FIRM CHARACTERISTICS AND DERIVATIVES HEDGING IN THE OIL AND GAS INDUSTRY

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ABSTRACT

This paper studies the hedging policies of oil and gas firms for the year 2003. My study shows that firm characteristics are significant determinants of the decision to hedge. Leverage and liquidity were found to be characteristics that have a direct correlation with the decision to hedge. Firms with higher leverage ratios and lower quick ratios hedge more extensively. The significance of these characteristics shows that a need for risk management and mitigation arises when a firm is not financially independent and it relies on external sources of capital. Both these characteristics are also directly related to a firm's ability to take advantage of and finance investment opportunities.

DEDICATION

I dedicate this project to my mother for being my inspiration, to my father for encouraging me, to Mahekaan for sacrificing so much, and to my Dost who I can always depend on.

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I would like to thank Dr. Geoffrey Poitras and Dr. Chris Veld for their support, guidance and encouragement. I am grateful to all my teachers for sharing with me their knowledge and expertise and providing moral support.

My appreciation from the bottom of my heart goes to Dost for whose heartfelt support, love and inspiration reinforced my personal desire to complete my degree.

Words would never be enough to express my gratitude to my affectionate father and loving mother, whose love enabled me to move forwards in tough times. I am also grateful to my sisters Zehra and Rabya, and my brother Rameez for their support and affection through life which helped me overcome many difficulties. I express sincere gratitude to all my friends for their assistance throughout life.

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1 INTRODUCTION

Risk is defined a concept which relates to the human expectations. It indicates a potential negative influence to an asset or some characteristic of value that may arise from some present process or from some future event. Financial risk can also be explained as an unexpected change or fluctuation in returns, including better or worse expected returns. All businesses 'financial or non-financial' desire to minimize the risk they face and maximize their returns in order to run a successful business in the short and long term.

There have been numerous developments in the area of risk management. A popular phenomenon for managing risk in the business world is with the use of derivatives. Derivatives are financial instruments whose values are derived from other instruments. These instruments are used for hedging and reducing the impact of the different types of risks that a firm might face. Recently the corporate world has seen a rapid growth in the use of derivatives.

Similar to other industries the oil and gas industry also strives to manage highly volatile returns. Oil and gas firms are affected by a number of risk factors including political risks, geographic risks and market risks. The intensity of the effects of these factors varies from region to region because of differing levels of regional. In particular global oil and gas prices are affected by the regional disturbances, due to highly sensitive nature of this industry. The high sensitivity of this business has in turn lead to extremely volatile years.
Developments in the field of risk management and the availability of new tools to mitigate risks, has enabled firms to better manage volatile returns, demand and price fluctuations, which impact the regularity of cash flows.

2 RISK MANAGEMENT

Risk management can be defined as stepwise process of firstly measuring, secondly, assessing risk and finally developing strategies to manage the risk. Financial risk management on the other hand focuses on risks that can be managed with the use of traded financial instruments. Poitras (2002) identifies risk management as a multi-step process which consists of the following steps: (1) outlining the level of risk that is desirable for an organization; (2) comparing the desired level to its current level of risk and; (3) modifying the current level of risk to the desired level through the use of derivatives and other financial instruments.

Risk is managed in order to minimize the possibility of negative returns and also to keep actual returns as close to the forecasted returns as possible. By minimizing risk future investments can be made with ease and the firm can withstand financial shocks and hardships.

Managing risk has evolved into such a broad and significant element of business that organizations have devoted entire departments to risk management. In firms big and small, risk management departments analyze the different risks associated with a multitude of transactions. This is because risk management activities and hedging can protect corporations from risks and also enable them to profit from the opportunities arising from them.

2.1 Hedging and Use of Derivatives

Hedging is a strategy of designing trades to cancel out the impact of another trade while still being able to take advantage of an investment opportunity. It is specifically used to cancel out the risk associated with another investment. Hedging can be carried out by investing in a

number of securities. Derivatives are also used as instruments for hedging. The scope of this paper is limited to hedging with derivatives in the oil and gas industry.

Typically, a hedger might invest in a security that he believes is under-priced relative to its "fair value" (for example a mortgage loan), and combine this with a short sale of a related security or securities. Thus the hedger does not care whether the market, as a whole, goes up or down in value, he only cares if the under-priced security appreciates relative to the market.

The use of corporate derivatives and the extent to which they are used make them a significant factor in determining the value and volatility of firms. For this reason their impact and implications cannot be overlooked. There are a number of reasons which make the oil industry an appropriate example for the study of hedging with derivatives. First, the industry faces volatility in price and therefore it needs to hedge for the risks caused by volatility. Second, oil and gas derivatives are traded on the exchanges so firms can choose to hedge their risks using futures, forwards, options and swaps.

Haushalter (2000) outlines three main factors the oil and gas industry provides a better illustration of hedging policies. Specifically they are: (1) exposure to cash flow fluctuations due to significant impact of changing prices; (2) availability of derivatives on organized exchanges; (3) measurability of the percentage of annual production that is hedged against the varying prices.

2.2 Accounting for Derivatives

Derivatives are an essential tool for risk managers which enable them to manage their risks more efficiently. But there are several drawbacks associated with the use of derivatives. First and foremost is the accounting issue. Given the current accounting rules and regulations, derivatives are very hard to account for properly in the financial statements of a company due to the very nature of the instruments. The instruments are hard to put an exact value upon due to the

unavailability of market data. This leads to the derivation of the value from mathematical models based on different assumptions. As a result there might be a discrepancy in the actual value and the book value of these instruments. This could have a considerable impact on the values reported in the financial statements. Therefore, the use of derivatives has been a very debatable and controversial issue. After the Enron, Metallgesellschaft cases, the use of derivatives has become somewhat of a suspicious phenomenon in terms of whether it is able to maximize shareholders wealth or not. And how better accounting practices can prevent the misuse of derivatives. Major difficulties exist in appropriately accounting for the derivatives and the transactions related to them.

Although the new SFAS 133/138 requires disclosure by companies on a much larger scale there are still loopholes that remain in the accounting regulations. SFAS 133 requires firms to discuss their hedging objectives and strategy and their use of derivatives to meet these objectives. Firms are required to disclose the net gain or loss, in net income or other comprehensive income, separately for fair value hedges and cash flow hedges. Firms are also required to disclose where these net gains or losses appear in the income statements. These disclosures help user of financial reports to spot hedge ineffectiveness or speculation.

One of the strengths of SFAS 133 is that it requires derivatives, used for hedging of other fair value derivatives and financial instruments, to be reported at fair value. This is attribute is not useful when comparing firms that use natural hedges to firms who hedge using derivatives. It also requires that gains and losses on ineffective part of overall effective hedges, except for cash flow underhedges, be immediately reported to net income. This allows for hedge ineffectiveness to be the cause of economic volatility and not treated as a transaction cost or deterministic fee which was the case under prior accounting regulations.

Another weakness associated with SFAS 133/138 the use of internal models to fair value derivatives. Since each firm can implement internal models at their own discretion, it becomes very difficult for outside investors to make comparisons across firms. Internal models can have very different fundamental assumptions as there are no strict guidelines that must be adhered since regulation of alternative investment products is very difficult. The regulation authority would have to have an in-depth knowledge of numerous highly complex financial products in order for regulation to be effective, but this is simply not realistic given the lack of human resources available with the necessary skills.

3 MOTIVATIONS FOR HEDGING

Two theories have been brought forward as to why managers undertake risk management activities. The first theory suggests that managers engage in hedging activities for risk management to maximize shareholders wealth by reducing the volatility of cash flows. There are three explanations for this motivation: (1) hedging reduces the expected costs associated with financial distress; (2) tax incentives associated with hedging activities, such as, convexity of a tax function reduces taxes, and, provide firms with greater leverage and a greater tax advantage; (3) hedging enables firms to take advantage of new investment opportunities. Being financially sound demonstrates that a firm can successfully finance other ventures and make full use of available investment opportunities.

The second theory suggests that hedging is used to increase managerial utility. This relates to the risk aversion of individuals. Risk averse managers seek to minimize the financial instability of the firm to protect their reputation and their status. Hedging allows them to perform their responsibility of maintaining the corporation's financially health. It also contributes toward helping their reputation as proficient managers, which in turn, allows them to keep their jobs and their remuneration.

In a study on hedging, Haushalter (2000) castes doubts on the second motive as an individual motive. He states that this motive is ultimately for the increase in shareholders wealth due to the costs linked to corporate hedging. Miller et. al. (2000) conducted a survey on the New Zealand market and its use of derivatives. They found that their results were consistent with those of the UK and US and that the single most important reason for hedging was to minimize fluctuation in real cash flows. The effects of hedging on firm value have been the focus of numerous research

studies. There are conflicting theories presented on the impact that hedging has on the value of a firm. In the following section I have attempted to discuss these theories.

3.1 Effects of Hedging on Firm Value

Informational asymmetries, taxes, transaction costs are the reasons that financial hedging can add value to a firm. These imperfections of the market are the underlying principle for hedging. In efficient markets, shareholders are able to negate such risk management activities at the same cost. Earlier theories such the classic Modigliani and Miller hypothesis suggest otherwise. It advocates that shareholders can manage risk by the use of well diversified portfolios.

Allayannis and Weston (2001) proposed that the value of firms with foreign operations is affected by the behaviour of the exchange rate. Firms reap the full benefits of hedging when the dollar appreciates and they have a net long position. In time periods when the dollar depreciates unhedged firms face financial distress relative to hedged firms. So hedging proves to be valuable in both instances.

4 LITERATURE REVIEW ON OIL AND GAS INDUSTRY PRACTICES: HEDGING WITH DERIVATIVES

The oil and gas industry is one of the most important and closely monitored industries in the world. A major fluctuation in the oil and gas industry has the potential of disturbing the global economic system and even crashing it. Any minor changes in the prices of oil are immediately reflected on stock exchanges around the world.

The oil industry itself faces a number of risk factors, although oil seems to have an endless power over the world economic system. Similar to the other firms the oil-producing firms also engage in risk management and use techniques such as hedging discussed above. I explore the research available on the determinants of hedging for these companies, in relation to the rest of the industry.

The oil and gas industry differs from the other industries in man respects. There are a number of oil and gas firms that do not engage in hedging. Among those firms, who do employ derivatives, the percentage of production hedged varies considerably. The empirical studies researched for this purpose also differentiate between the two aspects particular to the oil industry. Companies differ in the extent to which they choose to hedge with derivatives The characteristics of the firms that decide to hedge differ from the characteristics of those who do not engage in the hedging activities.

4.1 Decision to Hedge

Haushalter (2000) surveyed 100 oil and gas producing firms and concluded that the following characteristics are significant factors, in determining a firm's decision to hedge, or not:

1. **Size**: In his research size was not found associated with the extent a company hedges. The reason could be that smaller firms benefit more from hedging due to the difficulty they face in obtaining outside financing. The cost of hedging could be also associated with the risk management program and not the extent to which a company hedges. This argument is defended by Mian (1996)
2. **Location of reserves**: Firms located in regions which are the basis for the derivative pricing hedged more extensively.

The other variables given below were found not be significant for a firm's decision to hedge.

3. **Dividend payout**
4. **Bond rating**
5. **Debt ratio:** This is supported by the study conducted by Nance et.al (1993) who find that firms that hedge have greater growth opportunities.
6. **Production cost:** This factor was also found not to be significant.
7. **Insider ownership:** The significance of this factor is related to the motive of managerial utility. The risk aversion of individual who own part of the stocks plays a part in determining this factor. But the correlation between this factor and the extent of hedging is found to be negative.
8. **Options held by insiders:**

Dividend Payout, bond rating and debt ratio are factors that determine the difficulty for a firm to obtain outside financing. In such cases, a company would retain earnings instead of paying a dividend to be available for future investments and for times of financial distress. The bond rating of a firm also demonstrates the ability of a firm to obtain outside debt. The debt ratio is also a similar indicator. Thus the more difficult it is for a firm to secure outside financing the

greater its derivative activity. In other words there exists a positive relationship exists between the financial leverage and the extent to which a company hedges

Tufano (1996) observed that companies with low liquidity have higher hedge ratios whereas companies that do not offer shares to the managers rather reward then with stock option hedge less extensively. Guay and Kothari (2003) studied 234 firms to determine the extent to which firms hedge. Their results suggested that the scale of the derivatives positions held by most firms was small compared to their risk exposures. This was based on the assumption that firms who do decide to hedge perceive that the benefits of the derivatives program far exceed the costs associated with it.

4.2 Risk Exposures

According to Poitras (2002) to determine the risk exposure of a company we have to first analyse its economic exposure and accounting exposure. The measure used for economic exposure gauge the effects of a certain financial or commodity price on the net cash flow of the firm, such as the interest rate level and term structure. On the other hand, accounting exposures measures the risks on a transaction by transaction basis, it is focused on the specific transaction under consideration. Therefore the risk exposure is equal to the size of the transaction.

The method used to determine a firm's risk exposure is of extremely significant. If an exposure is an economic risk exposure such as a change in the level of the interest rates but instead it is wrongly identified as an accounting exposure of for example, production volume and production volume is hedged then the consequences can prove to be disastrous. On one hand the firm is completely exposed to the interest rate risk and on the other hand it is incurring the additional costs of hedging a risk that might not exist. Determination of the correct risk exposure is fundamental to risk management for a firm including Oil and Gas firms.

4.3 Hedging and Firm Value

Nance, Smith and Smithson (1993) identified corporate hedging as the use of off balance sheet instruments to reduce the volatility of firm value. The instruments used are derivatives such as future, forwards and swaps.

Corporations are exposed to uncertainties regarding a variety of prices. Hedging refers to activities undertaken by the firm in order to mitigate the impact of these uncertainties of the value of the firm (Mian 1996).

A number of studies have been conducted on how hedging affects the firm value in inefficient markets.

- Lowered contracting costs. (Mayers and Smith 1982)
- Imperfect access to external capital markets motivates hedging (Froot, Scharfstein and Stein1993)
- Financial distress costs (Mayers and Smith 1982 and Smith and Schultz 1985)
- Reduction in agency costs (Mayers and Smith 1982 and Bissembinder 1991)

Allaynnis and Weston (2001) study the effects of foreign currency on firm value using a sample of 720 large non-financial firms. They used Tobin's Q as a proxy for firm value. The control variables they used are:

1. Firm size:
2. Profitability
3. Investment growth
4. Access to financial markets
5. Leverage
6. Production costs
7. Geographic diversification

8. Industry effect
9. Credit rating (quality)
10. Time effects

They observed that the use of foreign currency derivatives increased value by an average of 4.87%. They also show that firms that start the policy of hedging see an increase in the firm value relative to firms that do not hedge. And the vice versa is true for firms that decide to stop hedging with foreign currency derivatives relative to firms that continue to hedge.

Jin and Jorion (2006) study a sample of 119 oil and gas firms over the period of four years from 1998 to 2001 to determine the effects of hedging on firm value. They use the following control variables:

1. Firm size:
2. Profitability
3. Investment growth
4. Access to financial markets
5. Leverage
6. Production costs
7. Industrial and geographic diversification

Their study differed from Allaynnis and Weston (2001) in the sense that they used a lesser number of control variables and their study was specific to the oil and gas industry.

They concluded that the issue of derivatives being able to add firm value if not clear and as simple. It is also cannot be generalized for an industry rather it is dependent upon the multitude of risks that a certain firm is facing.

5 OVERVIEW OF THE OIL AND GAS INDUSTRY

5.1 Unique Characteristics of the Oil and Gas Industry

The oil and gas industry has unique characteristics that allow us to use it as a better example in risk management studies. One of these characteristics is the periods of very high volatility in the oil and gas industry. These periods also have a large impact on other industries due to their dependence on the energy sector.

The volatility faced by the oil industry depends on several political, economical and geographic factors. It is also an integral part of every economy in the world and the global economy as a whole. The prices of most commodities are correlated to the price of oil and gas. This makes the oil and gas industry a focus of many studies, observations and research.

Another unique characteristic is the ever increasing demand for the commodity. In contrast to increasing demand, the reserves are not increasing at the same rate. This automatically causes investors to be nervous which in turn leads to higher prices and an increase in volatility. The higher volatility and production uncertainty of the oil and gas industry has caused energy companies to be actively engaged in risk management activities. Therefore, it has advanced further in the field of risk management when compared to other industries.

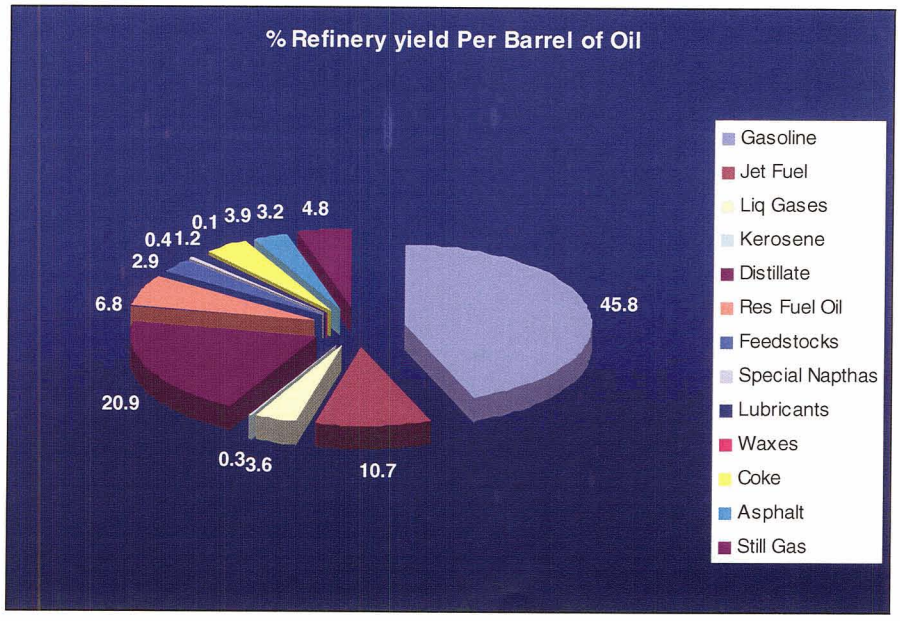
Risk management leads to the use of derivatives for hedging purposes. The use of derivatives has increased with risk management. And the oil and gas industry is unique because it has been using derivatives for quite some time which makes them an industry that is advanced in derivatives usage for risk management purposes. Relevant Data is more easily available due to the new disclosure requirements under the SFAS No. 133/138 for the purpose of analysis. These

unique characteristics make the oil and gas industry an ideal industry for a study of risk management.

5.2 Oil and Gas Market

The oil & gas market consists of the activities of exploration, development, production, refining, storage, transportation and marketing of oil & gas. It is mainly produced for energy purposes but there are a number of by-products of crude oil. These by-products have a number of uses.

Figure 1 Percentages of Refinery Yield per Barrel of Oil



5.3 Oil and Gas Production around the Globe

There is a long-standing proven correlation between energy use and population and economic growth. Economic growth continues to require reliable and affordable supplies of all

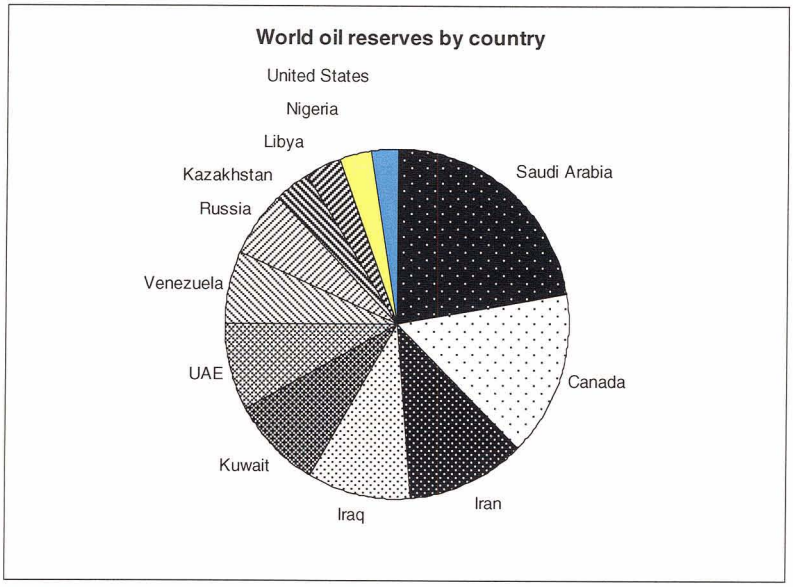
forms of energy. Events in 2003, such as the major power outage in Ontario and the north-eastern United States, showed us a glimpse of the reality that could face us due to breakage in the inextricable link between energy use and our way of life. Oil and natural gas supply a major proportion of this growing demand and will remain the dominant source of the world's energy for at least the next several decades. No other source of energy provides a competitive combination of availability, affordability, efficient infrastructure and relative ease of safe handling and storage. In addition, petroleum provides the feedstock for literally thousands of products that are critical to our daily lives and economic activity.

The total annual production in the year 2003 was 83,004700 barrels per day. Saudi Arabia topped the list of oil producing countries with 10,076800 barrels per day which is 12.7% of the world total production. Canada ranked at number 9 in the world with 3,109600 barrels per day almost 4% of the world production. Saudi Arabia will peak oil production in 2006 and the mid point for depletion of its reserves is 2010. Canadian oil production set to nearly double by 2020. Total Canadian oil production is projected to increase from 2.5 million barrels per day (b/d) in 2005 to 4.6 million b/d in 2015.

5.4 Oil and Gas Reserves by Country

The following graph shows the distribution of the reserves of oil by country.

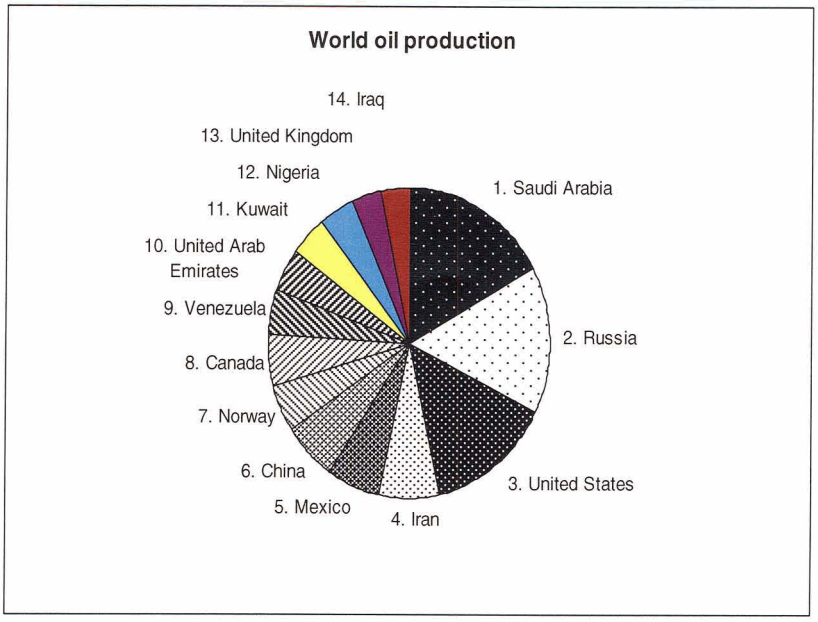
Figure 2 Oil Reserves of the World by Country



5.4.1 Oil and Gas Producing Countries

The following figure shows the distribution of oil production globally.

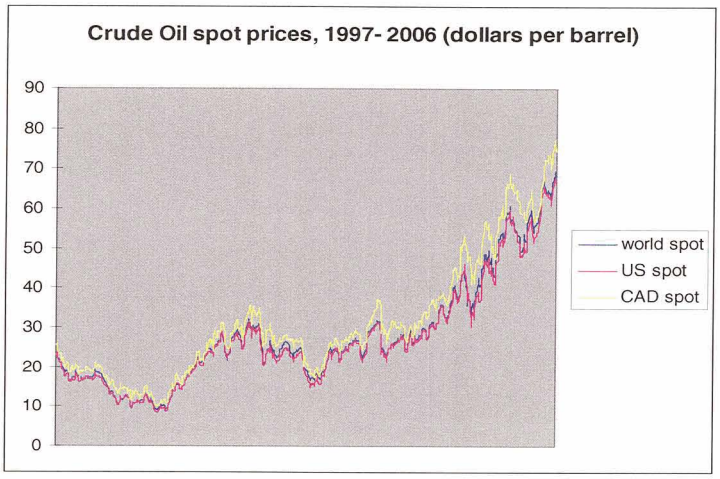
Figure 3 World's Oil Production by Country



5.5 Oil and Gas Prices

It is the price of the crude oil and the fluctuations in that price that cause the volatility in cash flows. Shown below is a comparison between the prices of crude oil over the years.

Figure 4 Crude Oil Spot Prices, 1997-2006



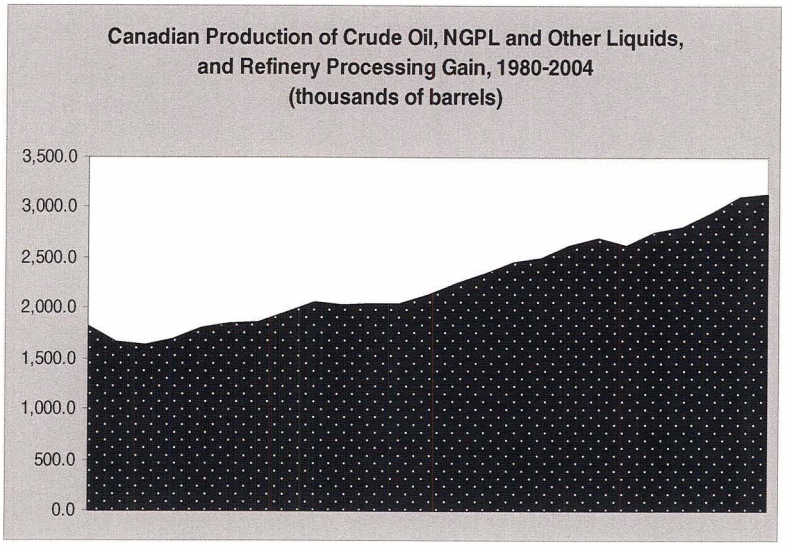
5.6 Canadian Oil and Gas Industry

Canada has vast, unexploited oil and gas reserves which contribute greatly to its economy and will keep on doing so for decades to come. But Canada is one of the most expensive places in the world to explore and produce oil and gas due to its severe weather. Recovering oil and gas from the majority of Canadian sites is a highly technical, complex, dangerous and expensive job. The conditions faced in Canadian oil production by the companies are among the most inhospitable in the world and therefore the companies operating in these conditions have to be technologically innovative and have to invest heavily in safe and efficient techniques to remain competitive.

Canada holds the world's second-largest oil reserves placing Canada ahead of Iraq and Iran and behind Saudi Arabia., taking into account Alberta oil sands previously considered too

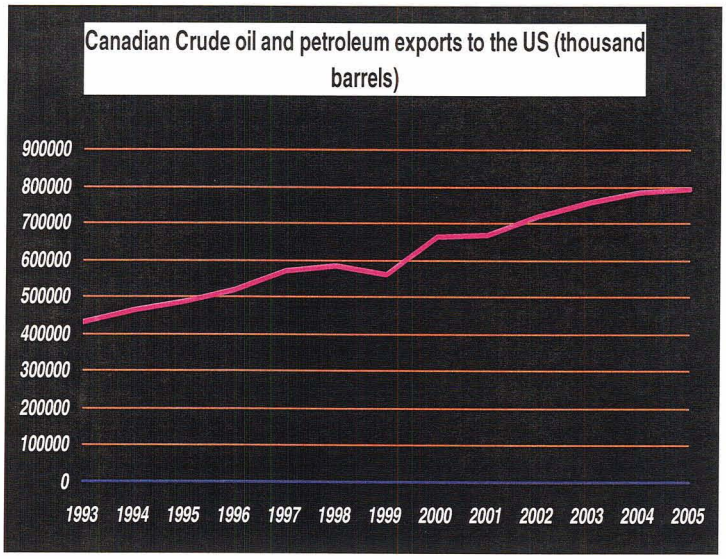
expensive to develop. Approximately 80% of Canada's oil and gas manufacturing and services facilities are located in Alberta and the remainder are in Newfoundland and Nova Scotia. The Alberta oil sands were previously not considered to be recoverable due to the associated costs. But now technology has enabled the exploration and thus Canada's proven oil reserves have swelled to 180 billion barrels from 4.9 billion barrels. CAPP's (Canadian association of petroleum producers) own estimate of Canada's recoverable oil sands is 315 billion barrels.

Figure 5 Canadian Production of Crude Oil



Canada produces more oil and gas than half of the OPEC members making it one of the largest producers of oil and gas in the world. Most of the oil and gas produced by Canada is used to fulfil US needs. Canada sends over 99% of its crude oil exports to the U.S., and the country is one of the most important sources of U.S. oil imports. During the first eleven months of 2004, Canada exported 1.62 million bbl/d of crude oil to the U.S., the single-largest component of U.S. crude oil imports. Canada also sent some 500,000 bbl/d of petroleum products to the U.S. during this period, the most from a single country.

Figure 6 Canadian Crude Oil Exports to the US



Canada's total oil production (including all liquids) was 3.1 million barrels per day in 2004, making it the seventh-largest oil producer in the world. Canada was also the seventh-largest world oil consumer in 2004 at 2.3 million barrels per day. The country's oil production has been increasing since 1999, as new oil sands and offshore projects have come on-stream to replace aging fields in the western provinces. Overall, analysts predict that oil sands production will increase significantly in coming years and offset the decline in Canada's conventional crude oil production. Canadian oil sands could produce 2.2 million barrels a day by 2025. The Canadian Association of Petroleum Producers estimates current projects will raise Alberta oil sands production to 1 million barrels per day in 2005 and continuing development will raise it further to 1.8 million barrels per day by 2010.

The oil and gas market in Canada generated total revenues of $97.7 billion in 2004, representing a compound annual growth rate (CAGR) of 11.6% for the five-year period spanning 2000-2004. The last four years have seen incredible growth in this market, with a monumental rise in value from the $63 billion in revenues generated in 2000. The oil and gas market in Canada is forecast to decelerate its current performance as the market matures, with an

anticipated CAGR of 4.4% for the five year period 2004-2009. Continued expansion and exploration is expected to drive the market's value to $120.9 billion by the end of 2009.

5.6.1 Past and Present States of the Oil and Gas Industry

Reflecting increasing consumer demand for petroleum products, world crude oil demand has been growing at an annualized compound rate slightly in excess of 2 percent in recent years. Demand growth is highest in the developing world, particularly in China and India (each with a population in excess of 1 billion) and to a lesser extent in Africa (0.8 billion) and South America (0.35 billion). Where high demand growth exists it is primarily due to rapidly rising consumer demand for transportation via cars and trucks powered with internal combustion engines. For economic and/or political reasons, this high demand growth component did not exist in most of the developing world even a decade ago. Dire effects on world oil prices, the welfare of mankind in general, and the United States' economy and lifestyle in particular are typically alleged to implicitly follow the predicted peaks. The times for many of these predicted peaks has already come and gone, or will soon do so.

The main issue that the world faces regarding the oil industry is the supply. Rising prices and the current thin cushion of spare oil production capacity hints a crisis regarding oil supply. The absence of lower-cost alternatives and high demand will not allow supply sustainability at the current prices. The worldwide production peak will in part depend on the rate of demand growth, which is subject to reduction via both technological advancements in petroleum product usage such as hybrid-powered automobiles and the substitution of new energy source technologies such as hydrogen-fed fuel cells where the hydrogen is obtained, for example, from natural gas, other hydrogen-rich organic compounds, or electrolysis of water. It will also depend, in part, on the rate at which technological advancement, operating in concert with world oil market economics,

accelerates large-scale development of unconventional sources of crude such as tar sands and very heavy oils.

The most fundamental challenge facing the global oil industry is to increase the capacity of oil production. Although there have been recent downside factors such as the slowing rate of expansion of capacity in Russia and continuing problems in Iraq, this is balanced by a more positive outlook for major producing countries such as Angola and Brazil, where a stream of large projects continues

One of the greatest problems at present is the severe lack of qualified manpower resources and limits imposed by rig and yard availability and materials. At current high oil prices, most oil companies want to increase activity levels, especially with existing producing fields, that will have a rapid return on investment, but increased competition has driven the cost of manpower and services higher. In addition, although we do not see a global peak in production capacity, the rate of growth in non-OPEC capacity will likely slow after 2010.

Political risks also have an impact on the capacity of expansion in the Middle East. The situation in Iraq continues to be highly problematic, and there is growing uncertainty about future events in Iran. In Russia, changes in ownership, the constraints of geology, and the fiscal and regulatory systems, as well as logistical bottlenecks and geological challenges have led to a decline in the growth of supply. In Venezuela fiscal and political changes have hindered the recovery of oil production and investment in the aftermath of the late 2002/early 2003 disruption and will likely further impact future oil production.

5.7 Major Market Risks Faced by the Oil and Gas Industry

The major market risks that the oil and gas industry faces are commodity price risk, interest rate risk, and exchange rate risk. These are the risks that can be hedged with the use of

financial derivatives. This study attempts to find a correlation between firm characteristics and hedging with derivatives for these risks.

5.7.1 Commodity Price Risk

Commodity risk refers to the uncertainty of future market values and of the size of the future income, caused by the fluctuation in the prices of commodities. Oil has an enormous price risk associated with it due to its volatility. This volatility and risk affects all the aspects of the finances of a firm. The price of oil is influenced by a number of factors that are beyond control. These factors range from speculation by traders, inflation rate, economic and political events, the dollar exchange rate, to a rise in demand. To be able to meet its obligations and mitigate the risk of decrease in income, a business can hedge the movements in the price of oil. There are a number of derivatives available which can be used for risk management purposes. A few examples are futures, forwards, options, swaps, and collars.

5.7.2 Interest Rate Risk

Interest rate risk is the risk that the relative value of a security, especially a bond, will fall due to an increase in the rate of interest. Oil producing companies are involved in a number of transactions that are directly related to the interest rate. Most of the borrowings and lendings and their value is correlated to the rate of interest. An increase in the rate of interest would reduce the value of such transactions which would result in a major financial short fall for the company. An adverse decrease in rate of interest would mean that the interest earnings for the company are reduced having a direct effect on the cash flows. Such increases and decreases would also have a huge impact on the prices of forward contracts.

Oil companies are exposed to interest rate risk on their variable rate debt of long term maturity. Risk management practices allow companies to mitigate this risk with the use of financial derivatives.

5.7.3 Exchange Rate Risk

Exchange rate risk is the risk that a business' operations or an investment's value will be affected by changes in exchange rates. Most of the oil companies have drilling and exploration operations in several countries or regions, which exposes them to currency risk. A change in the exchange rate can cause prices to inflate whereas the earnings on the other hand could be deflated. The operations that can affect the company cash flows and expose a firm to exchange rate risk are long term commitments for example long term debt or investments. Such investments are common in the oil industry due to operations scattered globally. Financial derivatives are widely used to mitigate the effects of exchange rate risk.

6 DATA AND METHODOLOGY

This study is conducted on 14 publicly traded oil and gas producing companies. Production of oil and gas is their primary business. These companies share common risks and their hedging practices are determined by their particular firm characteristics.

All companies are traded on the Toronto Stock Exchange except one is traded on the NYSE. The companies are all headquartered in Canada except two of them are head quartered in the US. The table below has the company name, location, exchange traded and ticker symbol.

Table 1 List of Sample Companies

Company Name	location	Exchange traded	Ticker symbol
Apache Corp	US	NYSE	APA
BlackRock Ventures Inc	Canada	TSX	BVI
Centurion Energy Int. Inc	Canada	TSX	CUX
Enbridge Inc	Canada	TSX	ENB
Encana Corporation	Canada	TSX	ECA
Esprit Exploration Ltd	US	TSX	EEE
Husky Energy Inc	Canada	TSX	HSE
Imperial Oil Ltd	Canada	TSX	IMO
Nexen	Canada	TSX	NXY
Petro Canada	Canada	TSX	PCA
Shell Canada Ltd	Canada	TSX	SHC
Canada Southern Petroleum Ltd	Canada	TSX	CSW
Suncor Energy	Canada	TSX	SU
Talisman Energy	Canada	TSX	TLM

The derivative and financial data used for the purpose of the study was obtained from the companies' annual reports and 10 k forms filed with the Securities and Exchange Commission (SEC). The financial ratios obtained and other firm characteristics data was obtained from Compustat.

I ran regressions for each of the firm's characteristics and the decision to hedge it production to find a possible relationship between the two. The results of this regression are not conclusive due to the small size of the sample. Any extreme value in the firm characteristics can cause the results to be distorted and superficial.

7 DERIVATIVES USAGE FOR OIL AND GAS FIRMS

The sample is divided into two groups i.e., firms that use derivative for hedging purposes and firms that do not use derivatives for hedging. Data used for the fiscal year 2003. Among the sample of 14 firms only 3 firms did not use derivatives to hedge their risks. Rest of the 10 firms used derivatives to hedge at least one of their market risks, which are commodity price risk, interest rate risk and exchange rate risk.

The firms that did not use derivatives for risk mitigation is due to the reason that it involves complicated accounting practices. They also perceived it as a matter of integrity since derivative instruments are associated with the motive to alter the real value of the accounts. BlackRock Ventures and Canada Southern petroleum have the advantage of a competitive cost structure which seems to be their motivation for not using derivatives. The former also believes that it does not need to hedge its major market risks because it maximizes its shareholders utility.

All the derivatives user firms hedged their commodity price risk with derivatives. And 57 percent of the firms were involved in hedging of all three risks, namely price risk, interest rate risk and exchange rate risk with derivatives use. None of the firms used in the sample hedged commodity price risk and interest rate risk only or commodity price risk and exchange rate risk only.

This study attempts to find a relationship between the firm characteristics and the decision to actively use derivatives for risk management purposes. The sample includes derivative user firms and derivative non user firms since it allows one to better analyze the

motives behind the use of derivatives for particularly the oil and gas industry. The firm characteristics that I used for this study are

1. Access to capital markets

The degree of access to capital market plays a major part in a firms risk and risk management decisions. Better access to capital markets ensures that the firm is able to meet its obligations and take advantage of better investment opportunity at competitive costs. This is related to the credit rating or the credit strength of a firm. A financially sound firm has a better chance of having access to capital markets and cheaper sources of funds as compared to a firm that is not financially as sound. We can analyze the credit strength of a firm by looking at a few variables that give us indications of the firm being financially sound. These are

a. **Dividend payout ratio**: The dividend payout ratio is the ratio of yearly dividend per share and the earnings per share. The payout ratio provides an idea of how well earnings support the dividend payments. More mature companies tend to have a higher payout. A firm paying dividend is assumed to have performed financially well during the past year and therefore has surplus earnings that it is able to distribute among it shareholders. A firm pressed financially would not be able to do so. 9 out of 14 firms in the sample paid dividends to shareholders. The dividend payout ratio low was 0 and the high was 39.394. Two of the non derivative firms did not pay dividend which shows the possibility of the earnings being retained in the retained earnings of the firms, this would allow the firm more flexibility in exploring investment opportunity as well as allowing it to maintain a higher liquidity to avert financial hardship.

   In the regression this variable was found to be insignificant with an R squared of 0.011 and t-statistics of 0.3757.

b. **Bond rating**: Bond ratings data was gathered from the standard and Poors and TSX web sites. Bond rating also reflects at the firms' financial health and its

ability to meet its obligations. Investors and creditors use the bond ratings for their investment decisions so it is a reliable measure of a firm's credit. Bond ratings can change very quickly so they have to be used in conjunction with other factors to make a better analysis.

This variable was not used in the regression due to the unavailability of ratings for firms. The bond ratings available had a range of AAA+ to BBB which shows that the even the lowest rating is investment grade. This illustrates that the industry is stable due to the high forecasted demands and increasing energy prices. The ratings for the firms also suggest that these firms have issued bonds and thus have credibility which allows them access to capital.

2. **Leverage**: The leverage of a firm is calculated by dividing the long term debt by the market value. A higher ratio would be interpreted as a higher level of obligations for a firm and substantial amounts of interest payments. This also reflects that the credit strength of a firm with a higher ratio will not be very high and creditors would not be willing to grant these firms additional credit on competitive terms. So these firms would not have easy access to capital markets as a result they would be unable to make use of growth and investment opportunities. In the sample used the range of the ratio is from zero to 0.784.

   The ratio of zero is for the firms that are not derivatives users which, reflects that they have alternative risk management practices. The firm with the highest leverage ratio is also the smallest firm in terms of size which indicates its need for external financing to be able to fund projects.

   In the regression this variable is found to be significant with R squared of 0.34 and t-statistics were 2.490.

3. **Firm size**: The firm size has been calculated by adding the market value to the size of the reserves. The size of reserves is important because it demonstrates the future growth

opportunities for a firm. A firm might seem to be financially well off but if its depleted reserves would be a concern since they illustrate a decline in the future growth and earnings. When obtaining external debt reserves can be looked upon as collateral and a lack of collateral translates into more expensive debt. In the sample used the firm with the highest leverage ratio is the smallest firm.

There was a sharp contrast seen in the sample with regards to firm size. There are three smaller firms, with size less than 1 billion, out of the three one firm has a leverage ratio of zero, another firm has the highest leverage ratio and the third has a leverage ratio of 0.12 which is at the lower end of the leverage ratios. The firm with the zero leverage ratio is not a derivative user, whereas the other two firms are actively involved in using derivatives.

The regression analysis on this variable shows this variable to be insignificant with R squares 0.029, the t-statistics 0.598.

4. **Average cash costs**: Average cash cost provides the per barrel cost associated with the capital expenditures by the firm, it was calculated by dividing the number of barrels produced per year by the capital expenditures. It gives an insight into the productivity and cost efficiency of the firm. A lower per barrel cost ensures that smooth flow of earnings which is necessary to meet financial commitments and obligations, whereas a higher cash cost translates into a thinner profit margin thereby results in decreased earnings and financial distress. The range of the average cash cost in the sample was $.15 per barrel to $70.68 per barrel. The lowest cost was for the firm that has no long term debt and does not use derivatives to manage risks.

   As discussed earlier it is actually the cost of the production of oil and not the supply that will eventually drive the industry to the brink. The regression analysis illustrates that this variable is not significant, the R squared 0.0982, the T-statistics 1.143.

5. **Liquidity**: The liquidity is measured by the quick ratio which is the ratio of cash, cash equivalents and receivables over short-term liabilities. It is the indicator of a firm's ability to sustain itself in case of sudden financial crisis. A firm short on liquidity would have to hedge more to be able to manage its risk better and sustain itself during emergencies and times of financial distress. The firm with a quick ratio of 14 is the one with the lowest leverage and the also does not hedge with derivatives, which shows that it has the ability to sustain financial hardship on its own without the use of derivatives. The R squared for this variable is 0.479, t-statistics were -3.319. Therefore, this variable is significant.
6. **Exploration expenditure**: The exploration expenditure shows the investments in exploration of oil and gas and their magnitude in relation to the market value. This also allows us to see how important the exploration expenditure is due to its ratio with the market value. A substantial investment in this field would carry higher risks with it. The impact of these risks can be significant on the cash flows and operations of the firm. Therefore there is an additional need for these risks to be hedged. The volatility of prices becomes more important here due to it relation with the earnings from such investments and exploration expenditure. This results in a decrease in prices which is not forecasted as a possibility with the oil and gas industry in the near future. A higher price would mean that the exploration expenditure and its related investment provides higher than forecasted returns. The range of this measure is from 24% to almost 0%. The higher end of this range seems to be an exception because 43% of the firms invested less than 1% of their market value in exploration expenditures. The firm with the highest percentage exploration expenditure has the second lowest reserves which can justify the motive for growth. The R squared for this variable is 0.097, t-statistics were 1.133. Therefore this variable is not significant.
7. **Profitability:**

a. **ROI:** The return on investment is the ratio of gain from investment minus the cost of investment all over the cost of investment. This provides an insight on the profitability of the investments undertaken. This is directly related to the cost of production which is a determinant of a firm's financial health. The return on investment and the corresponding earnings from the return impact the profitability of a firm. Adequate return on investment ensures that there is no additional need to hedge the risks associated with a major investment.

The lowest ROI in the sample studied was -9.045 compared to the highest at 18.119.

b. **ROE:** The return on equity is the ratio of net income over total shareholder's equity. Return on equity reveals how much profit a company earned in comparison to the total amount of shareholder equity found on the balance sheet. A business that has a high return on equity is more likely to be one that is capable of generating cash internally. The ROE range for the sample studied is -9.045 to 25.

c. **ROA:** The return on equity is the ratio of net income over total assets. The ROA figure gives and idea of how effectively the company is converting the money it has to invest into net income. A higher the ROA signifies the company is earning more money on less investment. The range for ROA for the sample studied is -7.34 to 10.19. The firm that has the highest ROA also has the highest ROI and its ROE is also one of the highest figures. This indicates that the particular firm is better able to make use of its investments, equity and assets. It is a derivatives user which signifies the importance of the investments and the need for hedging.

The regression analysis showed that all three profitability ratio, ROI, ROE, and ROA were insignificant. The detailed statistics are in appendix 1.

The regression results are not considered to be conclusive due to the small size of the sample. These statistics could be skewed because the data on any one of the firms could be large enough to effect the regression.

8 DERIVATIVES USE FOR HEDGING MAJOR MARKET RISKS

8.1 Commodity Price Risk

In the sample studied 11 out of the 11 derivatives user firms hedged their commodity price risk. These firms primarily used multiple derivative instruments including forwards, swaps, collars, options. Swaps were used by 45% of the firms, 73% of the firms used forwards, 64% of the firms used options, and 36% of the firms used collars as hedging instruments. With the exception of Shell Canada all the firms used a multitude of instruments.

The hedging horizon varies from 1 year maturity to 5 year maturity although a shorter horizon is more commonly seen. The shorter horizon may indicate the motive of investors to take advantage of the higher prices in the forward markets.

8.2 Interest Rate Risk

8 out of 11 or 82 % of the firms hedged their interest rate risk. The most commonly used derivative instrument used was swaps with 75% of the firms using them, forwards and debt was used by one firm each to hedge the interest rate risk.

The hedging horizon ranged from 1 year to 26 years. One firm used debt to manage interest rate risk but for the year 2003 there were no activities for interest rate risk management since the do not perceive a sudden significant change in the rates of interest.

8.3 Foreign Exchange Rate Risk

Foreign exchange rate risk was hedged by 8 firms out of the 11 which is 82%. In the sample 50% of the firms hedged their foreign exchange rate risk with swaps, 63% used forwards to hedge and 12.5% used debt to hedge this risk. The maturity of the instruments ranged from I year to 19 years.

The commodity price risk is the only risk that was hedged on its own. None of the other risks were hedged alone; they were hedged only in conjunction with commodity price risk. If a firm hedged its interest rate risk or its foreign exchange rate risk it chose to hedge all the three risks combined. No other combination of market risks was hedged by the companies included in the sample. The reason could be that the commodity price risk is considered as the most fundamental and significant risk of all market risks. The interest rate risk and exchange rate risk follow behind it in perceived importance and therefore do not need to be hedged when commodity price risk is not being hedged.

9 CONCLUSION

This study finds that oil and gas firms do hedge their market risks with the use of financial derivatives. The firm characteristics are a major factor in the decision to hedge. The characteristics that were found to be statistically significant are liquidity and leverage ratio, all the other variables considered in this study were found to be insignificant. No other correlation was found between the any other factors.

The significance of these characteristics shows that a need for risk management and mitigation arises when a firm is not financially independent and it relies on external sources of capital. Both these characteristics are also directly related to a firm's ability to take advantage of and finance investment opportunities. A firm with high liquidity can use the liquid assets to finance investments instead of costly external debt. A firm with a high leverage ratio has to make higher interest payments on its external debt which therefore puts financial strain on it and also makes its credit less attractive caused by the speculation that it will not be able to keep up with its obligations. The sample illustrates this point where the smaller firms has high leverage ratios showing their inability to generate cash internally and in turn motivating them to hedge their risks pertaining to the investments whose associated risk is inflated. Firms with low leverage ratios and high liquidity coupled with low costs of production are not derivative users and have alternative internal means to manage risk.

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APPENDICES

Appendix A: Derivatives Usage Data

Company Name	Commodity Price Risk Hedger	Maturity of Instruments Used (yrs)
Apache Corp	Yes	-
BlackRock Ventures Inc	No	Not applicable
Centurion Energy Int. Inc	Yes	-
Enbridge Inc	Yes	1 to 5
Encana Corporation	Yes	1 onwards
Esprit Exploration Ltd	Yes	1 to 2
Husky Energy Inc	Yes	1 to 2
Imperial Oil Ltd	No	Not applicable
Nexen	Yes	2 to 3
Petro Canada	Yes	1 to 2
Shell Canada Ltd	Yes	-
Canada Southern Petroleum Ltd	No	Not applicable
Suncor Energy	Yes	2
Talisman Energy	Yes	1 to 2

Company Name	Interest Rate Risk Hedger	Maturity of instruments used (yrs)
Apache Corp	No	Not applicable
BlackRock Ventures Inc	No	Not applicable
Centurion Energy Int. Inc	No	Not applicable
Enbridge Inc	Yes	1 to 26
Encana Corporation	Yes	1 onwards
Esprit Exploration Ltd	Yes	-
Husky Energy Inc	Yes	6 to 8
Imperial Oil Ltd	No	Not applicable
Nexen	Yes	-
Petro Canada	Yes	-
Shell Canada Ltd	Yes	-
Canada Southern Petroleum Ltd	No	Not applicable
Suncor Energy	Yes	4 to 7
Talisman Energy	Yes	1 to 6

Company Name	Exchange Rate Risk Hedger	Maturity of instruments used (yrs)
Apache Corp	No	Not applicable
BlackRock Ventures Inc	No	Not applicable
Centurion Energy Int. Inc	No	Not applicable
Enbridge Inc	Yes	1to 19
Encana Corporation	Yes	1 onwards
Esprit Exploration Ltd	Yes	-
Husky Energy Inc	Yes	3 to 9
Imperial Oil Ltd	No	Not applicable
Nexen	Yes	-
Petro Canada	Yes	-
Shell Canada Ltd	Yes	-
Canada Southern Petroleum Ltd	No	Not applicable
Suncor Energy	Yes	-
Talisman Energy	Yes	1 to 6

Company Name	Derivatives Use for Hedging
Apache Corp	User
BlackRock Ventures Inc	Non-user
Centurion Energy Int. Inc	User
Enbridge Inc	User
Encana Corporation	User
Esprit Exploration Ltd	User
Husky Energy Inc	User
Imperial Oil Ltd	Non-user
Nexen	User
Petro Canada	User
Shell Canada Ltd	User
Canada Southern Petroleum Ltd	Non-user
Suncor Energy	User
Talisman Energy	User

Company Name	Commodity Price Risk	Interest Rate Risk	Exchange Rate Risk
Apache Corp	Futures, swaps, options, fixed physical contracts	-	-
BlackRock Ventures Inc	-	-	-
Centurion Energy Inc	Unspecified derivatives	-	-
Enbridge Inc	Swaps, options	Swaps	Swaps, forwards
Encana Corporation	Swaps, collars, options	Swaps	Forwards
Esprit Exploration Ltd	Futures, collars, forwards	Swaps	Swaps
Husky Energy Inc	Futures, forwards	Swaps	Forwards
Imperial Oil Ltd	-	-	-
Nexen	Forwards. Options	Debt/borrowings	Debt/borrowings
Petro Canada	Forwards	Forwards	Forwards
Shell Canada Ltd	Futures, forwards	Swaps	Forwards
Canada Southern Pet.Ltd	-	-	-
Suncor Energy	Futures, swaps, forwards, options	Swaps	Swaps
Talisman Energy	Swaps, collars	Swaps	Swaps

Appendix B: Firm Characteristics Data

Company Name	Dividend Payout Ratio ($)	Bond rating	LTD (million $)	MV of Assets (million $)
Apache Corp	10.41	A	2158.82	12486.65
BlackRock Ventures Inc	0.00	-	0.00	313.57
Centurion Energy Int. Inc	0.00	-	30.23	186.75
Enbridge Inc	0.00	A-	5995.50	8370.49
Encana Corporation	13.91	A-	7852.00	23945.86
Esprit Exploration Ltd	0.00	-	48.48	429.83
Husky Energy Inc	19.21	BBB	1964.00	9637.01
Imperial Oil Ltd	26.28	AAA	1466.00	21413.00
Nexen	9.05	BBB-	1844.00	6076.51
Petro Canada	10.78	AAA	2701.00	15356.99
Shell Canada Ltd	39.39	AA-	523.00	16239.08
Canada Southern Petroleum Ltd	0.00	-	0.00	93.72
Suncor Energy	9.95	A-	2686.00	15012.30
Talisman Energy	16.00	BBB+	2997.00	9061.48

Company Name	Leverage	Oil Reserves (mmbbl)	Size
Apache Corp	0.26	1657.00	14143.65
BlackRock Ventures Inc	0.00	15.50	329.07
Centurion Energy Int. Inc	0.78	38.09	224.84
Enbridge Inc	0.80	-	8370.49
Encana Corporation	0.37	957.20	24903.06
Esprit Exploration Ltd	0.12	49.40	479.23
Husky Energy Inc	0.35	2603.20	9686.41
Imperial Oil Ltd	0.09	1670.00	23083.00
Nexen	0.44	1535.00	7611.51
Petro Canada	0.24	763.00	16119.99
Shell Canada Ltd	0.12	1085.00	17324.08
Canada Southern Petroleum Ltd	0.00	1255.00	1348.72
Suncor Energy	0.24	1838.00	16850.30
Talisman Energy	0.40	2685.00	11746.48

Company Name	Tot. cash cost (million $)	Oil Production (Mmbbl/yr)	Avg Cash Cost
Apache Corp	3118.00	78.30	39.82
BlackRock Ventures Inc	36.38	1.02	35.66
Centurion Energy Int. Inc	28.63	2.41	11.88
Enbridge Inc	259.50	-	-
Encana Corporation	5115.00	82.00	62.38
Esprit Exploration Ltd	113.37	2.80	40.52
Husky Energy Inc	1905.00	26.95	70.69
Imperial Oil Ltd	1526.00	57.00	26.77
Nexen	1494.00	67.25	22.22
Petro Canada	2203.00	75.75	29.08
Shell Canada Ltd	759.00	13.18	57.61

Canada Southern Petroleum Ltd	4.98	34.00	0.15
Suncor Energy	1702.00	62.88	27.07
Talisman Energy	2180.00	54.18	40.24

Company Name	ROI	ROE	ROA
Apache Corp	7.228	11.262	5.745
BlackRock Ventures Inc	-0.362	-0.472	-0.326
Centurion Energy Int. Inc	6.668	12.282	4.313
Enbridge Inc	6.268	19.235	4.827
Encana Corporation	0.592	0.718	0.524
Esprit Exploration Ltd	11.93	24.974	8.442
Husky Energy Inc	-9.045	-9.045	-7.34
Imperial Oil Ltd	5.312	7.058	4.613
Nexen	9.206	9.206	8.192
Petro Canada	9.757	25.185	6.235
Shell Canada Ltd	5.645	8.941	3.901
Canada Southern Petroleum Ltd	5.172	5.172	4.34
Suncor Energy	18.119	23.216	10.195
Talisman Energy	11.338	15.682	7.603

Company Name	Exploration expenditure (million $)	Average Exp Expenditure	Liquidity
Apache Corp	278	0.02224	1.089
BlackRock Ventures Inc	0.749	0.00239	6.260
Centurion Energy Int. Inc	1.117	0.00598	1.194
Enbridge Inc	0	0.00000	3.160
Encana Corporation	1053	0.04397	0.584
Esprit Exploration Ltd	106	0.24661	0.641
Husky Energy Inc	326	0.03383	0.713
Imperial Oil Ltd	57	0.00266	0.771
Nexen	329	0.05414	0.831
Petro Canada	344	0.02240	0.726
Shell Canada Ltd	323	0.01989	0.205
Canada Southern Petroleum Ltd	0	0.00000	13.985
Suncor Energy	51	0.00340	0.524
Talisman Energy	784	0.08652	0.754

Appendix C: Regions of Operation

Company Name	Regions of Operation
Apache Corp	US, Canada, Egypt, Australia, UK, China, Argentina
BlackRock Ventures Inc	Canada
Centurion Energy Int. Inc	Egypt, Tunisia
Enbridge Inc	Canada, US
Encana Corporation	Canada, US, UK, Ecuador
Esprit Exploration Ltd	Canada
Husky Energy Inc	Canada, China, Indonesia
Imperial Oil Ltd	Canada
Nexen	Canada, US, UK, Colombia, West Africa, Australia (abandoned)
Petro Canada	Denmark, UK, Netherlands, Syria, Libya, Tunisia, Algeria, Trinidad,
Shell Canada Ltd	Canada
Canada Southern Petroleum Ltd	Canada
Suncor Energy	Canada, US
Talisman Energy	Canada, US, Trinidad and Tobago, Colombia, UK, Algeria, Norway, Qatar, Malaysia, Indonesia, Vietnam