including heteroscedasticity and time-varying variances (GARCH) in the calculation of hedge ratios, the constant OLS hedge ratio is nearly as successful in reducing the portfolio variance on electricity contracts. The electricity markets is found to have higher volatility than traditional financial markets, which contributes to make hedging important, where the risk reduction is between 13%-18% compared to the unhedged position. Hence the authors conclude that companies can gain from hedging electricity futures.

This has also been seen in studies on other energy commodities where Yasdanfar (2003) provides empirical evidence that oil corporations engage in the futures markets with different types of hedging. In this study, this activity has significantly lowered the variability of their futures cash flows. Both the large and medium-size oil companies in this study normally hedge 50% of their exposure, where the large companies always have a futures position open. The companies all use selective hedging, where short-term contracts of one-month are the most common used contracts. Moreover, no single company in this study uses a full-hedged position (that is, the naive hedge). However, the portion to hedge increases during exceptionally uncertain situation, where the companies find it very difficult to predict the future prices. The international oil companies uses futures more extensively than the Swedish subsidiaries, which often is due to lack of information and knowledge present in smaller companies.

Myers (1991) has found by modeling wheat spot and futures prices that the GARCH model only performs magically better than a simple constant hedge ratio. Moreover, Myers (1991) states that using an OLS model may be sufficient in this case. Also, since the GARCH model only performs marginally better, and is much more complex to estimate, the author argues that the OLS model may be a sufficient method. The optimal hedge ratio for wheat in study by Myers (1991) with the OLS constant hedge ratio is 90% and the GARCH hedge ratio only deviates slightly around this ratio over time. The risk reduction for the OLS and the GARCH hedge is 45% for both models compared to the unhedged position, indicating that companies significantly can reduce their risk exposure to wheat.

Fackler (1991) supports this in their study. The study states that the relative complex nature of the GARCH framework makes it easier to implement an OLS, which generates result. In this study, live cattle and corn commodities are examined during the period 1976-1992 with a rollover procedure during these years. The constant (OLS) optimal hedge ratios are proven to be accepted over the time-varying optimal hedge ratio and are 91%for corn and 47% for live cattle, providing evidence that firms exposed to risk in theses commodities may reduce their risk significantly.

Satyanarayan et al., (1994) investigated the hedging performance of different cotton futures contracts calculating an ordinary least squares (OLS) on four different hedge ratios and compared the risk, return and risk reduction in the different cotton future. Satyanarayan et al., (1994) found that the risk can be reduced to 50% by employing cotton futures. The Naive (i.e. a fully hedged position) hedges also reduced the risk but some times it lead to significant risk increases instead of decreasing. The article concludes that developing countries that are highly depended on exporting different types of cotton significantly can reduce their risk exposure by employing cotton futures contracts on the New York commodity exchange.

Haglund, (2005) investigated the hedging performance in four commodities. In their study they examined the variance of spot and futures prices of copper, cotton, oil and gold and reached a conclusion of the optimal hedge ratio (OHR) and risk reduction in each respective commodity. Several statistical tests were calculated in order to examine the hedge ratio and risk reduction of a Naive (fully hedged), an ordinary least square regression (OLS) and a minimum variance model (MV). The results in this study established that companies dependent on copper, oil, cotton and gold could significantly reduce the risk by engaging in futures contract. The OHR for each commodity where; cotton 96%; copper 96%; gold 52%; and oil 88%. The study concluded that a company or country dealing in either of these commodities might reduce their risk exposure up to 90% compared to an unhedged position.

It is notable that local studies in the oil sector in Kenya have focused mainly on strategic management issues and not oil price risk management. Chepkwony (2001) who hold the view that the advent of liberalization in the petroleum sub sector has intensified to unprecedented influx of players into this sector. This has led to stiff competition, as the fight for customers seems to be a never-ending war. The major oil companies have lost a substantial part of their market share.

Mbugua (2005) focused on identification of perceived critical success factors in petroleum products retailing in Nairobi. The motivation of this was that there appeared to be an increasing proliferation of new petrol stations. Majority of the respondents implicated location of station in respect to type of road, demographics and business activity, use of effective financial controls and assessments of periodical returns, competitive product pricing and monitoring, manager's ability to perform across the perceived critical success factors, efficient and effective customer service, consistent product quality offering, maintenance of an efficient credit management policy and diversification of services as the main critical success factors. Enforcement of the government policy on fuel monopoly, management of fuelling equipments and pumps and maintenance of civil works are the major challenges facing independent petroleum products retailers' ability to address the critical success factors. On the other hand, dealers' ability to address the CSFs are constrained in product branding, service marketing, product pricing, and station location, as these remain prerogative decisions of the multinational oil companies.

2.4 General Statistical Tests

In this section, this study will discuss and present some general statistical tests that will be carried out on the data. The test evaluates if the data is stationary, normally distributed, auto-correlated and heteroscedasticy.

2.4.1 Test for Stationary Time Series

The usual properties in time series data are that observations follow a stationary stochastic process. A stochastic process is stationary if its mean and variance is constant over time, and the variance depends only on the lag and not on the actual times when the observations are made. Using non-stationary data in time series are called spurious and generates misleading results. If the data is non-stationary, the ordinary least square regression is not the most suitable model (Haglund.2005). Instead a more dynamic model GARCH model would be more suitable that takes in consideration the conditional (time varying) variance over time. According to Engles (1982), time-series data during longer time periods is often non-stationary since the volatility and variance are not constant. Hence, it is important to test if the data in a time-series is stationary (Griffiths, et al., 2001). The stationary of a time-series can be tested with a unit root test called Augmented Dickey-Fuller (ADF) test.

The ADF-test in equation 2.1 develops critical values to check for a unit root (a random walk process). This is important since financial time-series data often has a strong trend

$$Py_t = \alpha + .\beta y_{t-1} + \Sigma(\alpha .py_{t-1}) + \varepsilon \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2.1)$$

Where;

α is the population mean.

β is the simple regression slope.

Py_{t-1} is autocorrelation rags.

ε is the sampling error.

This value is compared to the *tau (t)* statistics and it must take a larger value in order to be a stationary process (Griffiths et al., 2001). In the study by Baillie (1991) on commodity contracts all time-series were non-stationary.

In the study by Bystrom (2000) the short-term electricity contracts with rollover procedure creating a four-year time-series, were found to be a non-stationary process. It makes sense that volatility and variance do not have a constant value during such a long period. However Haglund (2005) conducted a study with contracts no longer than 6 months. Unlike Bystroms (2000) study, no rollover procedure was adopted. In this study most of the time series were in stationary process. This study intends to use similar contract periods (6-month) without rollover.

2.4.2 Test for Normality

To test whether the data is normally distributed is important in order to select the best statistical model. With non-normal data i.e. high kurtosis and/or skewness, an ordinary least squares regression model is not suitable. Instead, a more dynamic GARCH model will fit the data better.

Skewness is a measure of the degree of asymmetry of a distribution .if the distribution stretches to the right more than to the left, the distribution is positively skewed. If the distribution stretches to the left more than to the right, it is left skewed (negative). Zero skewness implies a symmetric distribution. If Skewness, variance and mean for two distributions are equal, the shape may still be different (Haglund 2005). The relative kurtosis is important since it measures the peaked ness of the distribution. A kurtosis less than three implies a flatter distribution, also called platykurtic, than the normal distribution, and a kurtosis larger than three implies a more peaked distribution, also called leptokurtic (Aczel, 2002).

Besides analyzing the Skewness and kurtosis in order to see if the data is normally distributed, the Jarque-bera statistics under the null of normality is done. The Jarque-Bera test statistic is:

$$\text{Jarque-bera} = (N-k)/6\,[S^2 + (K-3)^2/4] \qquad (2.2)$$

Where;

N is the number of observations;

S is the skewness and;

K is the kurtosis.

This is considered an effective method to test for normality when the sample size is greater than 30 (Bystrom, 2000; Aczel, 2002; Haglund, 2005).

2.4.3 Test for Autocorrelation

A current error term may not only contain information from its own period but may be effected with information from previous time periods. In this case, the error term are said to be correlated in some way i.e. autocorrelation. Autocorrelation should always be tested when working with time-series data. If the data in a time-series is found to be auto correlated the ordinary least square method is not a suitable method, inferior to more dynamic models such as the GARCH.

The Ljung-box test statistics for autocorrelation will be tested. This is in line with (Haglund, 2005). This test makes it possible to analyze in more detail how the autocorrelation looks like.

The Ljung-Box test statistics is:

$$T_{LB} = N(N+2)\Sigma\,(t^2_j / N-j) \;\ldots\ldots\ldots\ldots\ldots\ldots(2.3)$$

Where;

t_j is the j^{th} autocorrelation and;

N is the number of observations.

Under the null hypothesis, T is distributed as an x^2 with degrees of freedom equal to the number of autocorrelations (Griffiths et al., 2001). Bystrom (2000) analyzed autocorrelation with Ljung-Box and found that no autocorrelation was present at long lags in the futures markets. In the study by Baillie (1991), no evidence of autocorrelation using Ljung-Box for lag 6 and lag 16,in order to see if the first observations Autocorrelated with the 6th and the 16th observations. This is same number of lags that Haglund, (2005) used in their study.

2.4.4 Test for Heteroskedasticity

If the variance for all observations in a time-series is not the same over time, the data is heteroscedastic, which means that the random variable y_t and the random error e_t is heteroscedastic. Homoskedasticity exists when y_t and e_t are the same for all observations. If the variance are not constant, the ordinary least square model is not suitable since it calculates the unconditional variance, i.e. a constant variance for all observations. A GARCH model generates a conditional variance, i.e. where the variance is not constant over time (Haglund, 2005; Enders, 2004).

A formal test for heteroskedasticity is the Goldfeld-quandt test. To compute this test, the sample is first split into two equally large sub-samples. The estimated error variance v^2_1 / v^2_2 is calculated for the two sub samples. At this stage, it can be seen if the two-sub samples have similar variances. Then, GQ= v^2_1/v^2_2 is calculated and reject the null hypothesis of equal variances if GQ>F_c, where F_c is a critical value from the F-distribution with (T_1-K) and (T_2-K) degrees of freedom. The values T_1 and T_2 are the number of observations in each of the sub samples (Griffiths et al., 2001).

2.5 The Optimal hedge Ratio and Risk Reduction Statistics

In this section, this study presents the Minimum Variance and Simple linear Regression methods. These are the methods that will be used to calculate the optimal hedge Ratio. This part will also cover the risk reduction statistics and show how the optimal hedge ratios reduce risk. This is in line with work done by Haglund, (2005).

2.5.1 The minimum Variance Hedge Ratio

When hedging price risk, the optimal proportion of the futures contracts that should be held to offset the cash position is called optimal hedge ratio (Haglund, 2005). This ratio is traditionally estimated by examining the ratio between the unconditional covariance between spot and futures prices and the unconditional variance of the price of futures (Bystrom, 2000; Haglund, 2005). In the study by Bystrom (2000) a minimum variance (MV) hedge ratio is calculated on electricity futures together with more elaborate GARCH models. The MV hedge ratio successfully reduces the variance compared to the spot position. However, even though the study shows that more elaborate models perform better, the simpler models is nearly as successful in reducing the portfolio variance (Haglund, 2005). Also in line with the study by Baille (1991) who also concludes that simpler models sometimes perform better or equally as good as the more advanced models. For each spot contract, the hedge ratio tells us how many futures contracts should be purchased or sold. The following equation represents the hedge ratio:

$$H = \rho_{sf} \; v_s / v_f \qquad (2.4)$$

Where;

H denotes the risk minimizing hedge ratio.

ρ_{sf} denotes the correlation coefficient between spot and futures prices

v_s denotes the variance of spot prices.

V_f denotes the variance of futures prices.

2.5.2 Simple linear Regression Analysis

Using an ordinary least square (OLS) simple regression model is a common tool to estimate the portfolio variance and optimal hedge ratio for commodity futures contracts. Previous studies by Baillie (1991), Bystrom (2000), Satyanarayan (1994) and Haglund (2005) included OLS in their studies for the optimal hedge ratio.

A simple regression analysis is a technique using two variables, one dependent and the other one independent. When there is a linear relation between the two variables; it is called a simple linear regression analysis (Haglund, 2005; Roon, 2003). The relationship can be expressed as:

$$C_t = \phi + \beta f_t + \varepsilon. \quad \text{..........(2.5)}$$

Where:

C_t = value of cash price at time t.

f_t = value of the futures price at time t.

ϕ = value of C_t when β =0.

β = the slope coefficient regression line.

ε= Random error term.

Fry et al., (2001) defines the regression slope coefficient as the average change in the dependent variable for a unit change in the independent variable. This regression line is the best estimation but since there are an infinite number of possible regression lines for a set of points, we need to determine a criterion for selecting the best line. The criterion is called the least square criterion and it is a method to determine the regression line that minimizes the sum of squared residuals.

2.5.3 Risk Reduction.

In the preceding two sections the research proposes the two statistical methods that will be used to calculate the optimal hedge ratio. At this point this study will calculate reduction in risk after applying the optimal hedge ratio.

$$\textbf{\% Reduction in risk} = 1-(\delta \text{ hedged})/\delta(\text{unhedged})) \quad \text{.......(2.6)}$$

Where δ is variance

CHAPTER THREE

3.0 RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter outlines the research design that was adopted in conducting this study. It focuses on the study design, the target population, sample design, research instruments, data collection procedures and the method of data analysis.

3.2 Research Design

The study design was an exploratory survey into the price changes in oil commodity and how use of futures contracts can mitigate untimely world crude oil price changes and its impact on the profitability of the companies dealing in oil trade in Kenya. This involved both descriptive qualitative and quantitative analysis. The data for this study covered ten years, the period from January 1997 to December 2006. The reason for choosing oil commodity is that oil Petroleum takes a third of all total Kenya imports and any slight change in price may affect not only the companies involved in its trade but all other sectors of the economy.

3.3 Target Population

A population is the aggregate of all cases that conform to some designated set of specifications (Nachmias and Nachmias, 1996). The target population for this study was all the 364 registered oil companies in Kenya in year 2006 (Petroleum Institute of East Africa, 2006).

3.4 Sampling Design

A sample is a representative subset of a population (Nachmias and Nachmias, 1996). According to Singleton and Royce (in Orodho, 2005), the extreme upper limit of a sample size is 2000 to 3000 while the extreme lower limit is 30 cases for statistical data analysis. In this study therefore, a sample size of 36 oil companies was drawn using systematic sampling method. The sample size is justified on the basis of the central limit theorem that states that a sample size of 30 and above is adequate in drawing inference on the entire population of study. Systematic sampling is a statistical method involving the selection of every k^{th} element from a sampling frame, where k, the sampling interval, is calculated as:

k = population size (N) / sample size (n)

Using this procedure each element in the population has a known and equal probability of selection. Systematic sampling is much more efficient than random and much less expensive to carry out.

From the sampling frame (refer to appendix 1), a starting point was chosen at random, and choices were thereafter made at regular intervals. For this study, the researcher drew a sample of 36 oil companies from a population of 364. Implying that 364/36=10, so every 10^{th} oil company in the sampling frame was chosen after a random starting point between 1 and 10. Our random starting point was 5, and the selected oil companies were Abha Petroleum Ltd, Akaba Investments, Alpha Beta Products Ltd, among others in that order (refer to appendix ii).

3.5 Research Instruments

Semi-structured questionnaires were utilized to collect primary data. This method is appropriate as it is most authoritative because the information has not been filtered by a second party (cooper et. al., 2003). The closed ended questions were drafted on both Likert scale and on a yes/ no scale basis.

3.6 Data Collection Procedures

Secondary data for daily futures and spot prices were collected for the 10- year period covering January 1997 to December 2006 from the official US Energy Statistics website. The futures data found on this website are traded at NYMEX and the spot prices from WTI (Western Texas Intermediate) Export Point.

For the primary data survey, self -administered questionnaires were completed by the Heads of risk management departments of the selected oil companies through drop and pick latter approach. Response rates were continuously and closely monitored by making follow up reminder calls to the respondents after the survey instrument was distributed. To ensure quality of responses the respondents were urged to be as honest as possible in filling the questionnaire. Again, participation was voluntary, anonymous and confidential. A cover letter signed by the researcher explaining the purpose of survey to the participants, how the survey information will be used, how to complete the survey and assurance of confidentiality and anonymity was also attached.

3.7 Data Analysis

Data collected was subjected to several statistical tests, using econometric tools as indicated in the literature review. Descriptive statistics were used to analyze the qualitative part of the data collected.

To compute the Optimal Hedge Ratio, daily returns instead of weekly were used as this was expected to improve the estimate (Duffie, 1989). This study used the logarithm differences in spot and futures prices. The price changes rather than price levels were used because spot and futures prices of commodities often are non-stationary (Haglund, 2005). The study used the logarithms of the price changes to control the non-stationary price levels (Milonas, 1987).

The futures contract was used as a hedging instrument, and not for Delivery of an actual commodity. Therefore in order to avoid the maturity effects, each contract was closed ten days before the maturity date. This is similar to the work done by Haglund (2005).

The study used six-month contracts because most companies normally do not engage in contracts with longer maturities than six months. This is also similar to the study on electricity futures by Bystrom (2000). In Haglund (2005), six months contracts where adopted without being rolled forward prior to the maturity date of each contract. The reason being that the rollover causes basis risk. This was found to be a problem in Bystrom study. To avoid this risk, the researcher used ten separate contracts without rolling the contracts forward. This is similar to the study by Haglund (2005) where four separate contracts of different commodities where selected without rolling them forward.

Similarly, Baillie (1991) selected one contract for each commodity without any rollover procedure.

After calculating the logarithm differences in spot and futures prices, the researcher subjected them to several statistical tests as per the literature. Using MV, the OHR was calculated as per the literature. This is a minimum variance hedge ratio that maximizes the mean-variance utility (Haglund, 2005). Several previous studies such as Ederington (1979); Endersson (1981); Baillie (1991), Satyanarayan et al., (1994) and Haglund (2005) used an ordinary least square (OLS) regression model to calculate the optimal hedge ratio. In contrast to the minimum variance hedge ratio, the OLS model is an invariant unconditional version. Therefore, a simple regression model was calculated as expressed in model 2.5, where the logarithm on futures price changes are regressed on the logarithm on spot prices changes. This model and the minimum variance model are presented together with a Naive hedge (a one-to-one hedge ratio). The calculations in this research were conducted in Microsoft Excel, E-Views, SPSS and STATA.

CHAPTER FOUR

4.0 DATA ANALYSIS, EMPERICAL FINDINGS AND PRESENTATIONS

4.1 Introduction

This chapter presents the analysis and the results of the study. The secondary data employed consist of closing daily prices for both the spot prices and the nearby futures prices for the world's most liquid and heavily traded oil futures contract, the NYMEX Light Sweet Crude Oil (WTI) contract. The NYMEX crude oil futures contract which was introduced in March 1983 is based on pipeline delivery of barrels of West Texas Intermediate (WTI) crude in Cushing, Oklahoma. The data are obtained from the U.S. Energy Information Administration. The data period extends from January 1998 to June 2006. In the first part the researcher presents the various general statistical tests for the data. In the second part, the optimal hedge ratio and the risk reduction for the oil are presented while in the third and final part, the researcher presents the assessment of price risk management by oil companies in Kenya. The primary data for the last part was obtained from the Head of Risk Management Departments of the sampled oil companies. Of all the 36 questionnaires that were sent out to the respondents, 30 were duly filled and returned, representing a response rate of 83.3%.

4.2 General statistical tests on the time series data

In this section the mean, variance, test for normality, test for stationary, test for autocorrelation and the test for homoskedasticity is presented. The vital parts of this section are to compare the values in the tables to the critical values for each statistical test. Note that all values used in this report are logarithm values. The critical values for the different tests presented below are attached below the tables. The mean and the variance are important variables in order to see if the mean is close to zero and how the variance may be different from the spot and the futures contract. If the skewness values are zero, it implies a symmetric distribution, where a positive value implies a right-skewed distribution and a negative value a left-skewed distribution. The kurtosis variable presents if the data is characterized by a flatter or more peaked setting. A kurtosis of three implies a normal distribution, a value of larger than three a fat-tailed distribution (leptokurtic) and smaller than three a flatter distribution (platykurtic).

The Jarque-Bera (J-B) test combines the skewness and kurtosis values and if the data is smaller than the critical value, it is considered to be normally distributed. The Augmented Dickey-Fuller (ADF) test presents if the data is stationary, where a value smaller than the critical value implies that the data is stationary. The Ljung-Box (L-B) tests for autocorrelation at lag 6 and lag 16, where a value smaller than the critical value implies that no autocorrelation exists in the data. The Goldmand-Quand (G-Q) tests for homoskedasticity in the data i.e. if the data has a constant variance over time, where a value smaller than the critical values implies that the data is homoscedastic.

The statistics for Oil Light Crude spot and futures contract during the years 1998- 2006 can be seen in table 4.1 below. The kurtosis and skewness values present evidence of a symmetric and normal distribution for most contracts. It is also evidenced that most of the contracts are normally distributed. The Augmented Dickey-Fuller (ADF) test provides clear evidence that the time-series are stationary and the Goldmand-Quand (G-Q) shows that all years are homoscedastic. This means that the variance for the spot and the futures contract are similar over time during the periods examined in this research paper. The Ljung-Box (L-B) statistics provides evidence that no autocorrelation is found in either the spot or the futures market. The futures contract has a lower variance than the spot position during all years.

Table 4.1 Oil Light Crude statistic for June contracts 1998-2006

Year	Position	Mean	Variance	Skewness	Kurtosis	ADF*	J-B	L-B (6)	L-B (16)	G-Q
1998	Spot	-.0008455	.000151	0.55	5.52	-9.85	35.31	5.67	16.45	0.95
	Future	-.0006992	.0001122	0.60	3.49	-10.63	35.85	5.23	16.98	0.67
1999	Spot	.0010968	.0001099	-0.56	3.45	-10.84	69.96	2.67	13.65	1.32
	Future	.0009113	.0001279	-0.08	3.40	-12.62	47.80	7.97	14.61	0.88
2000	Spot	.002024	.0002453	0.97	2.51	-17.11	40.24	5.98	18.95	0.98
	Future	.001656	.0001779	0.49	3.53	-16.70	36.75	2.34	17.34	1.12
2001	Spot	-.000704	.0001717	-0.90	3.88	-15.77	93.88	3.42	10.35	1.11
	Future	-.00056	.0001082	-0.02	3.80	-13.88	46.45	6.67	24.72	0.21
2002	Spot	-.0000323	.0001836	-0.01	3.53	-14.83	45.48	1.64	11.24	1.04
	Future	.0000806	.0001542	-0.08	3.74	-13.96	47.66	3.21	14.00	1.22
2003	Spot	-.0002276	.0001539	-.56	3.65	-12.92	69.84	6.81	14.86	1.02
	Future	-.0001545	.00011	-.51	3.27	-11.90	67.21	9.32	16.05	0.93
2004	Spot	.0004146	.000166	.026	3.42	-15.32	44.08	7.76	17.56	0.57
	Future	.0005203	.0000802	.046	2.81	-12.04	43.74	5.11	11.67	0.80
2005	Spot	.0016	.000132	0.24	3.51	-14.37	39.73	4.87	19.27	0.62
	Future	.00156	.000094	0.58	2.88	-12.45	36.65	3.09	14.60	0.65

Year	Position	Mean	Variance	Skewness	Kurtosis	ADF*	J-B	L-B (6)	L-B (16)	G-Q
2006	Spot	.00096	.0000735	0.11	3.98	-12.41	42.36	1.34	17.92	1.06
	Future	.000928	.000064	0.14	3.90	-12.35	41.67	2.21	15.44	1.12

The critical values for Augmented Dickey-Fuller (ADF), the test for non-stationary data, on the 0.01 level is -3.4, on 0.05 is -2.88 and on 0.1 is -2.8 from MacKinnon (1996). The asterisk denotes significance at 1% level. The critical values for 0.01 for Ljung-Box (L-B), the test for autocorrelation, are 31.99 for lag 16 and 16.8 for lag 6. The critical value for Jarque-Bera (J-B), the test for normality, is 9.21 on the 0.01 level. The Goldmand-Quand (G-Q), the test for homoskedasticity, critical values is 1.54 on the 0.05 level.

Source: Field Data (2008)

4.2.1 Summary of the General Statistical tests

The variance for the spot and futures data are generally very close to each other for all the years considered which is expected since the spot and futures contracts often follow each other closely. Most of the spot and futures time-series above have symmetric and normal distributed characteristics. All time series for spot and futures where found to be stationary and homoscedastic i.e. the variance is constant over time. This is in contrast to previous studies, where longer time periods than 6-months have been examined. Since we focused on a 6-month hedging decision, which is a relative short period, the variance is therefore constant over time. No autocorrelation was found in either short or long lags in the spot and the futures time series. Based on the above tests, the researcher can conclude that since the time-series are stationary with a close to constant variance over time and close to normally distributed data for most time-series, the researcher continued by using an ordinary least squares regression and a minimum variance model to analyze the optimal hedge ratio and risk reduction for the different commodities. Thus, using more elaborate methods such as the GARCH framework was not be necessary and was therefore not be used by the researcher.

4.3 Optimal Hedge Ratio and Risk Reduction

The optimal hedge ratio (OHR) and risk reduction for crude oil are presented. There are four different portfolios examined for each year: the unhedged that is, buying in the spot market, the Naïve, that is, a fully hedged position (100%), the ordinary least square (OLS) hedge ratio and the minimum variance (MV) hedge ratio. In this part we focus on the OHR calculated by the OLS and MV in order to analyze what may be the OHR for each year. The variance will also be examined since this gives evidence which portfolio that may reduce the variance most effectively. The risk reduction parameter is important since it presents how much, in percentage, that a portfolio may reduce the risk compared to the unhedged portfolio. In addition to this, the researcher presented a general discussion how companies exposed to risk in crude oil importation may offset this risk.

The four different portfolios for Oil Light Crude during the time period 1998-2006 are presented in table 4.2 below.

Table 4.2 Oil Light Crude OHR and Risk reduction

Year	Portfolio	Hedge ratio	Variance	Risk reduction
1998	Unhedged	0.00	0.00015112	
	Naïve	1.00	0.0000374	75.25%
	OLS	0.77	0.0000271	82.07%
	MV	1.00	0.000043465	71.24%
1999	Unhedged	0.00	0.00010996	
	Naïve	1.00	1.27502E-05	88.40%
	OLS	0.81	0.0000254	76.90%
	MV	0.99	1.38481E-05	87.41%
2000	Unhedged	0.00	0.00024394	
	Naïve	1.00	1.78004E-05	92.70%
	OLS	0.79	0.0000595	75.61%
	MV	0.94	1.65112E-05	93.23%
2001	Unhedged	0.00	0.00017103	
	Naïve	1.00	1.08043E-05	93.68%
	OLS	0.78	0.0000463	72.93%
	MV	0.98	0.000011703	93.16%
2002	Unhedged	0.00	0.00018331	
	Naïve	1.00	1.53683E-05	91.62%
	OLS	0.88	0.0000332	81.89%
	MV	0.98	1.64783E-05	91.01%
2003	Unhedged	0.00	0.00020231	
	Naïve	1.00	1.37152E-05	93.22%
	OLS	0.79	0.0000922	54.43%
	MV	0.89	1.48161E-05	92.68%
2004	Unhedged	0.00	0.00016496	
	Naïve	1.00	0.000080436	51.24%
	OLS	0.78	0.00011176	32.25%
	MV	0.97	0.000081527	50.58%
2005	Unhedged	0.00	0.0001312	
	Naïve	1.00	9.37084E-06	92.86%
	OLS	0.68	0.00004	69.51%
	MV	0.98	9.47193E-06	92.78%
2006	Unhedged	0.00	0.00007337	
	Naïve	1.00	6.5092E-06	91.13%
	OLS	0.85	0.0000156	78.74%
	MV	0.94	6.3185E-06	91.39%

Source: Field Data (2008)

The Oil data reveals evidence of different hedge ratios for the OLS and MV models, where the MV in most cases are higher than OLS. The Naive hedge generates almost a similar trend in risk reduction as MV and slightly better than OLS. The unhedged position has a higher variance than the Naive, OLS and MV, hence it is not recommended to remain unhedged when companies have an exposure of volatility in the Oil price volatility.

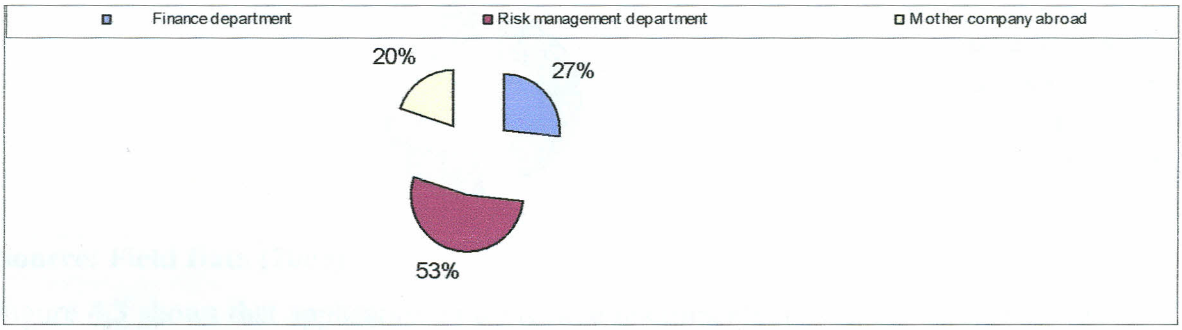
It is difficult to conclude an OHR for Oil due to the statistical small variations in the percentage of risk reduction for OLS and MV. However, common is that they both reduce the risk significantly compared to the unhedged position. Based on the foregoing, it is recommended to use a hedge close to 1 as much as possible. The range of OHR is 68%-100% with an average of 92%.

4.4 Assessment of Price Risk Management by Oil Companies in Kenya

Threat of untimely crude oil price changes to profitability

All the respondents indicated that they considered price changes on crude oil as a big threat to their profitability. This implies that risk managers in these oil companies are aware of the risks associated with volatility of crude oil prices and are therefore more likely to put measures to mitigate the same.

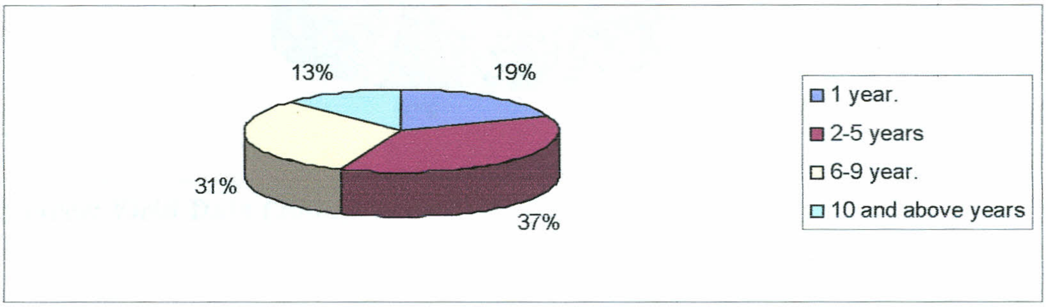
Figure 4.1: Responsibility of hedging crude oil risks



Source: Field Data (2008)

Figure 4.1 shows that in more than half of the responding oil companies (53%), risk management departments are entrusted with hedging crude oil risks while 20% entrust the same duty with their finance departments. However, 20% of the participating oil firms rely on their mother companies abroad for hedging crude oil risks. This implies that some of the oil companies still do not have the adequate capacity to handle oil price volatility risks.

Figure 4.2: Experience in handling price risk management

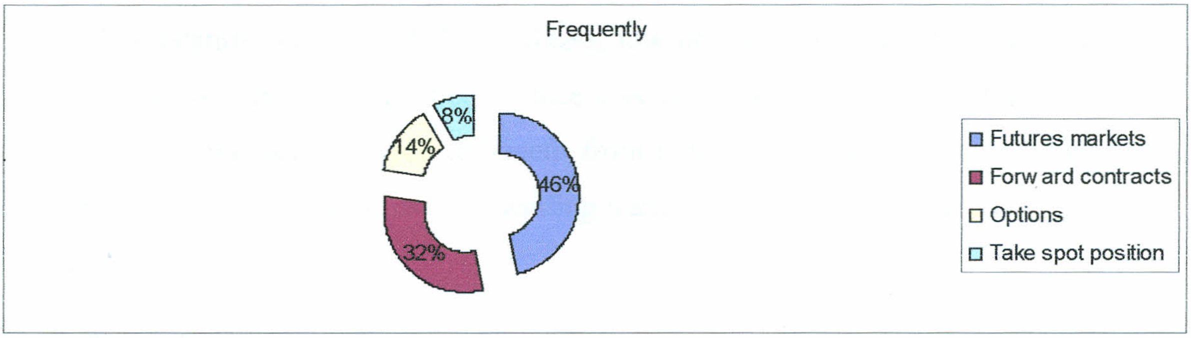


Source: Field Data (2008)

Figure 4.2 shows that more than half of the participating oil companies (56%) have been handling oil price risks in the last 5 years. This implies that these companies have a short experience in oil price risk management.

4.4.1 Methods used by Oil Companies in Kenya to Hedge Price Risk.

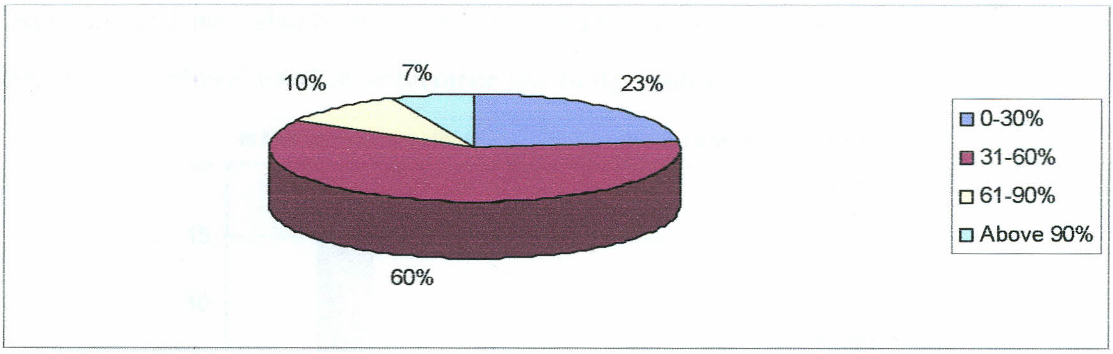
Figure 4.3: Derivatives used to mitigate crude oil price changes



Source: Field Data (2008)

Figure 4.3 shows that application of derivative instruments in hedging of crude oil price risks by oil in Kenya. Of the oil companies in the sample, that 46% use future markets while 36% use forward contracts to hedge volatility in oil prices. Options and spot positions are however used by 14% and 8% of the participating oil companies respectively. This implies that futures and forward contracts are the most popular hedging methods used by oil companies in Kenya. It is also evident from the data that no oil company engages in the use of only one hedging instrument.

Figure 4.4: Ratio of total volume hedged in the futures market

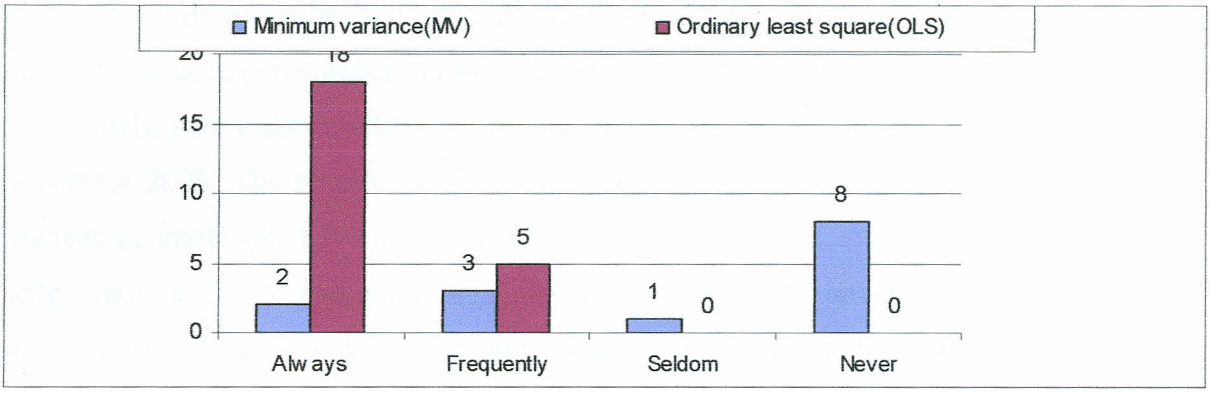


Source: Field Data (2008)

Majority of the oil companies (60%) hedge about 30 to 60 percent of their oil volumes using futures market as shown in Figure 4.4. This compares unfavorably to the average optimal hedge ratio of 92%. The results imply that oil companies in Kenya are currently under-hedging their futures markets and are therefore exposed to high price risks resulting from the underlying price volatility. It is also apparent from the results that none of the studied oil companies engaged in a Naive hedge. The reason for this hedge trend may be that the oil companies' studied primarily use selective, short-term hedging, where securing a price in a distant future is not an objective. As discussed by Uptigrove (2004) large oil companies with solid balance sheets, low per unit costs and multiple revenues sources may be very well equipped to face less commodity exposure. These kinds of firms may be very well equipped to benefit from high prices at peaks and handling low prices through the downturns, while avoiding transaction costs and opportunity costs of hedging.

However, as discussed by Cameron (2002) a reason why large oil producers often do not hedge is due to the backwardation (i.e. the current spot price is higher than the current futures price) in the crude oil markets. This can clearly be seen in the price levels of futures and spot in Appendix 1, where a clear backwardation effect is present during some of the years and especially at the beginning of the period examined. Hence, Oil producers may be reluctant to hedging in the futures market because of this effect. In contrast to large oil companies that only hedge a portion of their commodity, other companies that are dependent on oil as an input in production have a different risk exposure, and may also be positively affected by the backwardation effect.

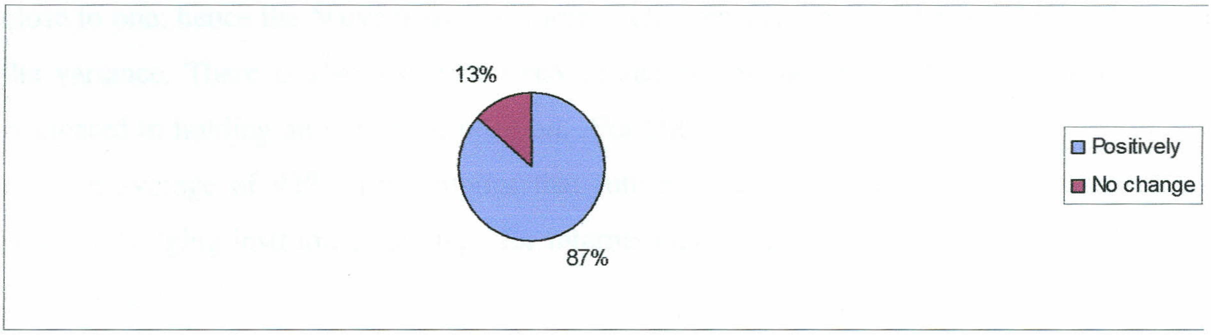
Figure 4.5: Model used to determine the hedge volume



Source: Field Data (2008)

Figure 4.5 indicates that OLS is the most frequently used model in determining oil hedge volumes by oil companies in Kenya compared to the minimum variance approach.

Figure 4.6: Impact of futures contracts on company profitability



Source: Field Data (2008)

Figure 4.6 was intended to determine whether companies using oil futures to hedge price risk can maintain their profit margins incase world prices change unexpectedly. As shown, 87% of the respondents indicated that their use of futures contracts impacted positively on their profit margins. However, the oil firms indicated that they review their petrol pump prices whenever international crude oil prices go up. This implies that as the oil companies sustain their earnings as a result of hedging, they continue to pass the price hikes to their customers.

CHAPTER FIVE

5.0 SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Key Findings

This research project estimated optimal hedge ratios, examined the hedging effectiveness and the associated percentages in risk reduction for the NYMEX and WTI using OLS and MV models, over a six month 9-year period starting January- June 1997 to January- June December 2006. The researcher also examined the variance of spot and futures price changes of crude oil. Several statistical tests were calculated in order to examine the hedge ratio and risk reduction of a Naive (fully hedged), an ordinary least square regression (OLS) and with a minimum variance model (MV). Further, the study also sought to establish whether companies hedging using futures can still maintain their profit margins without passing on the price hikes to the consumers.

Findings indicate mixed results for the optimal hedge ratio for the different years using the different portfolios. A backwardation effect is present in the price levels with an OHR close to one; hence the Naive hedge performs well even though the OLS and MV reduce the variance. There is also significant risk reduction for the different hedge portfolios compared to holding an unhedged position. For Oil, the span of the OHR is 68%-100% with an average of 92%. This implies that futures contract require consideration as a possible hedging instrument/ strategy for international oil market price risks by oil firms in the country.

The findings also show that oil companies in Kenya give due consideration to crude oil price volatility mainly due to the attendant threat to their profitability. As a result they use a hybrid of derivatives, mainly futures market and forward contracts. Further, findings show that majority of the oil companies in Kenya hedge about thirty one to sixty percent of their oil volumes using futures market. This compares unfavorably to the optimal hedge ratio of 82%. The results imply that oil companies in Kenya are currently under-hedging their futures markets and are therefore likely to be exposed to high price risks resulting from the underlying price volatility. The findings therefore indicate that oil companies in Kenya should scale up the value of the hedged oil volumes in line with optimal hedge ratio.

Further, the results indicate that oil companies use of futures contracts as a measure of hedging price risk and this impacts positively on their profit margins. However, the oil firms indicated that they usually review their petrol pump prices whenever international crude oil prices go up. This implies that even as the oil companies sustain their earnings as a result of hedging, they continue to pass the prices hikes to their customers.

Finally, the unhedged position was found to have a higher variance than the Naive, OLS and MV, hence it is not recommended to remain unhedged when companies have an exposure of volatility in the Oil price volatility.

5.2 Conclusions

It can be concluded that oil market currently offers an almost bewildering array of trading instruments that can be used to reduce the price risks incurred by companies buying physical oil among them futures contract. These derivative trading instruments have transformed the structure and operation of the oil market over the past decades, giving oil companies much more control over prices and also widening their profit margins.

Another notable conclusion is that that even as oil companies in Kenya hedge against international price volatilities, they are usually quick at reviewing pump prices upwards by the similar margins whenever crude prices go up but never reverse the same when crude prices trend downwards. This implies a serious market failure as these companies are engaged in cartelist and collusive behavior in controlling pump prices rather than the market forces thus exploiting consumers by passing the international price "hikes" at the slightest opportunity. This scenario is sustained by the grossly incompetitive structure of oil market in the country which is currently oligopolised by five major companies- Total, Shell BP, Caltex, Mobil and Kenol/Kobil, controlling at least 85% of the total market share. The petroleum trade liberalization in 1994 has therefore failed to inject the required competition in the market as the market value chain is said to be under control of a few companies who have formed cartelist tendency in the supply, marketing and retaining of petroleum products. They thus continue to exploit the public by fixing high pump prices. It has been argued that this leads to excessive profit margins by oil companies.

It can also be concluded that companies dependent on Oil, especially major oil companies, can also significantly reduce the price volatility risk by engaging in futures contract because the OHR close to one also significantly reduced the risk. In general, it is vital for companies to consider an active engagement in the futures market in order to secure steady cash flows. If there are no signs of the otherwise, oil prices continue to be highly volatile, raw material costs and production costs are uncertain. This will result in profit margins, cash flows and share prices that are highly dependent on price movements in oil prices.

Another conclusion is that under the assumption that the hedger's objective is to minimize risk regardless of the risk-reduction trade off, that is, the hedger is highly risk-averse, an OHR of 93% for Oil is recommended. By applying the optimal hedge ratio, a company may reduce their risk exposure up to 81.03% compared to an unhedged position.

5.3 Recommendations

Considering the fluctuating and insecure future price movements of oil, it is recommended that companies consider how their current hedging activities may benefit from applying the results of this research. Based on the research findings, this research recommends that in the short run it is important for companies to consider the presence of a backwardation or contango effect, since this may effect the hedging decision. However, in the long-run, this may not be as important since hedging the uncertainty in price movements is the primarily objective. In view of the OHR discussed and the fact that Kenyan oil companies are currently under-hedging their portfolios, the researcher further recommends that: large oil consuming companies take advantage of hedging to normalize their profitability; oil importing companies upscale their hedging positions; and that government intervenes by reviewing the 1994 liberalization policy in order to ensure comprehensive mechanisms for regulating the current oligopolistic behavior of oil companies.

5.4 Suggestions for Further Research

i. Since this study used OLS to model the hedging ratio between spot and futures, the same study should be carried out using GARCH Models and the findings compared.

ii. A more interesting study will be to forecast the optimal hedge ratio for oil commodity. This however requires a more detailed analysis and use of forecasting models which was beyond the scope of this study.

iii. Another implication of the findings is that all market participants can use the futures prices as a forecast of future spot prices, even if they do not actually trade in futures themselves. This is the price discovery role of the futures contracts. Physical market decisions can thus be guided by examining the futures prices. A suggestion to further studies is to test if the futures prices are able to forecast future spot prices better than forecasts from time series models based on present and past spot prices.

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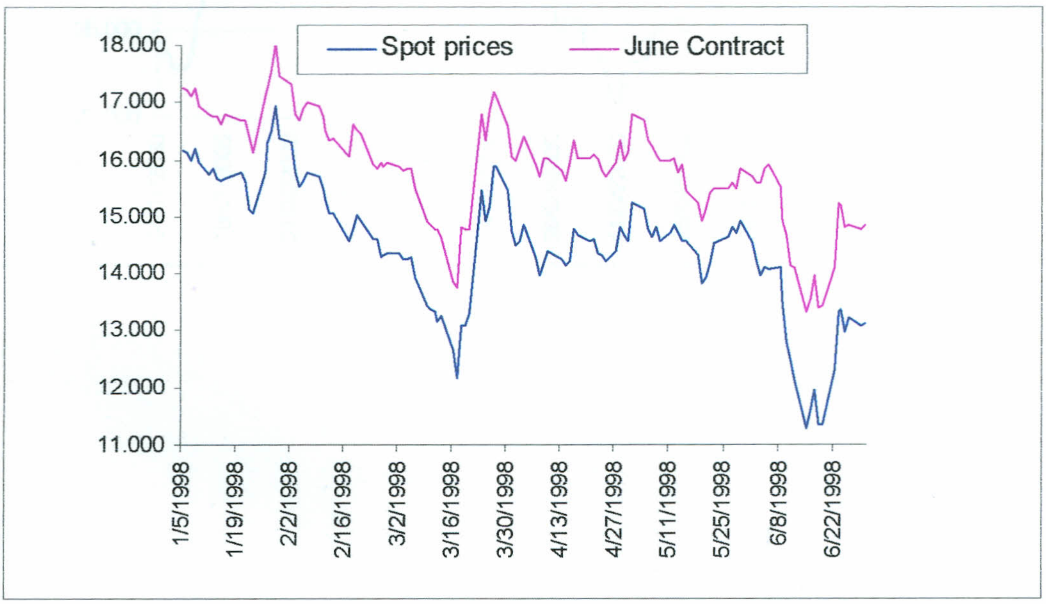
APPENDIX I: OIL PRICE LEVEL TIME-SERIES DATA

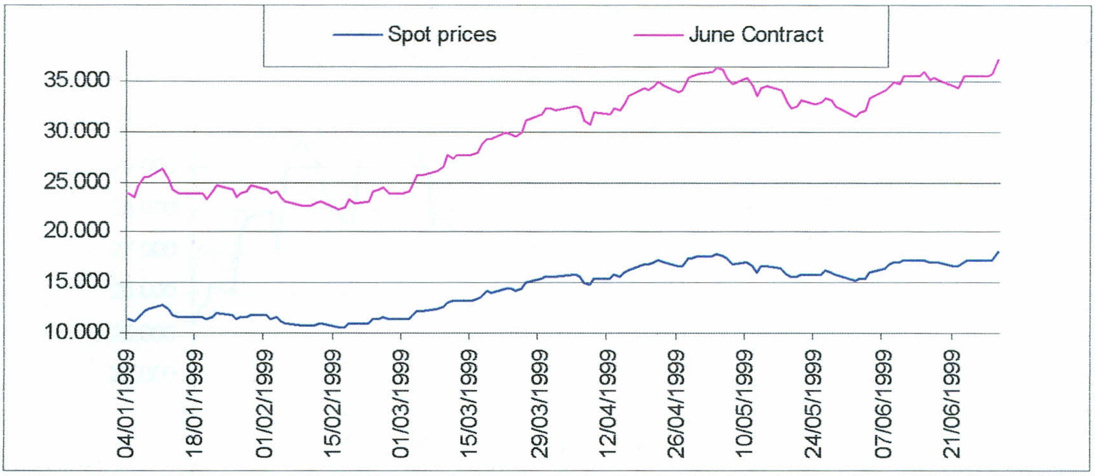
The price levels in US Dollars of the Spot and June contract time-series of Oil Light Crude during the years 1998-2006. Each time-series consist of data during the period Jan-Jun, hence when the contract starts trading in January until 10 days prior to expiration in June. Since the contract is expired 10 days prior to maturity, the basis risk on this chart is not equal to zero (zero basis risk is when spot and futures price is equal) at the end of the period examined.

The price levels in US Dollars of the Spot and June contract time-series of Oil Light Crude during the years 1998-2006. Each time-series consist of data during the period Jan-Jun, hence when the contract starts trading in January until 10 days prior to expiration in June. Since the contract is expired 10 days prior to maturity, the basis risk on this chart is not equal to zero (zero basis risk is when spot and futures price is equal) at the end of the period examined.

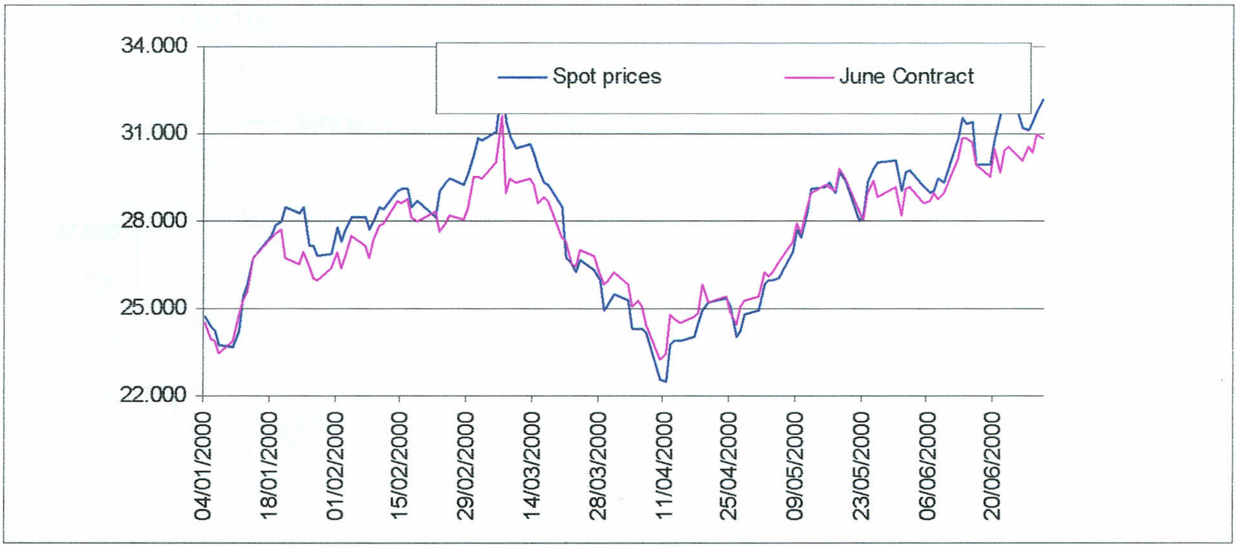
Graph 1: Oil 1998



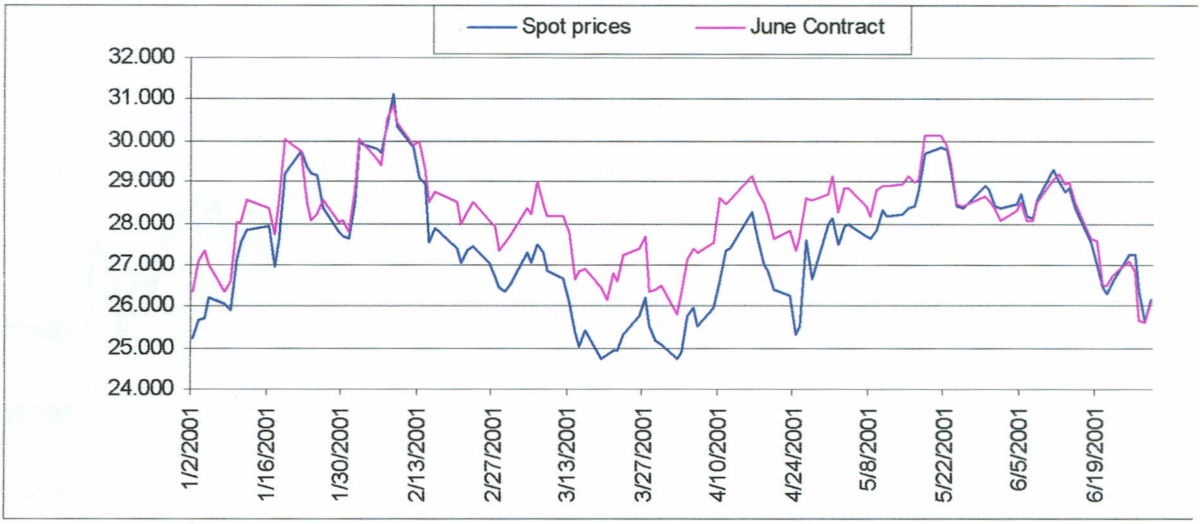
Graph 2: Oil 1999



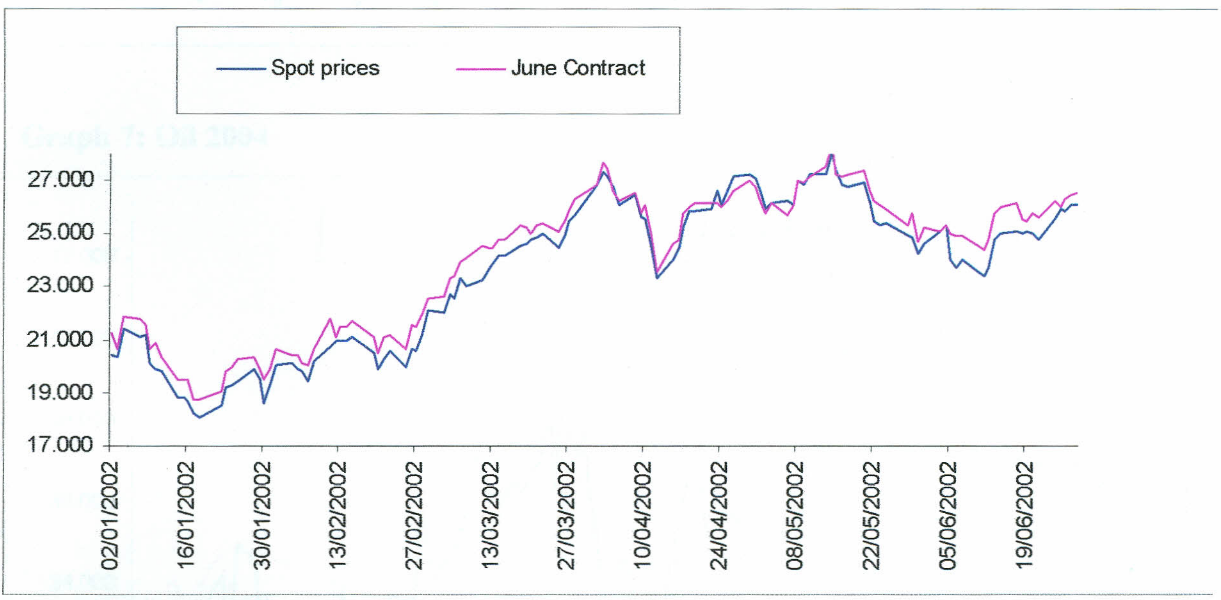
Graph 3: Oil 2000



Graph 4: Oil 2001



Graph 5: Oil 2002



Graph 6: Oil 2003

Graph 7: Oil 2004

Graph 8: Oil 2005

Graph 9: Oil 2006

APPENDIX II: SAMPLING FRAME

No.	Company Name	Reference Numbers
1	ABDI JUMA AWALE FILLING STATION	ME/CONF/7/1/15/217
2	ABDUL HASSAN ENTERPRISES	ME/CONF/7/1/15/287
3	ABDULHAKIM AHMED BAYUSUF AND SONS	ME/CONF/7/1/15/320
4	ABEL PETROL STATION	ME/CONF/7/1/15/243
5	ABHA PETROLEUM LTD	ME/CONF/7/1/15/110
6	ACROSS OCEAN TRADERS LTD	ME/CONF/7/1/15/82
7	ADDAX KENYA LTD	ME/CONF/7/1/15/304
8	ADIPONDO INTRASALES (K) LTD	ME/CONF/7/1/15/298
9	ADRA (K) LTD	ME/CONF/7/1/15/151
10	ADVENTURE PETROLEUM	ME/CONF/7/1/15/205
12	AFRICAN GAS &OIL CO. LTD	ME/CONF/7/1/15/216
13	AFRICAN HOMEWAY	ME/CONF/7/1/15/57
14	AFRIQ ENTERPRISES LTD	ME/CONF/7/1/15/345
15	AKABA INVESTMENTS	ME/CONF/7/1/15/149
16	AKWANA ENTERPRISES LTD	ME/CONF/7/1/15/72
17	AL AMIRA OIL LTD	ME/CONF/7/1/15/220
18	ALAM AGENCIES	ME/CONF/7/1/15/121
19	ALBA PETROLEUM	ME/CONF/7/1/15/60
20	ALBAS ENERPRISES	ME/CONF/7/1/15/126
22	ALBSAR ENERPRISES	ME/CONF/7/1/15/125
23	AL-HAYAT TRADING CO.	ME/CONF/7/1/15/77
24	ALMEKA INVESTMENTS LTD	ME/CONF/7/1/15/289
25	ALPHA BETA PRODUCTS LTD	ME/CONF/7/1/15/112
26	ALTHABIB FILLING STATION	ME/CONF/7/1/15/197
27	AMAL SERVICE STATION	ME/CONF/7/1/15/190
28	AMBOS LTD	ME/CONF/7/1/15/79
29	AMIHARI PETROLEUM PRODUCTS LTD	ME/CONF/7/1/15/174
30	ANNEL (K) LTD	ME/CONF/7/1/15/97
32	APPLE IMPEX LTD	ME/CONF/7/1/15/130
33	ARSENIO AGENCIES	ME/CONF/7/1/15/263
34	ASNOOR ENTERPRISES	ME/CONF/7/1/15/338
35	AUTOPETROLEUM INTERNATIONAL LTD	ME/CONF/7/1/15/167
36	AWAL LTD	ME/CONF/7/1/15/281
38	BAHARIYA PETROLEUM LTD	ME/CONF/7/1/15/137
39	BAKRI INTERNATIONAL ENERGY CO. LTD	ME/CONF/7/1/15/318
40	BAMBURI CEMENT LTD	ME/CONF/7/1/15/319
41	BAMI AGENCIES LTD	ME/CONF/7/1/15/87
42	BAZAM LTD	ME/CONF/7/1/15/180
43	BELAC AGNOSAW LTD	ME/CONF/7/1/15/236
44	BEN OIL	ME/CONF/7/1/15/237

1	ABDI JUMA AWALE FILLING STATION	ME/CONF/7/1/15/217
45	BEN-WIDE AUTOSPARES	ME/CONF/7/1/15/214
46	BENZINA (CE)LTD	ME/CONF/7/1/15/349
48	BEUTSTACHE INVESTMENTS	ME/CONF/7/1/15/185
49	BIMA PETROLEUM DISTRIBUTORS	ME/CONF/7/1/15/105
50	BOC KENYA LTD	ME/CONF/7/1/15/56
51	BOGOL NETWORK KENYA LTD	ME/CONF/7/1/15/150
52	BP KENYA LTD	ME/CONF/7/1/15/7
53	BRIDGE ROCK LTD	ME/CONF/7/1/15/244
54	BRITANIA OILS LTD	ME/CONF/7/1/15/32
55	BUG 2000 SYSTEMS LTD	ME/CONF/7/1/15/249
56	CALTEX OIL KENYA LTD	ME/CONF/7/1/15/2
57	CENTURY OIL TRAKING CO. LTD	ME/CONF/7/1/15/276
58	CHAIRMAN GENERAL AGENCIES	ME/CONF/7/1/15/317
59	CHARMON GENERAL AGENCIES	ME/CONF/7/1/15/321
60	CHARTERED OIL LTD	ME/CONF/7/1/15/172
61	CHELSA AGENCIES	ME/CONF/7/1/15/122
62	CHEPNEL TRAKING AGENCY	ME/CONF/7/1/15/247
63	CHRISTOLITE KENYA LTD	ME/CONF/7/1/15/357
64	CONSOLIDATED FUEL KENYA LTD	ME/CONF/7/1/15/284
65	COPANA LTD	ME/CONF/7/1/15/146
66	CROSS BORDER LTD	ME/CONF/7/1/15/299
67	CROSS FRONTIER	ME/CONF/7/1/15/152
68	CROWN PETROLEUM KENYA LTD	ME/CONF/7/1/15/301
69	CUSH OIL LTD	ME/CONF/7/1/15/218
70	DALBIT INVESTMENTS LTD	ME/CONF/7/1/15/187
71	DANEX PETROLEUM KENYA LTD	ME/CONF/7/1/15/334
72	DASH PETROLEUM SERVICES	ME/CONF/7/1/15/192
73	DEWA ENERGY LTD	ME/CONF/7/1/15/71
74	DIATOM INTERNATIONAL LTD	ME/CONF/7/1/15/344
75	DIESEL POWER CO. LTD	ME/CONF/7/1/15/170
76	DIPTI ENTERPRISES	ME/CONF/7/1/15/193
77	DIZOLUB LTD	ME/CONF/7/1/15/61
78	DOHANI LTD	ME/CONF/7/1/15/59
79	DOLLA TRADING AND CONSULTANCY LTD	ME/CONF/7/1/15/68
80	DOMINION PETROLEUM PRODUCTS LTD	ME/CONF/7/1/15/348
81	DUNGA WHOLESALERS LTD	ME/CONF/7/1/15/302
82	EAGLE PETROLEUM LTD	ME/CONF/7/1/15/19
83	EAST AFRICAN MOLASSES CO. LTD	ME/CONF/7/1/15/136
84	EAST COAST BUNKERING LTD	ME/CONF/7/1/15/156
85	EASTEIG PETROLEUM PRODUCTS LTD	ME/CONF/7/1/15/201
86	EASTMOON COMMUNICATION CO. LTD	ME/CONF/7/1/15/232
87	ECO-HOLDING KENYA LTD	ME/CONF/7/1/15/18

1	ABDI JUMA AWALE FILLING STATION	ME/CONF/7/1/15/217
88	EDEVA ENTERPRISES	ME/CONF/7/1/15/250
89	ELBURGON STORES LTD	ME/CONF/7/1/15/303
90	ELDORET PETROLEUM SERVICES	ME/CONF/7/1/15/40
91	ELF OIL KENYA LTD	ME/CONF/7/1/15/30
92	EPPIC OIL (K) LTD	ME/CONF/7/1/15/31
93	ELGON BROOK PRODUCTS	ME/CONF/7/1/15/17
94	ENGEN KENYA LTD	ME/CONF/7/1/15/11
95	EQUATORIAL ESTABLISHMENTS	ME/CONF/7/1/15/46
96	ESABS INVESTMENT	ME/CONF/7/1/15/23
97	EURO PETROLEUM PRODUCTS E.A LTD	ME/CONF/7/1/15/76
98	EXCEL PETROLEUM COMPANY	ME/CONF/7/1/15/64
99	EXPON OIL KENYA LTD	ME/CONF/7/1/15/269
100	FALCON PETROLEUM LTD	ME/CONF/7/1/15/21
101	FANS PETROLEUM LTD	ME/CONF/7/1/15/271
102	FUEL OUTLET SUPPLIES	ME/CONF/7/1/15/341
103	FIFI OIL COMPANY	ME/CONF/7/1/15/241
104	FLOW COMPANY LTD	ME/CONF/7/1/15/297
105	FLOWER FILLING STATION KENYA LTD	ME/CONF/7/1/15/210
106	FOSSIL FUELS LTD	ME/CONF/7/1/15/273
107	FRESH PRINT SERVICES	ME/CONF/7/1/15/138
108	FUELEX KENYA LTD	ME/CONF/7/1/15/10
109	GAITHO OIL LTD	ME/CONF/7/1/15/94
110	GALANA KENYA LTD	ME/CONF/7/1/15/45
111	GAMO COMPANY LTD	ME/CONF/7/1/15/313
112	GAPCO KENYA LTD	ME/CONF/7/1/15/14
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114	GAS PETRO BUILD LTD	ME/CONF/7/1/15/256
115	GENERATION PETROLEUM LTD	ME/CONF/7/1/15/224
116	GENTECH SERVICES	ME/CONF/7/1/15/131
117	GEO CAPITAL OIL 9E.Ao LTD	ME/CONF/7/1/15/135
118	GEOLOY INVESTMENTS LTD	ME/CONF/7/1/15/106
119	GLOBAL PETROLEUM PRODUCTS	ME/CONF/7/1/15/309
120	GOLDEN GULF INTERNATIONAL	ME/CONF/7/1/15/335
121	GOLDRING PETROLEUM LTD	ME/CONF/7/1/15/28
122	GOOD OIL PETROLEUM	ME/CONF/7/1/15/162
123	GREAT TORNADO INTERNATIONAL LTD	ME/CONF/7/1/15/134
124	GRID AND SERVICES POWER SYSTEM	ME/CONF/7/1/15/234
125	GULF ENERGY LTD	ME/CONF/7/1/15/235
126	GULFSTREAM PETROLEUM E.A LTD	ME/CONF/7/1/15/312
127	GUSA PETROLEUM PRODUCTS LTD	ME/CONF/7/1/15/98
128	HALUX HOLDINGS LTD	ME/CONF/7/1/15/260
129	HARDSTONE STD	ME/CONF/7/1/15/283

1	ABDI JUMA AWALE FILLING STATION	ME/CONF/7/1/15/217
130	HARED PETROLEUM LTD	ME/CONF/7/1/15/296
131	HASHEMITE PETROLEUM CO.	ME/CONF/7/1/15/67
132	HASHI EMPEX	ME/CONF/7/1/15/25
133	HASS PETOLEUM KENYA LTD	ME/CONF/7/1/15/175
134	HELLER PETROLEUM	ME/CONF/7/1/15/144
135	HEMOGRAM COMPANY	ME/CONF/7/1/15/31
136	HENRY &J.F COMPANY	ME/CONF/7/1/15/84
137	HIDAYA IMPORT AND EXPORT CO.	ME/CONF/7/1/15/70
138	HIKMA AGENCIES	ME/CONF/7/1/15/212
139	HOPELAND GENERAL SHIPPEERS	ME/CONF/7/1/15/160
140	HOPEWELL PETROLEUM AND FUEL MARKET	ME/CONF/7/1/15/177
141	HORN AFRICA OIL LTD	ME/CONF/7/1/15/282
142	HORSEED COMPANY	ME/CONF/7/1/15/75
143	HUNKAR TRAKING CO. LTD	ME/CONF/7/1/15/287
144	IDMAN OIL RESELLER	ME/CONF/7/1/15/333
145	IGWE GENERAL STORES	ME/CONF/7/1/15/27
146	IMPACT PETOLEUM LTD	ME/CONF/7/1/15/15
147	INNOVATIVE PETROLEUM LTD	ME/CONF/7/1/15/252
148	INTER STATES TRADE LINK LTD	ME/CONF/7/1/15/29
149	INTER STATE OIL SUPPLIES LTD	ME/CONF/7/1/15/290
150	INTOIL LTD	ME/CONF/7/1/15/101
151	JACADA AGENCIES LTD	ME/CONF/7/1/15/347
152	JADE PETROLEUM LTD	ME/CONF/7/1/15/274
153	JAMERE DISTRIBUTORS	ME/CONF/7/1/15/158
154	JEIKAN HOLDINGS LTD	ME/CONF/7/1/15/293
155	JONAFLOW ENTERPISES	ME/CONF/7/1/15/194
156	JORIACO AGENCIES LTD	ME/CONF/7/1/15/35
157	JOVENNA E. A LTD	ME/CONF/7/1/15/13
158	JUBA PTROLEUM CO.	ME/CONF/7/1/15/165
159	JUPITER PETOLEUM AFRICA	ME/CONF/7/1/15/305
160	K. KIRAGU ENTERPRISES	ME/CONF/7/1/15/123
161	K.K KEROSENE DISTRIBUTORS	ME/CONF/7/1/15/104
162	KABUITO CONTRACTORS LTD	ME/CONF/7/1/15/354
163	KADDAS OIL DERVICES LTD	ME/CONF/7/1/15/117
164	KAMKIS TRAKING CO. LTD	ME/CONF/7/1/15/169
165	HAPROTUK ESTATES LTD	ME/CONF/7/1/15/73
166	KAREME PETROL STATION	ME/CONF/7/1/15/159
167	KATWE MARKETING AGENCIES	ME/CONF/7/1/15/231
168	KELLY PETROLEUM LTD	ME/CONF/7/1/15/102
169	KENLINK INTERNATIONAL LTD	ME/CONF/7/1/15/223
170	KENTESOM LTD	ME/CONF/7/1/15/204
171	KENYA INDEPENDENT PET. D.	ME/CONF/7/1/15/114

1	ABDI JUMA AWALE FILLING STATION	ME/CONF/7/1/15/217
172	KENYA INVESTMENT OIL AND TRANSPORT	ME/CONF/7/1/15/251
173	KENYA MULTITRANSPORT LTD	ME/CONF/7/1/15/179
174	KENYA OIL LTD	ME/CONF/7/1/15/4
175	KESTER KENYA LTD	ME/CONF/7/1/15/5
176	KENYA SHELL LTD	ME/CONF/7/1/15/6
177	KEY GAS PRODUCTS LTD	ME/CONF/7/1/15/270
178	KISSI PETROLEUM PRODUCTS	ME/CONF/7/1/15/93
179	KITHIME OIL KENYA LTD	ME/CONF/7/1/15/127
180	KOBIL PETROLEUM LTD/KENOL	ME/CONF/7/1/15/5
181	KORU STORES (KENYA)	ME/CONF/7/1/15/291
182	LADBROKE HOLDINGS KENYA LTD	ME/CONF/7/1/15/256
183	LANSEAIR LIMITED	ME/CONF/7/1/15/314
184	LIAM LTD	ME/CONF/7/1/15/139
185	LIBRA SPORT SERVICES LTD	ME/CONF/7/1/15/49
186	LONEK ENTERPRISES	ME/CONF/7/1/15/346
187	LUBSCHEM KENYA LTD	ME/CONF/7/1/15/92
188	MAFUTA LINK ENTERPRISES	ME/CONF/7/1/15/191
189	MAFUTA PRODUCTS LTD	ME/CONF/7/1/15/47
190	MANLOK ENTERPRISES	ME/CONF/7/1/15/161
191	MANTISSA ENTERPRISES	ME/CONF/7/1/15/331
192	MARKER INVESTMENT LTD	ME/CONF/7/1/15/44
193	MASCOT ENTERPRISES	ME/CONF/7/1/15/228
194	MASEFIELD TRAKING KENYA LTD	ME/CONF/7/1/15/91
195	MATUTA AND PARTNER ENTERPRISES	ME/CONF/7/1/15/142
196	MAXLUBE LIMITED	ME/CONF/7/1/15/310
197	MEGA PETROLEUM	ME/CONF/7/1/15/95
198	MENENGAI ENGINEERING AND PETROLEUM	ME/CONF/7/1/15/285
199	MENENGAI NGIERING AND	ME/CONF/7/1/15/209
200	METRO PETROLEUM LTD	ME/CONF/7/1/15/107
201	MGS INTERNATIONAL KENYA LTD	ME/CONF/7/1/15/261
202	MIBEN KENYA LTD	ME/CONF/7/1/15/145
203	MID OIL AFRICA	ME/CONF/7/1/15/24
204	MID RIFT MERCHANTS LTD	ME/CONF/7/1/15/352
205	MID RIFT MERCHANTS	ME/CONF/7/1/15/148
206	MIRIGREEN LTD	ME/CONF/7/1/15/149
207	MIMI TIMBER SUPPIES	ME/CONF/7/1/15/118
208	MOBIL OIL KENYA LTD	ME/CONF/7/1/15/3
209	MOBIPLUS AGENCIES	ME/CONF/7/1/15/306
210	MOCO AFRICA LTD	ME/CONF/7/1/15/248
211	MOCOH ENERGY KENYA LTD	ME/CONF/7/1/15/108
212	MOCOL KENYA LTD	ME/CONF/7/1/15/351
213	MODE5N DISTRIBUTORS	ME/CONF/7/1/15/157

1	ABDI JUMA AWALE FILLING STATION	ME/CONF/7/1/15/217
214	MODEX ENTERPRISES	ME/CONF/7/1/15/337
215	MOIL KENYA LTD	ME/CONF/7/1/15/240
216	MOSAIC KOLDINGS LTD	ME/CONF/7/1/15/286
217	MUCHARAGE PETROLEUK LTD	ME/CONF/7/1/15/300
218	MUJTAHID FREIGTERS	ME/CONF/7/1/15/173
219	MULTI RELIACNCE KTD	ME/CONF/7/1/15/221
220	MULTI SHPPERS LTD	ME/CONF/7/1/15/211
221	MUMINEEN FREIGHTERS	ME/CONF/7/1/15/203
222	MWAKE KENYA LTD	ME/CONF/7/1/15/129
223	NAFIL AUTOMOTIVE COMPONENT LTD	ME/CONF/7/1/15/229
224	NAIMA ENTERPRISES	ME/CONF/7/1/15/141
225	NAIMA TRADING CO.	ME/CONF/7/1/15/329
226	NAJIB OIL LTD	ME/CONF/7/1/15/219
227	NATIONAL OIL CORPORATION OF KENYA	ME/CONF/7/1/15/9
228	NECTEL (K) LTD	ME/CONF/7/1/15/10
229	NECTA OIL PETROLEUM	ME/CONF/7/1/15/253
230	NESSO OILS LTD	ME/CONF/7/1/15/50
231	NISALEN FREIGHTERS LTD	ME/CONF/7/1/15/279
232	NORTH WEST PETROLEUM	ME/CONF/7/1/15/196
233	NYAYAR INVESTMENT LTD	ME/CONF/7/1/15/166
234	OCEANIC BUNK AND OIL PR. LTD	ME/CONF/7/1/15/119
235	OFILO ENTERPRISES LTD	ME/CONF/7/1/15/181
236	OILCOM KENYA LTD	ME/CONF/7/1/15/259
237	OILMARK EASTERN AFRICA KENYA LTD	ME/CONF/7/1/15/326
238	OJODE AND COMPANY	ME/CONF/7/1/15/294
239	OMAOIL KENYA LTD	ME/CONF/7/1/15/295
240	OMAR PETROLEUM LTD	ME/CONF/7/1/15/292
241	OYSTER HOLDING LTD	ME/CONF/7/1/15/267
242	P.J. PETROLEUM EQUIPMENT	ME/CONF/7/1/15/133
243	PACKAGING AND ALLIED KENYA LTD	ME/CONF/7/1/15/198
244	PAJU & COMPANY	ME/CONF/7/1/15/113
245	PAN AFRICAN PETROLEUM	ME/CONF/7/1/15/38
246	PAN AFRICAN OIL LTD	ME/CONF/7/1/15/268
247	PARRAFINE PETROLEUM PRODUCTS LTD	ME/CONF/7/1/15/12
248	PASSIFLORA ENTERPRISES	ME/CONF/7/1/15/195
249	PEBEA OILS LTD	ME/CONF/7/1/15/336
250	PEMA PETROLEUM PRODUCTS DISTRIBUTORS	ME/CONF/7/1/15/171
251	PENTOIL PETROLEUM LTD	ME/CONF/7/1/15/316
252	PERMANENT WAY CO. LTD	ME/CONF/7/1/15/143
253	PETROKENYA LTD	ME/CONF/7/1/15/155
254	PETROCEL LTD	ME/CONF/7/1/15/36
255	PETROCITY ENTERPRISES LTD	ME/CONF/7/1/15/275

1	ABDI JUMA AWALE FILLING STATION	ME/CONF/7/1/15/217
256	PETROL OIL KENYA LTD	ME/CONF/7/1/15/132
257	PETROLEUM ENERGY DISTRI	ME/CONF/7/1/15/120
258	PETROLINK (EA) LTD	ME/CONF/7/1/15/207
259	PETROLINK LTD	ME/CONF/7/1/15/288
260	PETROPEK LTD	ME/CONF/7/1/15/41
261	PETROPLUS AFRICA KENYA LTD	ME/CONF/7/1/15/280
262	PETSTEP CONSTRUCTION KENYA LTD	ME/CONF/7/1/15/128
263	PLURAL TRADE AGENCIES	ME/CONF/7/1/15/86
264	POWER PURCHASE SYSTEM LTD	ME/CONF/7/1/15/227
265	PRIME OIL TRADING CO.	ME/CONF/7/1/15/228
266	PRISKO PETROLEUM NETWORK LTD	ME/CONF/7/1/15/235
267	QUANTUM BUNKERING LTD	ME/CONF/7/1/15/325
268	QUARREY TRADING CO.	ME/CONF/7/1/15/48
269	QUASAR LTD	ME/CONF/7/1/15/311
270	QURDOBA ENTERPRISES	ME/CONF/7/1/15/34
271	RAMJI HARIBHAI DEVANI LTD	ME/CONF/7/1/15/226
272	RANA ENTERPRISES	ME/CONF/7/1/15/147
273	RANFER COMPANY LTD	ME/CONF/7/1/15/74
274	RASMUD INVESTMENT	ME/CONF/7/1/15/33
275	RELIEF SITE SUPPLIES LTD	ME/CONF/7/1/15/189
276	REMOTE SENSING INFORMATION LTD	ME/CONF/7/1/15/42
277	REXON PRODUCTS KENYA LTD	ME/CONF/7/1/15/200
278	RIJADH PETROLEUM PRODUCTS	ME/CONF/7/1/15/307
279	RIVA OILS COMPANY LTD	ME/CONF/7/1/15/213
280	RIVA OILS LTD	ME/CONF/7/1/15/340
281	RIVA PETOLEUM DEALERS	ME/CONF/7/1/15/78
282	RIVETON INVESTMENT	ME/CONF/7/1/15/272
283	RIZ PETROLEUM LTD	ME/CONF/7/1/15/308
284	ROADSTER LTD	ME/CONF/7/1/15/109
285	ROKAM EQUITY TRADERS	ME/CONF/7/1/15/339
286	ROLYN PRODUCTS	ME/CONF/7/1/15/327
287	ROMO PETROLEUM LTD	ME/CONF/7/1/15/153
288	RWIMPEX PETROLEUM	ME/CONF/7/1/15/53
289	S.G.M INVESTMENT	ME/CONF/7/1/15/239
290	SACHEM PETROLEUM DEALERS	ME/CONF/7/1/15/63
291	SAFINTA LTD	ME/CONF/7/1/15/238
292	SAGEM KENYA LTD	ME/CONF/7/1/15/328
293	SAHARA PETROLEUM LTD	ME/CONF/7/1/15/350
294	SAMAKI BUNKERING SERVICES	ME/CONF/7/1/15/37
295	SAMAKI MANAGEMENT	ME/CONF/7/1/15/140
296	SANIFU SUPPLIES	ME/CONF/7/1/15/83
297	SASCO PETROLEUM CO. LTD	ME/CONF/7/1/15/202

1	ABDI JUMA AWALE FILLING STATION	ME/CONF/7/1/15/217
298	SCHEKAN FREIGHTERS	ME/CONF/7/1/15/90
299	SEED GROUP LTD	ME/CONF/7/1/15/16
300	SEYDOU RESOURCES	ME/CONF/7/1/15/17
301	SERVANT AND LIGHT DEV.	ME/CONF/7/1/15/255
302	SHEMEL COMODITIES	ME/CONF/7/1/15/230
303	SIMOSHA PETROLEUM ENTERPRISES	ME/CONF/7/1/15/66
304	SILENT VENTURES	ME/CONF/7/1/15/67
305	SIRIKWA PETROLEUM DISTRIBUTORS	ME/CONF/7/1/15/182
306	SKYFISH LINE LTD	ME/CONF/7/1/15/88
307	SNOBER LTD	ME/CONF/7/1/15/58
308	SOCIO TRADING CO. LTD	ME/CONF/7/1/15/154
309	SOLCAH ENTERPRISES	ME/CONF/7/1/15/264
310	SOMA INDUSTRIES	ME/CONF/7/1/15/332
311	SOMKEN LTD	ME/CONF/7/1/15/111
312	SONYAK PETOLEUM LTD	ME/CONF/7/1/15/163
313	SOUTH WEST ENERGY RESOURCES LTD	ME/CONF/7/1/15/265
314	SPAKI AUTO SPARES	ME/CONF/7/1/15/188
315	STEGLAD AGENCIES	ME/CONF/7/1/15/116
316	SUB SAHARA PETOLEUM LTD	ME/CONF/7/1/15/353
317	SUEZ DISTRIBUTORS	ME/CONF/7/1/15/54
318	SUNNYLAND TECHNICAL SERVICES	ME/CONF/7/1/15/262
319	SUREGA ENTERPRISES	ME/CONF/7/1/15/330
320	SURUO GENERAL WORKS LTD	ME/CONF/7/1/15/176
321	SYLKWE PETROLEUM INV. CO. LTD	ME/CONF/7/1/15/178
322	TALIB BULK OIL TERMINAL LTD	ME/CONF/7/1/15/277
323	TAWAKAL LTD	ME/CONF/7/1/15/278
324	TANICOM TRADE	ME/CONF/7/1/15/225
325	TARGET SUPPLIES	ME/CONF/7/1/15/26
326	TECAFLEX LTD	ME/CONF/7/1/15/103
327	TEKOIL KENYA LTD	ME/CONF/7/1/15/343
328	TEXTILE DYESTUFF LTD	ME/CONF/7/1/15/115
329	THADAYO OIL KENYA LTD	ME/CONF/7/1/15/99
330	TIMRIKA ENTERPRISES	ME/CONF/7/1/15/315
331	TONWILL ENTERPRISES	ME/CONF/7/1/15/233
332	TOBBY OIL COMPANY	ME/CONF/7/1/15/39
333	TOTAL KENYA LTD	ME/CONF/7/1/15/8
334	TRANS GAS COMPANY	ME/CONF/7/1/15/20
335	TRANS HIGH WAY SERVICE STATION	ME/CONF/7/1/15/199
336	TRANSOIL KENYA LTD	ME/CONF/7/1/15/324
337	TRANS OIL INTERNATIONAL LTD	ME/CONF/7/1/15/183
338	TRANSDEN REED LTD	ME/CONF/7/1/15/184
339	TRENTINA LTD	ME/CONF/7/1/15/85

1	ABDI JUMA AWALE FILLING STATION	ME/CONF/7/1/15/217
340	TRIFOIL PETROLEUM	ME/CONF/7/1/15/51
341	TRITON GAS STATION	ME/CONF/7/1/15/245
342	TRITON PETROLEUM CO.	ME/CONF/7/1/15/22
343	UMALI QURA ENTERPRISES	ME/CONF/7/1/15/55
344	UISYS SERVICE ENTERPRISES LTD	ME/CONF/7/1/15/168
345	UNIVAC TRADERS (EA) LTD	ME/CONF/7/1/15/81
346	VICTOR CONSULTS LTD	ME/CONF/7/1/15/216
347	VIRGIN OIL LTD	ME/CONF/7/1/15/342
348	WAJIR ENTERPRISES	ME/CONF/7/1/15/65
349	WAMAGANA TIMBER HARD WARE AND G	ME/CONF/7/1/15/278
350	WARSAMA PETROL STATION	ME/CONF/7/1/15/257
351	WATA EXPO LTD	ME/CONF/7/1/15/164
352	WAYENI WHOLESALERS	ME/CONF/7/1/15/124
353	WELL PETRLEUM DEALERS	ME/CONF/7/1/15/89
354	WELL PETROLEUM DEALERS	ME/CONF/7/1/15/246
355	WEMCO PETROLEUM LTD	ME/CONF/7/1/15/242
356	WEST POINT CONTRACTORS LTD	ME/CONF/7/1/15/237
357	WIGEDOJE ENTERPRISES LTD	ME/CONF/7/1/15/323
358	WINBAN PETROLEUM	ME/CONF/7/1/15/96
359	YANNA OIL LTD	ME/CONF/7/1/15/254
360	ZENNEX PETROLEUM LTD	ME/CONF/7/1/15/206
361	ZENUS TRADING	ME/CONF/7/1/15/52
362	ZEON OIL LTD	ME/CONF/7/1/15/186
363	ZUHUR FREIGHT LTD	ME/CONF/7/1/15/208
364	ZYNMAT ENERGY LTD	ME/CONF/7/1/15/356

Source: Petroleum Institute of East Africa (2006)

APPENDIX III: COMPANIES IN THE STUDY SAMPLE

	Company Names	Reference Numbers
01	ABHA PETROLEUM LTD	ME/CONF/7/1/15/110
02	AKABA INVESTMENTS	ME/CONF/7/1/15/149
03	ALPHA BETA PRODUCTS LTD	ME/CONF/7/1/15/112
04	AUTOPETROLEUM INTERNATIONAL LTD	ME/CONF/7/1/15/167
05	BEN-WIDE AUTOSPARES	ME/CONF/7/1/15/214
06	BUG 2000 SYSTEMS LTD	ME/CONF/7/1/15/249
07	COPANA LTD	ME/CONF/7/1/15/146
08	DIESEL POWER CO. LTD	ME/CONF/7/1/15/170
09	EASTEIG PETROLEUM PRODUCTS LTD	ME/CONF/7/1/15/201
10	EQUATORIAL ESTABLISHMENTS	ME/CONF/7/1/15/46
11	FLOWER FILLING STATION KENYA LTD	ME/CONF/7/1/15/210
12	GENERATION PETROLEUM LTD	ME/CONF/7/1/15/224
13	GULF ENERGY LTD	ME/CONF/7/1/15/235
14	HEMOGRAM COMPANY	ME/CONF/7/1/15/31
15	IGWE GENERAL STORES	ME/CONF/7/1/15/27
16	JONAFLOW ENTERPISES	ME/CONF/7/1/15/194
17	HAPROTUK ESTATES LTD	ME/CONF/7/1/15/73
18	KESTER KENYA LTD	ME/CONF/7/1/15/5
19	LIBRA SPORT SERVICES LTD	ME/CONF/7/1/15/49
20	MATUTA AND PARTNER ENTERPRISES	ME/CONF/7/1/15/142
21	MID RIFT MERCHANTS	ME/CONF/7/1/15/148
22	MOBIL KENYA LTD	ME/CONF/7/1/15/240
23	NAIMA TRADING CO.	ME/CONF/7/1/15/329
24	OFILO ENTERPRISES LTD	ME/CONF/7/1/15/181
25	PAN AFRICAN PETROLEUM	ME/CONF/7/1/15/38
26	PETROCITY ENTERPRISES LTD	ME/CONF/7/1/15/275

	Company Names	Reference Numbers
27	PRIME OIL TRADING CO.	ME/CONF/7/1/15/228
28	RELIEF SITE SUPPLIES LTD	ME/CONF/7/1/15/189
29	ROKAM EQUITY TRADERS	ME/CONF/7/1/15/339
30	SAMAKI MANAGEMENT	ME/CONF/7/1/15/140
31	SIRIKWA PETROLEUM DISTRIBUTORS	ME/CONF/7/1/15/182
32	STEGLAD AGENCIES	ME/CONF/7/1/15/116
33	TARGET SUPPLIES	ME/CONF/7/1/15/26
34	TRANS HIGH WAY SERVICE STATION	ME/CONF/7/1/15/199
35	UNIVAC TRADERS (EA) LTD	ME/CONF/7/1/15/81
36	WEMCO PETROLEUM LTD	ME/CONF/7/1/15/242

APPENDIX IV: LETTER OF INTRODUCTION- QUESTIONNAIRE

Kenyatta University,
Po Box 43844,
Nairobi

ABHA PETROLEUM LTD
Po Box 46350-00100
Nairobi.

Dear Respondent

RE: Collection of Survey Data

I am a postgraduate student at Kenyatta University, School of Business. In order to fulfill the degree requirement, I am undertaking a management research project on managing price risk using futures: case of oil companies in Kenya

This is to kindly request you to assist me collect the data by filling out the accompanying questionnaire.

The information you provide will be used exclusively for academic purposes. My Supervisor and I assure you that the information you give will be treated with strict confidence. A copy of the final paper will be availed to you upon request.

Your co-operation will be highly appreciated.

Thank you in advance

Yours faithfully,

GIDEON VUNGA NZUKI.

APPENDDIX V: QUESTIONNAIRE TO OIL COMPANIES.

NAME OF COMPANY: ______________________________.

YEARS IN BUSINESS: __________________________.

1) How many stations do you have in Kenya? Please tick one box.

☐ Below 5 stations.

☐ 5-10 stations.

☐ 11-20 stations.

☐ Above 20 stations

2) Which of the following services do you offer? Please tick the applicable box(es).

☐ Import

☐ Export

☐ Wholesale.

3) How many barrels of crude oil do you import per month on average?

.______________________________.

4) Do you consider untimely price changes on crude a big threat to your profits?

☐ Yes.

☐ No. [If you tick this box please go to no.12]

5) Who is entrusted with the hedging against (4) above?

Finance department ------------------------------------

Risk management department-------------------------

Mother company abroad----------------------------

6) How long has this department been in operation handling price risk management?

☐ 1 year.

☐ 2-5 years

☐ 6-9 year.

☐ 10 and above years

7) If yes in (4) above, which of the following derivatives do your organization use to mitigate such price changes?

	Always	Frequently	seldom	never
Futures markets				
Forward contracts				
Options				
Take spot position				

Explain any other method you may be using to hedge against price risk.

---

8) If you use futures market as a tool to check price volatility, what ratio of your total volume do you hedge in the commodity market? Tick one box only.

☐ 0-30%

☐ 31-60%

☐ 61-90%

☐ Above 90%

9) Which model do you use to determine the portion to hedge in (8) above.

	Always	Frequently	Seldom	Never
Minimum variance(MV)				
Ordinary least square(OLS)				
None of the above				

10) According to your opinion, do you consider MV and OLS to be good measures of optimal hedge ratio? Explain your opinion

.--

----

11) When you started using futures contracts in the commodity markets, how has it impacted on your profit margins? Tick one box.

☐ Positively

☐ Negatively

12) Please indicate your company's profitability for the following years

1997	Ksh
1998	Ksh
1999	Ksh
2000	Ksh
2001	Ksh
2002	Ksh
2003	Ksh
2004	Ksh
2005	Ksh
2006	Ksh

Thank you for taking your time to answer all the questions to the best of your ability.

Your assistance is highly appreciated.