THE EFFECT OF HEDGING ON THE VALUE OF U.S. OIL AND GAS PRODUCERS

by

Ali Marami
B.Sc., Electrical Engineering – Amir Kabir University of Technology, 1996

PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF FINANCIAL RISK MANAGEMENT

In the
Faculty of Business Administration

SIMON FRASER UNIVERSITY

Summer 2008

APPROVAL

Name:	**Ali Marami**
Degree:	**Master of Financial Risk Management**
Title of Project:	**The Effect of Hedging on the Value of U.S. Oil and Gas Producers**

Supervisory Committee:

____

Dr. Alexander Vedrashko
Senior Supervisor
Assistant Professor, Faculty of Business Administration

____

Dr. George Blazenko
Second Reader
Associate Professor, Faculty of Business Administration

Date Approved: ______________________________________

ABSTRACT

This paper evaluates the effect of hedging on the values of 42 U.S. oil and gas producing firms from 2002 to 2006. We use a unique hand-collected data set on all linear and nonlinear hedging positions of these firms. In contrast to recent studies, we find that hedging oil price risk using nonlinear instruments, such as options, increases the value of the firm. Linear hedging contracts have little (oil contracts) or negative (gas contracts) effect on firm valuation. In addition, we find that energy price volatility negatively affects firm valuation, but has little influence on the relation between hedging activities and the value of the firm.

ACKNOWLEDGEMENTS

I would like to express my gratitude to my supervisor, Dr. Alexander Vedrashko, whose invaluable support, comments and encouragement helped me in all of my research and writing of this thesis and especial thanks to Dr. George Blazenko for his kind support and stimulating suggestions.

TABLE OF CONTENTS

LIST OF TABLES

1. Introduction

The effect of hedging on the value of the firm is a controversial issue. Perfect capital structure in the world of Modigliani and Miller (1958), in which there are no information asymmetries, taxes, and transaction costs, risk management cannot add value to the firm, since investors are able to implement individually the same strategy and mitigate the risk; however, the lack of the perfect capital structure in the real world rationalizes the hedging activities.

On the theoretical level, studies state that risk management has an impact on the value of the firm; however, empirical evidence is diverse[1]. In a recent study, Jin and Jorion (2006) use a sample of firms in the U.S. oil and gas industry and conclude that hedging reduces the sensitivity of the stock price to the movement of the price of oil and gas, but does not influence firm value.

We employ a more recent sample of oil and gas firms than that of Jin and Jorion and show that hedging has an impact on the value of the firm. We collect our data for the period 2002 to 2006, when the price (volatility) of oil and gas is higher (lower) than the price (volatility) during 1998 – 2001, which is the period of Jin and Jorion (2006) study. We differentiate between "linear" contracts (such as futures and forwards), whose impact is either negative (for gas industry) or negligible (for oil industry), and nonlinear contracts (e.g., options), which increase the value of the firm. We also implement a

[1] The theoretical papers are Mayers and Smith (1982), Smith and Stulz (1985), Leland (1998), Froot, Scharfstein, and Stein (1993), Nance et al. (1993), Géczy et al. (1997), and empirical studies are Tufano (1996), Allayannis and Weston (2001), Carter, Rogers, and Simkins (2005), Guay and Kothari (2003), and Jin and Jorion (2006).

model based on 180 days historical volatility of future oil and gas prices to evaluate the effect of volatility on the impact of hedging on firm value.

Considering a sample of oil and gas producers has several advantages. Energy companies not only have a financial exposure, but also use a wide variety of hedging positions. In addition, changes in the price of oil and gas have a substantial effect on the cash flows of these firms. Moreover, hedging a position against movements in energy prices is easy relative to hedging foreign currency exchange rates. Therefore, an oil and gas producer might not gain from hedging, thereby satisfying Modigliani and Miller conclusions. Our sample of oil and gas producers also includes a broad variety of firm sizes, in contrast to Allayannis and Weston (2001) sample, which consists of firms whose assets are greater than $500 million. Therefore, our sample allows us to investigate the effect of hedging not only in large firms, but also in small firms. An additional advantage of studying energy producers is that they disclose their hedging positions in a greater detail than other firms do. They consistently report the value of oil and gas reserves, extraction costs and net present value of profits from the reserves in their 10-K filings required by Securities and Exchange Commission (SEC). This information minimizes the likelihood of missing variables in our sample.

We hand-collect the data on 42 U.S. oil and gas producers from 2002 to 2006 that results in 210 firm-year observations. Our sample is smaller than that of Jin and Jorion, which included 119 firms, because a number of mergers and acquisitions have taken place in this industry in recent years. We also face hedging positions in some firms, which are impossible to value due to their complexity and corresponding lack of information. Despite these issues, our sample is still larger than that of Carter et al. (2005), in which they study only 27 airlines.

In order to evaluate the hypothesis that hedging increases the value of the firm, we implement a model similar to the model in Jin and Jorion (2006), but with separate variables for linear and nonlinear contracts. The model estimates a linear relation between Tobin's Q and the relative delta, representing the hedging positions in the firm normalized by the firms' production or reserves of oil and gas. In our model, the coefficient on the relative delta of nonlinear contracts for both production and reserve in oil hedging is positive and significant. This result implies that nonlinear oil hedging increases the value of the firm. The coefficient on the oil linear contracts is negligible and insignificant; however, the coefficient on gas linear contracts is negative and significant that describes gas linear contracts as a negative impact on the value of the firm. We find a positive and significant coefficient for the investment growth variable. This result explains that future investment opportunities have a large positive impact on the value of the firm. In contrast to the results in Jin and Jorion (2006), the coefficient on the production cost is negligible implying that the relatively high gross profit of oil and gas producers underweights the negative impact of production cost on the value of the firm.

We also test the hypothesis that oil and gas price volatility influences the relation between hedging activities and the value of the firm. We do not obtain statistically significant results; nevertheless, the coefficient on the cross term between nonlinear oil contracts and the value of 180-day historical volatility of oil prices is consistently negative. This implies a small negative impact of nonlinear oil contracts on the firm value in a relatively volatile market.

2. Motivation and Background

Mayers and Smith (1982) and Smith and Stulz (1985) state that hedging reduces the costs related to highly volatile cash flows. It reduces the expected tax in case of a convex tax function and expected cost of financial distress. Leland (1998) explains that hedging increases the debt capacity of the firm and, consequently, helps the firm to benefit from tax advantages of higher leverage. Froot, Scharfstein, and Stein (1993), Nance et al. (1993) and Géczy et al. (1997) argue that hedging may mitigate the problem of underinvestment when the cost of external financing is high and limiting the expansion capacity of the firm. Tax incentives, when the tax function is convex, cost of borrowing that increases by the volatility of earnings, cost of bankruptcy and liquidation costs are some of explanations for implementing hedging in a firm.

Other studies explain the benefit of hedging from the management's point of view and conclude that hedging has no effect on market value. Stulz (1984) and Smith and Stulz (1985) claim that risk-averse managers implement hedging when the company that they manage is the substantial part of their capital. Moreover, DeMarzo and Duffie (1995) state that hedging is a signal of better management to investors.

There are other characteristics of the firm in relation to the hedging. While small firms are more vulnerable to financial distress, large firms are more likely to hedge (Mian, 1996). The high fixed cost of hedging accounts for this contradiction. For instance, Brown (2001) estimates that a $3 billion derivative position costs about $4 million for a large multinational firm. In addition, Dolde (1995) and Haushalter (2000) claim for a positive relation between hedging and leverage. Graham and Rogers (2002) underweight tax convexity as a reason for hedging, but claims that hedging bolsters the increasing of debt capacity.

Nevertheless, there is no strong support for a single theory, and empirical evidence is diverse. Tufano (1996) finds no evidence for value maximization due to hedging in gold mining firms. Allayannis and Weston (2001) provide evidence that the market value of firms with foreign currency derivatives is 5% higher on average than the market value of firms without these derivatives. In addition, Graham and Rogers (2002) state that debt capacity induced by derivatives increases the value of the firm by 1.1%. Carter, Rogers, and Simkins (2005) report 14% hedging premium for U.S. airlines with fuel cost hedging. However, Guay and Kothari (2003) bring these results into question. They evaluate a sample of non-financial derivative users and conclude that the hedging premium is relative small, compared to cash flows and changes in equity values. They also claim that other risk management practices account for gains in the market value. Jin and Jorion (2006) also find that hedging is unlikely to have an effect on the market value of the U.S. oil and gas producers.

In next three sections, we describe the sample and variables, review the models for testing the hypotheses that hedging increases the value of the firm and the historical volatility influences the impact of hedging on the value of the firm, report our results, and finish with concluding remarks.

3. Sample Description

We hand-collect a sample of 42 U.S. oil and gas firms from 2002 to 2006 and obtain 210 firm-year observations. Similarly to Jin and Jorion (2006), we select firms with Standard Industrial Classification (SIC) codes of 1311, that is related to group 13 “Oil and Gas Extractions”. SIC 1311 limits our list to “Crude Petroleum and Natural Gas” that eventually produces a list of 92 companies. Then we select companies which meet the following conditions for the period of our study: they filed 10-K reports, oil and gas production and reserve data are available, the market value of the equity is available, the information in 10-K filing is sufficient to value the hedging position of the firm and the book value of assets is greater than $20 million. The final list includes 42 companies, all present in all 5 years, and 210 firm-year observations in total. All companies in our list have exposures to both oil and gas and are engaged in exploration and production, which means linear contracts, such as fixed-price contracts or swaps are included in hedging positions. Our sample includes both small and large firms, whose main activities are oil and gas exploration and production, rather than refining or processing. Therefore, in terms of type of exposure to commodity price, our sample is relatively homogeneous that limits the correlation between hedging and other firm characteristics. For instance, Coles, Lemmon and Meschke (2003) explain such correlation between firm value and managerial ownership, and Jin and Jorion (2006) refute the positive effect of foreign currency derivatives on the value of the firm and state that “the hedging premium observed for multinationals reflects other factors, such as informational asymmetries or operational hedges, which add value but happen to be positively correlated with the presence of derivatives. In a sample without such spurious correlation, the effect of derivatives disappears."

3.1. Hedging Variables

In January 1997, SEC expanded its requirement for market risk disclosure under Financial Reporting Release No. 48, (FRR 48). Under this issue, companies must provide quantitative information about their market risks in tabular, sensitivity analysis or value-at-risk formats. In our sample, the tabular disclosure is the most common format, in which instruments are classified as follows:

1) Fixed or variable rate assets or liabilities
2) Long or short forwards or futures
3) Written or purchased call or put options
4) Received-fixed or variable swaps

The weighted average settlement price of contracts, weighted average pay and receive rates and/or prices of the swaps, weighted average of strike price of option and the amount of all contracts are reported based on FRR 48 requirement.

To value the hedging positions of the companies in our list, we manually extract this information from 10-K filings of the companies. Then, following Jin and Jorion, we assume Δ=-1 for all shorting positions in linear contracts such as fixed-price contracts, short futures and forwards, and received-fixed swaps and Δ=1 for all long positions in the same contracts.

We use the Black-Sholes option pricing model to calculate the delta for all nonlinear contracts. Next, we multiply the size of the contract by the value of delta and sum them up to obtain the total value of the delta for both contract types, as well as the total delta for all linear and nonlinear contracts separately. All firms in our sample have a zero or negative delta in oil and gas, indicating hedging, rather than speculating positions in all firm years. Finally, we scale the total value of delta by the production in the next year or the value of the reserves:

(1)

Relative delta (Total/Linear/Nonlinear) oil(gas) production=-delta oil(gas) / Next-year oil(gas) production

(2)

Relative delta (Total/Linear/Nonlinear) oil(gas) reserve=-delta oil(gas) / Same-year oil(gas) reserve

The first measure indicates the percentage of the next year production hedged, and the second one indicates the percentage of the reserve hedged.

In our sample, 145 firm-years hedge both oil and gas; there is no hedging in 33 observations. Table I provides the information about the hedging positions of our sample.

For the evaluation of the effect of the historical volatility, we calculate the historical volatility of NYMEX future crude oil and gas prices during 180 calendar days ending on the last day of the fiscal year. We also use the median of all 180 days historical volatilities to construct a high/low dummy variable for the volatility. The dummy variable is equal to 1 when the value of the 180-day historical volatility is higher than the 10 years median and 0 when it is lower, for oil and gas separately.

3.2. Q ratios

We use Tobin's Q ratio to measure the market value of the firm. In fact, Tobin's Q is the ratio of the market value of the firm to the current replacement cost of the assets. Jin and Jorion propose several methods to calculate the Q ratio since oil and gas reserves are the main assets of the firms in this industry. We follow this approach and construct three different measures of Q ratio for each firm-year.

The numerators in all Q ratios are identical and approximate the market value of the firm. We obtain it by adding the book value of assets and the difference of book value and market value of the equity. The denominator should reflect the replacement cost of the assets. For the first definition of Q ratio, Q1, it is the book value of the assets minus the book value of the proved oil and gas reserves, plus the net present value of the future revenues from the reserves. This NPV is "Standardized measure of oil and gas reserves" required by SFAS No.69 that is the estimated future revenues after extraction costs and taxes, generated from the production of proven reserves discounted by 10% annual rate. In Q2, the denominator is the same as in Q1, except we replace the net present value of the reserves by the book value. Finally, denominator in Q3 is simply the book value of assets.

$$Q1 = \frac{\text{BV total assets - BV common equity + MV common equity}}{\text{BV total assets - BV oil/gas proved reserves + NPV oil/gas proved reserves}} \quad (3)$$

$$Q2 = \frac{\text{BV total assets - BV common equity + MV common equity}}{\text{BV total assets - BV oil/gas proved reserves + MV oil/gas proved reserves}} \quad (4)$$

$$Q3 = \frac{\text{BV total assets - BV common equity + MV common equity}}{\text{BV total assets}} \quad (5)$$

There is a positive correlation between Q variables, 0.68, 0.46 and 0.77 between Q1 and Q2, Q2 and Q3, and Q1 and Q3, respectively. Table II presents the value and characteristics of the firm-years in our sample.

Panel A presents the distribution of the assets, market value, reserve, and Q ratios for all 210 observations. Due to the oil and gas prices being higher than those in the period of Jin and Jorion (2006) sample, the values of the assets and reserves are substantially higher than the values reported in their paper. The large number of mergers and acquisitions in recent years also account for the higher market and reserve values relative to the period from 1998 to 2001. In addition, Panel A indicates that our sample includes small firms—ten percent of observations have total assets less than $87 million. Panels B to G provide information about oil hedgers and gas hedgers for linear and nonlinear contracts separately. An average (median) firm hedges 30% (27%) of its next year production, which corresponds to only 3% (2%) of their reserves. For gas hedging, these numbers amount to 36% (32%) and 4% (3%) for hedging ratios of next year production and reserve, respectively. In all firm-years the hedging ratios are positive, indicating hedging positions.

Panel H describes the statistics of nonhedgers. It does not show any substantial difference between the average size of these firms and those of oil or gas hedgers. In contrast to Jin and Jorion (2006) sample firms, our study shows slightly higher Q ratio for nonhedgers.

4. Firm Value and Hedging

We adopt the same multivariate analysis as in Jin and Jorion (2006) to test the impact of hedging on Q ratios. Since a number of other variables can affect the Q ratios, we use a multivariate model to isolate the effect of hedging for our analysis. We implement three regressions for each Q and for oil and gas separately, resulting in six regressions:

$$Q = \alpha + \beta \times Hedging\_dummy + \Sigma_j \gamma_j \times Control\_Variable_j + \varepsilon \quad (6)$$
$$Q = \alpha + \beta \times Delta\_production_k + \Sigma_j \gamma_j \times Control\_Variable_j + \varepsilon \quad (7)$$
$$Q = \alpha + \beta \times Delta\_reserve_k + \Sigma_j \gamma_j \times Control\_Variable_j + \varepsilon \quad (8)$$
$$k = \{Linear, Nonlinear, Total\}$$

For instance, Delta_reserve $_{(\text{Linear})}$ for gas is the relative delta of linear gas contracts of reserves calculated in equation (2). The hedging dummy is one if the company hedges and is zero otherwise, for oil and gas separately.

In models 7 and 8, we measure the effect of the value of hedging that provides more information than model 6, in which we measure exclusively the effect of whether the company hedges or not.

To analyze the effect of historical volatility on the value of hedging, which is our second hypothesis, we implement the following models:

$$Q = \alpha + \beta \times Delta\_production_k + \Sigma_j \gamma_j \times Control\_Variable_j + \eta_1 \times HV180\_Dummy + \eta_2 \times HV180\_Dummy \times Delta\_production_k + \varepsilon \quad (9)$$

$$Q = \alpha + \beta \times Delta\_reserve_k + \Sigma_j \gamma_j \times Control\_Variable_j + \eta_1 \times HV180\_Dummy + \eta_2 \times HV180\_Dummy \times Delta\_reserve_k + \varepsilon \quad (10)$$

$$Q = \alpha + \beta \times Delta\_production_k + \Sigma_j \gamma_j \times Control\_Variable_j + \eta_1 \times HV180 + \eta_2 \times HV180 \times Delta\_production_k + \varepsilon \quad (11)$$

$$Q = \alpha + \beta \times Delta\_reserve_k + \Sigma_j \gamma_j \times Control\_Variable_j + \eta_1 \times HV180 + \eta_2 \times HV180 \times Delta\_reserve_k + \varepsilon \quad (12)$$
$$k = \{Linear, Nonlinear, Total\}$$

Here, HV180_Dummy is one if the 180-day historical volatility of NYMEX future oil (gas) prices on the last day of the fiscal year is higher than the median of the last 10 years historical 180-day volatility of same underlying asset. HV180 is the 180-day historical volatility of NYMEX future oil (gas) prices on the last day of the fiscal year.

Control variables in our models are the same as those in Jin and Jorion (2006) as follows:

a) *Firm Size*: since large firms tend more to hedge than small firms, we include this factor as a control variable. The log of the total book value of the assets is the substitute for this variable in our model.

b) *Profitability*: we use ROA as the substitute for profitability which is supposed to increase (positive coefficient) the Q ratio.

c) *Investment Growth*: we assume that firms with a higher potential for future investment have a higher value. We use the ratio of capital expenditures to total assets as a substitute and expect a positive coefficient in our model.

d) *Access to financial markets*: it is rational to assume that limited access to financial resources shifts firm's investments in projects with higher net present value and consequently these firms have higher Q ratios. We use a dividend dummy, which is one if the firm pays dividend, as the substitute for this parameter. Based on our explanation the coefficient of this parameter is supposed to be negative.

e) *Leverage*: Capital structure also has an impact on the firm value. We calculate the financial leverage as the average total assets over average total common equity.

f) *Production costs*: firms with higher production costs should have lower Q ratios. Oil and gas producers report their production costs per BOE (Barrel of Oil Equivalent) or Mcfe (thousand cubic feet equivalent) in their 10-K filings. We expect a negative coefficient for this parameter.

To eliminate the skewness of the Q ratios, the dependent variables in our model are the log of the Q ratios and depict the elasticity. Annual dummies are also included in our model. In addition, we eliminate the effect of firm specific clustering and heteroskedasticity using the Generalized Estimating Equations (GEE) method (Liang and Zeger, 1986).

Table III reports the regression results for models 6, 7 and 8. The coefficients of hedging dummies are not statistically significant. However, the coefficient of the relative delta of nonlinear contracts, for both production and reserve, in oil hedging is positive and significant for Q1 and Q2. It is reasonable because Q3 does not take into account the values of oil and gas reserves. Since the market value of the reserves is included into Q2 formula, we find positive and significant coefficients for all linear, nonlinear, and total oil hedging deltas relative to reserve and nonlinear gas hedging relative to reserve. The table also reports the negative impact of linear gas contracts on the value of the firm; however, they are not statistically significant except for Q3 and delta relative to reserve. The latter result is intuitive because most of the linear contracts are long term fixed-price contracts that do not allow the firm to fully capture the benefits from the substantial increase in energy prices in recent years. Consequently, these contracts decrease the value of the firm. This price increase did not occur in years 1998 to 2001, the period of Jin and Jorion (2006) sample.

The results for the control variables are similar to the results in Jin and Jorion (2006). Investment growth is the only variable that is always positive and statistically significant in all Q ratios and models. ROA is also positive and significant for Q1 and Q3 ratios, however, it has no significant value for Q2. It is rational since the average value of the reserve is four times greater than the value of the assets in our sample, which means the large values of the reserves dominate the effect of the value of the assets in Q2 and impact the effect of ROA in our model. In contrast to the results of Jin and Jorion (2006), production costs do not show a negative value for Q3 in our research, i.e. it is almost zero for all Q3 models. This implies the profit margin of oil and gas producers is so high due to the high energy prices in recent years that it dominates the negative impact of production costs on the value of the firm.

Table IV describes the result of our models 9, 10, 11 and 12 for analyzing the effect of historical volatility. In all models, we focus on cross terms HV180*Delta_Production(Reserve) and HV180_Dummy* Delta_Production(Reserve). The coefficient of this parameter is consistently negative for all nonlinear oil hedging, it is significant only for the conventional definition of Q (the Q3 dependent variable). It implies that nonlinear hedging has a smaller impact on the value of the firm in a highly volatile market. For the gas hedging, the coefficient of Delta_Production*HV180 and Delta_reserve*HV180 for all linear contracts is negative but insignificant. It implies that a volatile market reduces the impact of linear contracts on the value of the firm. We had the same result in nonlinear contracts for oil hedging, because linear contracts in gas hedging and nonlinear contracts in oil hedging have the highest portion of hedging activities in term of the size of the contracts. In addition, the coefficient of HV180 variable is negative for all oil hedging contracts and Q ratios and significant for Q1 and Q2, while this coefficient is positive for all gas hedging contracts and Q ratios. It implies that a higher volatility of oil (gas) prices decreases (increases) the value of the firm. The results for the gas hedging are not consistent across different definitions of the Q ratio.

This might be the effect of long term fixed-price contracts. These results are robust to the choice of 30-day and 90-day horizons for measuring historical volatility.

5. Conclusions

In this paper, we evaluate the hedging of 42 U.S. oil and gas producers over the period from 2002 to 2006. The problem of endogeneity, which usually occurs when we collect samples from one industry, is negligible here since this industry is homogenous, and the hedging positions are substantially different across firms. We price the value of hedging contracts by taking advantage of the relatively informative 10-K filings by these firms. Oil and gas producers also disclose all information about their reserves and production costs, that helps us to construct reliable Q ratios for testing our hypotheses. With Q ratios calculated based on our samples, we find a significant positive impact of hedging on the value of the firm for nonlinear oil hedging contracts and a negative impact of linear hedging gas contracts. Moreover, energy price volatility decreases the impact of hedging with nonlinear oil and linear gas contracts on the firm value.

Clearly, there is no consensus about a theory that would explain the advantages or disadvantages of hedging activities yet. Further research, such as studying why nonlinear oil hedging has a positive and linear gas hedging has a negative impact on the value of the firm should be performed. The timing of financial report releases and corresponding effect on market valuations should be addressed to improve the measurement of the Q ratios. The findings in this paper will also be made more general by extending the sample to the period from 1998 to 2001 studied by Jin and Jorion (2006). Finally, our econometric model can be improved by combining linear and nonlinear deltas for both oil and gas contracts in the same equation.

Table I

Description of Sample by Hedging Decisions

This Table displays the number of firm-years that have/have not oil or gas hedging position

	Oil Hedgers	Nonoil Hedgers	Total
Gas Hedgers	145	30	175
Nongas Hedgers	2	33	35
Total	147	63	210

Table II

Summary Statistics for Firm Characteristics

Panel A presents the statistics of 42 U.S. oil and gas producers over the period of 2002 to 2006, Panels B to H present subsamples of linear and nonlinear oil hedgers, linear and nonlinear gas hedgers, and non-hedgers, respectively.

	Observation	Mean	SD	Median	10th Percentile	90th Percentile
Panel A: All Firm-Years						
Total assets($m)	210	3,751	7,616	775	87	12,463
Market value of equity($m)	210	3,465	6,440	787	71	12,004
Value of reserve($m)	210	16,083	30,826	3524	365	55,746
Q1	210	1.37	0.73	1.22	0.82	2.03
Q2	210	0.40	0.29	0.35	0.22	0.56
Q3	210	1.77	1.38	1.50	1.12	2.38
Panel B: Firm-Years with Oil Hedging Activities						
Total assets($m)	147	4,078	7,680	982	179	12,604
Market value of equity($m)	147	3,496	5,973	1,068	149	12,277
Value of reserve($m)	147	17,071	2,986	4,582	609	54,974
Oil Production hedged(%)	147	30%	19%	27%	8%	59%
Oil reserve hedged(%)	147	3%	3%	2%	1%	5%
Q1	147	1.35	0.52	1.23	0.88	1.95
Q2	147	0.39	0.15	0.36	0.23	0.55
Q3	147	1.59	0.48	1.49	1.14	2.23
Panel C: Firm-Years with Linear Oil Hedging Activities						
Total assets($m)	95	5,110	8,431	1,633	218	15,872
Market value of equity($m)	95	4,370	6,557	1,472	209	13,236
Value of reserve($m)	95	21,209	31,406	7,308	768	64,206
Oil Production hedged(%)	95	27%	22%	23%	4%	58%
Oil reserve hedged(%)	95	3%	2%	2%	0%	5%
Q1	95	1.36	0.52	1.26	0.95	1.86
Q2	95	0.37	0.13	0.34	0.23	0.52
Q3	95	1.61	0.45	1.49	1.17	2.27

Table II – *Continued*

Panel D: Firm-Years with Nonlinear Oil Hedging Activities						
Total assets($m)	100	4,303	8,650	912	201	16,427
Market value of equity($m)	100	3,494	6,476	997	215	12,004
Value of reserve($m)	100	14,443	33,426	4,357	629	68,466
Oil Production hedged(%)	100	19%	14%	18%	3%	31%
Oil reserve hedged(%)	100	2%	4%	2%	0%	4%
Q1	100	1.39	0.58	1.24	0.89	2.09
Q2	100	0.40	0.17	0.39	0.23	0.57
Q3	100	1.56	0.49	1.47	1.12	2.20
Panel E: Firm-Years with Gas Hedging Activities						
Total assets($m)	175	3,783	7,425	929	173	9,750
Market value of equity($m)	175	3,446	5,998	972	119	11,846
Value of reserve($m)	175	16,074	29,237	3,955	565	53,694
Gas Production hedged(%)	175	36%	22%	32%	13%	68%
Gas reserve hedged(%)	175	4%	3%	3%	1%	8%
Q1	175	1.35	0.57	1.23	0.81	2.00
Q2	175	0.41	0.30	0.35	0.23	0.55
Q3	175	1.71	1.05	1.47	1.12	2.33
Panel F: Firm-Years with Gas Linear Hedging Activities						
Total assets($m)	124	5,019	8,497	1,263	218	16,193
Market value of equity($m)	124	4,552	6,776	1,384	161	14,710
Value of reserve($m)	124	21,360	33,136	6,820	768	69,804
Gas Production hedged(%)	124	31%	29%	26%	4%	64%
Gas reserve hedged(%)	124	3%	4%	2%	0%	7%
Q1	124	1.40	0.59	1.25	0.87	2.06
Q2	124	0.40	0.34	0.34	0.22	0.54
Q3	124	1.80	1.20	1.52	1.15	2.48
Panel G: Firm-Years with Gas Nonlinear Hedging Activities						
Total assets($m)	140	3,788	7,445	938	169	10,113
Market value of equity($m)	140	3,103	5,143	820	126	11,763
Value of reserve($m)	140	15,574	28,073	3,917	507	55,746
Gas Production hedged(%)	140	17%	27%	14%	1%	51%
Gas reserve hedged(%)	140	2%	3%	1%	0%	5%
Q1	140	1.31	0.52	1.21	0.82	1.93
Q2	140	0.38	0.15	0.36	0.23	0.54
Q3	140	1.53	0.46	1.45	1.09	2.09
Panel H: Firm-Years without Hedging Activities						
Total assets($m)	33	3,755	8,727	92	47	17,844
Market value of equity($m)	33	3,684	8,531	171	30	15,229
Value of reserve($m)	33	16,731	38,823	653	193	78,758
Q1	33	1.52	1.30	1.18	0.88	2.20
Q2	33	0.37	0.23	0.30	0.18	0.62
Q3	33	2.11	2.48	1.58	1.13	2.62

Table III
Hedging and Firm Value

This table presents the regression results of the cross sectional time series least square regression testing the impact of hedging on firm value. The sample includes 210 firm-year observations over the period from 2002 to 2006. The natural logs of the Q1, Q2 and Q3 are the dependent variables. Hedging dummies, relative delta values for linear, nonlinear and total contracts, the control variables and year dummies are the independent variables. We use the Generalized Estimation Equations (GEEs) method to eliminate the effect of firm specific clustering and heteroskedasticity. Year dummies are used in the model, but their coefficients are not reported. t-statistics are shown in parenthesis. * and ** indicate the significance at the 95% and 99% levels, respectively.

Panel A: dependent variable is ln(Q1), Q1=(MV Assets)/(BV Total Assets - BV Oil/Gas Reserves+NPV of Reserves)

	Oil							Gas						
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Observations	210	210	210	210	210	210	210	210	210	210	210	210	210	210
Hedging dummy	-0.050							-0.182						
	(-0.64)							(-1.37)						
Delta_Production(Total)		0.080							0.035					
		(0.64)							(0.26)					
Delta_Production(Linear)			-0.043							-0.126				
			(-0.41)							(-1.14)				
Delta_Production(Nonlinear)				0.133**							0.350			
				(3.70)							(1.59)			
Delta_Reserve(Total)					1.24							-0.983		
					(1.90)							(-0.95)		
Delta_Reserve(Linear)						-0.400							-1.564	
						(-0.37)							(-1.82)	
Delta_Reserve(Nonlinear)							1.904**							-0.227
							(3.18)							(-0.62)
Log(asset)	0.020	0.014	0.017	0.013	0.013	0.016	0.013	0.035	0.015	0.019	0.013	0.019	0.020	0.017
	(1.06)	(0.71)	(0.85)	(0.68)	(0.68)	(0.82)	(0.68)	(1.87)	(0.81)	(0.96)	(0.64)	(1.01)	(1.01)	(0.84)
ROA	0.017**	0.018**	0.018**	0.019**	0.019**	0.018**	0.019**	0.016**	0.018**	0.018**	0.019**	0.017**	0.017**	0.018**
	(2.7)	(2.72)	(2.62)	(2.71)	(2.81)	(2.61)	(2.74)	(2.62)	(2.72)	(2.61)	(2.87)	(2.60)	(2.59)	(2.62)
Inv_Growth	0.71*	0.647*	0.690*	0.640*	0.603*	0.689*	0.640*	0.785*	0.662*	0.695*	0.622	0.719*	0.721*	0.679*
	(2.17)	(1.96)	(2.08)	(1.98)	(1.99)	(2.20)	(2.02)	(2.37)	(2.06)	(2.11)	(1.95)	(2.18)	(2.20)	(2.09)
Leverage	0.004	0.003	0.004	0.005	0.004	0.004	0.006	0.003	0.004	0.005	0.007	0.003	0.005	0.004
	(0.52)	(0.45)	(0.51)	(0.64)	(0.55)	(0.49)	(0.70)	(0.44)	(0.48)	(0.58)	(0.75)	(0.40)	(0.57)	(0.43)
Dividend dummy	-0.018	-0.020	-0.017	-0.01	-0.020	-0.015	-0.005	-0.050	-0.018	-0.018	-0.01	-0.024	-0.017	-0.022
	(-0.21)	(-0.23)	(-0.19)	(-0.11)	(-0.23)	(-0.18)	(-0.06)	(-0.52)	(-0.20)	(-0.21)	(-0.11)	(-0.28)	(-0.20)	(-0.24)
Production cost	0.003*	0.003	0.003	0.003	0.003	0.003	0.003	0.003*	0.003	0.003	0.003	0.003	0.003	0.003
	(1.99)	(1.82)	(1.77)	(1.72)	(1.75)	(1.78)	(1.64)	(2.00)	(1.78)	(1.75)	(1.43)	(1.81)	(1.71)	(1.81)

Table III – *Continued*

Panel B: dependent variable is ln(Q2), Q2=(MV Assets)/(BV Total Assets - BV Oil/Gas Reserves+MV of Reserves)

				Oil							Gas			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Observations	210	210	210	210	210	210	210	210	210	210	210	210	210	210
Hedging dummy	0.022							-0.051						
	(0.28)							(-0.38)						
Delta_Production(Total)		0.129							-0.116					
		(1.01)							(-0.85)					
Delta_Production(Linear)			-0.023							-0.312*				
			(-0.19)							(-2.33)				
Delta_Production(Nonlinear)				0.132**							0.397*			
				(3.37)							(2.05)			
Delta_Reserve(Total)					3.03**							1.23		
					(3.39)							(1.19)		
Delta_Reserve(Linear)						2.262*							-0.578	
						(2.28)							(-0.57)	
Delta_Reserve(Nonlinear)							2.860*							1.861**
							(2.46)							(4.04)
Log(asset)	0.006	0.005	0.009	0.005	0.002	0.007	0.004	0.013	0.012	0.015	0.005	0.004	0.010	0.004
	(0.21)	(0.16)	(0.29)	(0.18)	(0.06)	(0.22)	(0.14)	(0.50)	(0.42)	(0.53)	(0.15)	(0.14)	(0.34)	(0.13)
ROA	0.007	0.007	0.007	0.007	0.009	0.008	0.008	0.006	0.006	0.006	0.008	0.007	0.007	0.007
	(1.24)	(1.24)	(1.13)	(1.23)	(1.52)	(1.29)	(1.31)	(1.24)	(1.12)	(1.12)	(1.34)	(1.30)	(1.14)	(1.22)
Inv_Growth	0.77**	0.749**	0.800**	0.759**	0.002	0.704**	0.743**	0.823**	0.829**	0.845**	0.734**	0.735**	0.810**	0.753**
	(3.15)	(2.98)	(3.07)	(3.00)	(0.21)	(2.89)	(3.00)	(3.14)	(3.11)	(3.16)	(2.92)	(2.80)	(3.10)	(2.96)
Leverage	0.000	0.000	0.000	0.002	-0.173	-0.001	0.003	0.000	0.000	0.002	0.003	0.001	0.001	0.003
	(0.02)	(-0.00)	(0.06)	(0.20)	(-1.42)	(-0.09)	(0.36)	(0.03)	(0.03)	(0.27)	(0.37)	(0.12)	(0.06)	(0.32)
Dividend dummy	-0.169	-0.170	-0.168	-0.160	0.001	-0.187	-0.149	-0.178	-0.171	-0.168	-0.159	-0.161	-0.169	-0.144
	(-1.35)	(-1.37)	(-1.34)	(-1.27)	0.93	(-1.49)	(-1.20)	(-1.37)	(-1.38)	(-1.37)	(-1.26)	(-1.30)	(-1.35)	(-1.15)
Production cost	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001
	(0.81)	0.90	(0.81)	(0.70)	(0.93)	(1.12)	(0.60)	(0.86)	(0.86)	(0.54)	(0.31)	(1.00)	(0.77)	(0.84)

Panel C: dependent variable is ln(Q3), Q3=(MV Assets)/(BV Total Assets)

				Oil							Gas			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Observations	210	210	210	210	210	210	210	210	210	210	210	210	210	210
Hedging dummy	-0.126							-0.086						
	(-1.44)							(-0.77)						
Delta_Production(Total)		-0.070							0.056					
		(-0.52)							(0.46)					
Delta_Production(Linear)			-0.042							0.077				
			(-0.33)							(0.52)				
Delta_Production(Nonlinear)				0.039							-0.032			
				(1.05)							(-0.14)			
Delta_Reserve(Total)					-0.107							-2.362**		
					(-0.14)							(-3.31)		
Delta_Reserve(Linear)						-0.553							-1.289**	
						(-0.47)							(-2.29)	
Delta_Reserve(Nonlinear)							0.158							-0.911
							(0.21)							(-1.62)
Log(asset)	-0.046*	0.056**	-0.057**	-0.058**	-0.057**	-0.057**	-0.058**	-0.049**	-0.059**	-0.059**	-0.057**	-0.050*	-0.054**	-0.055**
	(-2.20)	(-2.75)	(-2.78)	(-2.83)	(-2.78)	(-2.78)	(-2.80)	(-2.84)	(-3.06)	(-3.04)	(-2.75)	(-2.36)	(-2.66)	(-2.68)
ROA	0.026**	0.027**	0.027**	0.028	0.027**	0.027**	0.027**	0.026**	0.028**	0.028**	0.027**	0.026**	0.027**	0.027**
	(3.07)	(3.04)	(2.99)	(2.98)	(3.01)	(2.96)	(2.98)	(2.86)	(2.98)	(2.97)	(3.00)	(2.91)	(2.93)	(2.96)
Inv_Growth	0.745*	0.675*	0.668*	0.642*	0.658*	0.674*	0.649*	0.704*	0.633*	0.639*	0.657*	0.760*	0.691*	0.671*
	(2.28)	(2.10)	(2.12)	(1.99)	(2.03)	(2.15)	(2.01)	(2.30)	(2.07)	(2.08)	(2.00)	(2.41)	(2.21)	(2.10)
Leverage	0.015*	0.015*	0.015*	0.015*	0.014*	0.014*	0.015*	0.014*	0.014*	0.014*	0.014*	0.013*	0.015*	0.013
	(2.24)	(2.14)	(2.11)	(2.16)	(2.11)	(2.09)	(2.12)	(2.11)	(2.08)	(1.99)	(2.01)	(2.00)	(2.26)	(1.89)
Dividend dummy	0.083	0.084	0.085	0.086	0.083	0.088	0.084	0.068	0.084	0.083	0.082	0.069	0.084	0.070
	(0.88)	(0.87)	(0.89)	(0.86)	(0.85)	(0.91)	(0.84)	(0.71)	(0.86)	(0.85)	(0.83)	(0.71)	(0.87)	(0.70)
Production cost	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.29)	(0.10)	(0.09)	(0.09)	(0.11)	(0.09)	(0.11)	(0.14)	(0.10)	(0.15)	(0.14)	(0.03)	(0.03)	(0.12)

Table IV
Hedging, Historical Volatility and Firm Value

This table presents the regression results of the cross sectional time series least square regression testing the impact of hedging on firm value. The sample includes 210 firm-year observations over the period from 2002 to 2006. The natural logs of the Q1, Q2 and Q3 are the dependent variables. The natural logs of the Q1, Q2 and Q3 are the dependent variables. Relative delta values for linear, nonlinear and total contracts, the control variables, and year dummies are the independent variables. HV_180_Oil (Gas) is the 180-day historical volatility of NYMEX future oil (gas) prices on the last day of the fiscal year. HV_Dummy is one if the 180-day historical volatility of NYMEX future oil (gas) prices on last day of the fiscal year is higher than the median of the 180-days historical volatility in last 10 years. We use the Generalized Estimation Equations (GEEs) method to eliminate the effect of firm specific clustering and heteroskedasticity. t-statistics are shown in parenthesis. * and ** indicate the significance at the 95% and 99% levels, respectively.

Panel A: dependent variable is ln(Q1), Q1=(MV Assets)/(BV Total Assets - BV Oil/Gas Reserves+NPV of Reserves)

	Oil						Gas					
	1	2	3	4	5	6	1	2	3	4	5	6
Observations	210	210	210	210	210	210	210	210	210	210	210	210
Delta_Production(Total)	0.214						-0.043					
	(0.39)						(-0.12)					
Delta_Production(Total)*HV180	-0.377						0.151					
	(-0.20)						(0.26)					
Delta_Production(Linear)		0.049						-0.026				
		(0.10)						(-0.09)				
Delta_Production(Linear)*HV180		-0.049						-0.089				
		(-0.03)						(-0.20)				
Delta_Production(Nonlinear)			0.214						-0.082			
			(1.09)						(-0.14)			
Delta_Production(Nonlinear)*HV180			-0.397						0.622			
			(-0.52)						(0.72)			
Delta_Reserve(Total)				4.612						0.071		
				(1.39)						(0.03)		
Delta_Reserve(Total)*HV180				-11.612						-1.234		
				(-0.96)						(-0.36)		
Delta_Reserve(Linear)					3.061						0.231	
					(0.59)						(0.11)	
Delta_Reserve(Linear)*HV180					-7.966						-2.219	
					(-0.50)						(-0.61)	
Delta_Reserve(Nonlinear)						4.693						0.592
						(1.50)						(0.14)
Delta_Reserve(Nonlinear)*HV180						-11.640						-1.270
						(-0.97)						(-0.26)
HV180	-3.850**	-3.919**	-3.824**	-3.670**	-3.875**	-3.730**	1.454**	1.517**	1.408**	1.549**	1.537**	1.52**
	(-3.66)	(-4.04)	(-3.90)	(-3.61)	(-4.04)	(-3.80)	(3.09)	(3.77)	(3.41)	(3.47)	(3.88)	(4.10)
Log(asset)	-0.004	-0.001	-0.002	-0.003	-0.002	-0.001	-0.003	0.002	-0.002	0.003	0.004	0.001
	(-0.19)	(-0.06)	(-0.07)	(-0.17)	(-0.08)	(-0.07)	(-0.15)	(0.12)	(-0.09)	(0.16)	(0.22)	(0.03)
ROA	0.017**	0.017**	0.018**	0.018**	0.017**	0.018**	0.017**	0.017*	0.018**	0.017**	0.017**	0.017**
	(2.70)	(2.60)	(2.72)	(2.84)	(2.63)	(2.76)	(2.66)	(2.55)	(2.99)	(2.67)	(2.58)	(2.61)
Inv_Growth	0.365	0.387	0.393	0.331	0.366	0.393	0.381	0.428	0.379	0.441	0.453	0.409
	(1.10)	(1.13)	(1.20)	(1.04)	(1.11)	(1.21)	(1.20)	(1.30)	(1.17)	(1.29)	(1.32)	(1.23)
Leverage	0.002	0.002	0.004	0.003	0.002	0.004	0.003	0.003	0.006	0.002	0.003	0.002
	(0.26)	(0.27)	(0.44)	(0.41)	(0.24)	(0.48)	(0.31)	(0.38)	(0.61)	(0.24)	(0.41)	(0.23)
Dividend dummy	-0.012	-0.012	-0.005	-0.012	-0.016	-0.002	-0.01	-0.010	-0.002	-0.017	-0.012	-0.016
	(-0.14)	(-0.14)	(-0.06)	(-0.15)	(-0.19)	(-0.03)	(-0.12)	(-0.12)	(-0.02)	(-0.19)	(-0.15)	(-0.19)
Production cost	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.79)	(0.78)	(0.78)	(0.78)	(0.76)	(0.80)	(0.75)	(0.77)	(0.46)	(0.81)	(0.75)	(0.78)

Table IV – *Continued*

Panel B: dependent variable is ln(Q2), Q2=(MV Assets)/(BV Total Assets - BV Oil/Gas Reserves+MV of Reserves)	Oil						Gas					
	1	2	3	4	5	6	1	2	3	4	5	6
Observations	210	210	210	210	210	210	210	210	210	210	210	210
Delta_Production(Total)	0.510						-0.054					
	(1.02)						(-016)					
Delta_Production(Total)*HV180	-1.159						-0.037					
	(-0.63)						(-0.08)					
Delta_Production(Linear)		0.452						-0.172				
		(0.97)						(-0.61)				
Delta_Production(Linear)*HV180		-1.222						-0.121				
		(-0.77)						(-0.31)				
Delta_Production(Nonlinear)			0.257						0.246			
			(1.13)						(0.51)			
Delta_Production(Nonlinear)*HV180			-0.597						0.142			
			(-0.65)						(0.20)			
Delta_Reserve(Total)				3.774						1.555		
				(1.15)						(0.76)		
Delta_Reserve(Total)*HV180				-2.262						0.844		
				(-0.19)						(0.23)		
Delta_Reserve(Linear)					6.890						1.375	
					(1.37)						(0.69)	
Delta_Reserve(Linear)*HV180					-10.413						-1.569	
					(-0.65)						(-0.43)	
Delta_Reserve(Nonlinear)						3.107						2.841
						(1.06)						(0.98)
Delta_Reserve(Nonlinear)*HV180						-2.919						-1.463
						(-0.23)						(-0.43)
HV180	-3.510**	-3.624**	-3.613**	-3.778**	-3.798**	-3.675**	1.448**	1.461**	1.401**	1.418**	1.454**	1.427**
	(-3.96)	(-4.50)	(-4.59)	(-4.48)	(-4.76)	(-4.69)	(3.75)	(4.52)	(3.98)	(4.23)	(4.53)	(4.61)
Log(asset)	-0.018	-0.015	-0.014	-0.019	-0.019	-0.015	-0.010	-0.005	-0.015	-0.022	-0.014	-0.017
	(-0.63)	(-0.51)	(-0.47)	(-0.65)	(-0.61)	(-0.49)	(-0.36)	(-0.19)	(-0.49)	(-0.77)	(-0.51)	(-0.57)
ROA	0.004	0.004	0.005	0.006	0.005	0.005	0.004	0.004	0.005	0.005	0.004	0.005
	(0.90)	(0.82)	(0.89)	(1.25)	(0.99)	(1.01)	(0.76)	(0.82)	(1.06)	(0.97)	(0.80)	(0.88)
Inv_Growth	0.402	0.427	0.455	0.290	0.273	0.448	0.492*	0.532*	0.431	0.340	0.440	0.427
	(1.81)	(1.77)	(1.89)	(1.36)	(1.21)	(1.87)	(1.98)	(2.04)	(1.78)	(1.42)	(1.77)	(1.73)
Leverage	-0.003	-0.003	-0.001	-0.000	-0.004	0.000	-0.002	-0.000	0.001	-0.001	-0.002	0.000
	(-0.30)	(-0.31)	(-0.11)	(-0.07)	(-0.48)	(0.04)	(-0.24)	(-0.03)	(0.08)	(-0.11)	(-0.24)	(0.01)
Dividend dummy	-0.156	-0.158	-0.148	-0.157	-0.181	-0.140	-0.155	-0.153	-0.146	-0.136	-0.153	-0.129
	(-1.29)	(-1.30)	(-1.20)	(-1.33)	(-1.51)	(-1.14)	(-1.29)	(-1.28)	(-1.18)	(-1.11)	(-1.25)	(-1.05)
Production cost	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.001	-0.001	-0.001
	(-0.67)	(-0.69)	(-0.67)	(-0.78)	(-0.67)	(-0.76)	(-0.60)	(-0.70)	(-0.92)	(-0.74)	(-0.67)	(-0.64)

Table IV – *Continued*

Panel C: dependent variable is ln(Q3), Q3=(MV Assets)/(BV Total Assets)	Oil						Gas					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
Observations	210	210	210	210	210	210	210	210	210	210	210	210
Delta_Production(Total)	-0.270						0.346					
	(-0.58)						(1.09)					
Delta_Production(Total)*HV180	0.686						-0.387					
	(0.42)						(-0.80)					
Delta_Production(Linear)		-0.259						0.406				
		(-0.76)						(1.31)				
Delta_Production(Linear)*HV180		0.851						-0.467				
		(0.72)						(-1.11)				
Delta_Production(Nonlinear)			0.351						-0.190			
			(1.71)						(-0.43)			
Delta_Production(Nonlinear)*HV180			-1.207						0.250			
			(-1.51)						(0.41)			
Delta_Reserve(Total)				2.343						-0.629		
				(0.65)						(-0.37)		
Delta_Reserve(Total)*HV180				-8.670						-2.562		
				(-0.71)						(-0.92)		
Delta_Reserve(Linear)					-2.365						0.638	
					(-0.63)						(0.35)	
Delta_Reserve(Linear)*HV180					7.478						-2.941	
					(0.67)						(-0.93)	
Delta_Reserve(Nonlinear)						5.910*						-3.913
						(2.04)						(-1.29)
Delta_Reserve(Nonlinear)*HV180						-21.771*						3.506
						(-2.03)						(1.02)
HV180	1.002	1.053	1.363	1.36	1.077	1.467	-0.338	-0.373	-0.467	-0.41	-0.389	-0.463
	(0.90)	(1.01)	(1.28)	(1.24)	(1.04)	(1.39)	(-0.71)	(-0.87)	(-1.10)	(-1.14)	(-0.92)	(-1.18)
Log(asset)	-0.060*	-0.061**	-0.062**	-0.062**	-0.062**	-0.062**	-0.064**	-0.064**	-0.062**	-0.052*	-0.057*	-0.060*
	(-2.54)	(-2.61)	(-2.66)	(-2.65)	(2.61)	(-2.66)	(-3.09)	(-3.06)	(-2.66)	(2.20)	(-2.51)	(-2.57)
ROA	0.025**	0.025*	0.025**	0.025**	0.025**	0.025**	0.025**	0.025**	0.025**	0.024**	0.025	0.025**
	(2.63)	(2.57)	(2.59)	(2.63)	(2.58)	(2.59)	(2.61)	(2.58)	(2.66)	(2.59)	(2.56)	(2.60)
Inv_Growth	0.602	0.578	0.582	0.586	0.589	0.577	0.550	0.564	0.585	0.705	0.628	0.610
	(1.61)	(1.53)	(1.60)	(1.58)	(1.57)	(1.60)	(1.63)	(1.71)	(1.61)	(1.88)	(1.71)	(1.71)
Leverage	0.015*	0.015*	0.015*	0.014*	0.015*	0.015*	0.015*	0.014*	0.015*	0.013*	0.015*	0.013*
	(2.41)	(2.33)	(2.42)	(2.44)	(2.28)	(2.38)	(2.39)	(2.27)	(2.20)	(2.20)	(2.55)	(2.05)
Dividend dummy	0.093	0.093	0.092	0.092	0.093	0.090	0.095	0.096	0.092	0.072	0.089	0.075
	(0.91)	(0.92)	(0.89)	(0.90)	(0.94)	(0.87)	(0.95)	(0.97)	(0.89)	(0.69)	(0.87)	(0.72)
Production cost	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.50)	(-0.46)	(-0.48)	(-0.52)	(-0.48)	(-0.43)	(-0.53)	(-0.49)	(-0.51)	(-0.51)	(-0.56)	(-0.52)

Table IV – *Continued*

Panel D: dependent variable is ln(Q1), Q1=(MV Assets)/(BV Total Assets - BV Oil/Gas Reserves+NPV of Reserves)	Oil						Gas					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
Observations	210	210	210	210	210	210	210	210	210	210	210	210
Delta_Production(Total)	0.054						-0.004					
	(0.30)						(-0.02)					
Delta_Production(Total)*HV_Dummy	0.083						0.097					
	(0.36)						(0.34)					
Delta_Production(Linear)		-0.023						-0.061				
		(-0.13)						(-0.41)				
Delta_Production(Linear)*HV_Dummy		0.099						-0.036				
		(0.47)						(-0.16)				
Delta_Production(Nonlinear)			0.114**						0.143			
			(3.22)						(0.43)			
Delta_Production(Nonlinear)*HV_Dummy			-0.015						0.278			
			(-0.28)						(0.67)			
Delta_Reserve(Total)				1.863*						-0.339		
				(2.55)						(-0.28)		
Delta_Reserve(Total)*HV_Dummy				-1.036						-0.664		
				(-1.02)						(-0.35)		
Delta_Reserve(Linear)					1.347						-0.475	
					(0.62)						(-0.43)	
Delta_Reserve(Linear)*HV_Dummy					-0.969						-1.266	
					(-0.46)						(-0.68)	
Delta_Reserve(Nonlinear)						1.845**						0.154
						(2.95)						(0.06)
Delta_Reserve(Nonlinear)*HV_Dummy						-0.823						-0.654
						(-0.94)						(-0.25)
HV_Dummy	-0.352**	-0.345**	-0.330**	-0.312**	-0.328**	-0.320**	0.299*	0.317*	0.279*	0.330*	0.323**	0.327**
	(-3.30)	(-3.90)	(-3.87)	(-3.33)	(-3.85)	(-3.72)	(2.04)	(2.52)	(2.35)	(2.39)	(2.58)	(3.06)
Log(asset)	-0.004	-0.001	-0.002	-0.003	-0.002	-0.001	-0.003	0.002	-0.002	0.003	0.004	0.001
	(-0.19)	(-0.06)	(-0.08)	(-0.16)	(-0.08)	(-0.07)	(-0.15)	(0.12)	(-0.09)	(0.16)	(0.22)	(0.03)
ROA	0.017**	0.017**	0.018**	0.018**	0.017**	0.018**	0.017**	0.017*	0.018**	0.017**	0.017**	0.017**
	(2.70)	(2.60)	(2.71)	(2.81)	(2.63)	(2.74)	(2.69)	(2.56)	(2.93)	(2.68)	(2.59)	(2.61)
Inv_Growth	0.359	0.380	0.391	0.332	0.365	0.394	0.380	0.428	0.381	0.442	0.455	0.409
	(1.09)	(1.12)	(1.19)	(1.05)	(1.12)	(1.21)	(1.20)	(1.31)	(1.17)	(1.28)	(1.33)	(1.23)
Leverage	0.002	0.0025	0.004	0.003	0.002	0.004	0.0025	0.003	0.005	0.002	0.003	0.002
	(0.28)	(0.30)	(0.44)	(0.39)	(0.23)	(0.48)	(0.31)	(0.38)	(0.57)	(0.25)	(0.40)	(0.24)
Dividend dummy	-0.010	-0.010	-0.005	-0.011	-0.016	-0.002	-0.010	-0.010	-0.002	-0.017	-0.012	-0.016
	(-0.12)	(-0.13)	(-0.05)	(-0.14)	(-0.19)	(-0.02)	(-0.12)	(-0.13)	(-0.02)	(-0.19)	(-0.15)	(-0.19)
Production cost	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.81)	(0.82)	(0.77)	(0.76)	(0.78)	(0.75)	(0.75)	(0.77)	(0.46)	(0.81)	(0.75)	(0.78)

Table IV – *Continued*

Panel E: dependent variable is ln(Q2), Q2=(MV Assets)/(BV Total Assets - BV Oil/Gas Reserves+MV of Reserves)												
	Oil						Gas					
	1	2	3	4	5	6	1	2	3	4	5	6
Observations	210	210	210	210	210	210	210	210	210	210	210	210
Delta_Production(Total)	0.222						-0.056					
	(1.56)						(-0.30)					
Delta_Production(Total)*HV_Dummy	-0.090						-0.035					
	(-0.39)						(-0.15)					
Delta_Production(Linear)		0.136						-0.222				
		(0.85)						(-1.25)				
Delta_Production(Linear)*HV_Dummy		-0.079						-0.047				
		(-0.39)						(-0.23)				
Delta_Production(Nonlinear)			0.121**						0.376			
			(3.88)						(1.35)			
Delta_Production(Nonlinear)*HV_Dummy			-0.070						-0.068			
			(-1.12)						(-0.19)			
Delta_Reserve(Total)				3.201**						1.784		
				(3.02)						(1.75)		
Delta_Reserve(Total)*HV_Dummy				-0.127						0.569		
				(-0.12)						(0.29)		
Delta_Reserve(Linear)					4.502**						0.808	
					(2.70)						(0.75)	
Delta_Reserve(Linear)*HV_Dummy					-1.053						-0.722	
					(-0.55)						(-0.36)	
Delta_Reserve(Nonlinear)						2.516**						2.510
						(3.08)						(1.35)
Delta_Reserve(Nonlinear)*HV_Dummy						-0.502						-0.946
						(-0.49)						(-0.50)
HV_Dummy	-0.301**	-0.312**	-0.305**	-0.324**	-0.322**	-0.310**	0.341**	0.320**	0.327**	0.343**	0.353**	0.344**
	(-3.30)	(-4.26)	(-4.42)	(-4.13)	(-4.55)	(-4.43)	(2.85)	(3.21)	(3.24)	(2.95)	(3.53)	(3.88)
Log(asset)	-0.018	-0.015	-0.014	-0.019	-0.018	0.000	-0.010	-0.005	-0.015	-0.022	-0.015	-0.017
	(-0.62)	(-0.50)	(-0.47)	(-0.65)	(-0.61)	(0.04)	(-0.36)	(-0.19)	(-0.49)	(-0.77)	(-0.51)	(-0.57)
ROA	0.005	0.004	0.005	0.006	0.005	0.005	0.004	0.004	0.005	0.005	0.004	0.005
	(0.89)	(0.81)	(0.88)	(1.25)	(0.98)	(1.00)	(0.77)	(0.81)	(1.02)	(0.98)	(0.80)	(0.87)
Inv_Growth	0.402	0.426	0.456	0.290	0.273	0.448	0.493*	0.533*	0.428	0.340	0.440	0.425
	(1.81)	(1.77)	(1.88)	(1.36)	(1.21)	(1.88)	(1.98)	(2.04)	(1.74)	(1.42)	(1.77)	(1.72)
Leverage	-0.003	-0.003	-0.001	-0.001	-0.004	0.000	-0.002	-0.000	0.001	-0.001	-0.002	0.000
	(-0.32)	(-0.32)	(-0.11)	(-0.07)	(-0.50)	(0.04)	(-0.24)	(-0.03)	(0.06)	(-0.11)	(-0.25)	(0.02)
Dividend dummy	-0.155	-0.157	-0.148	-0.157	-0.181	-0.140	-0.154	-0.154	-0.147	-0.136	-0.152	-0.130
	(-1.28)	(-1.29)	(-1.20)	(-1.33)	(-1.51)	(-1.14)	(-1.28)	(-1.28)	(-1.19)	(-1.11)	(-1.25)	(-1.05)
Production cost	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.001	-0.001	-0.001
	(-0.67)	(-0.65)	(-0.68)	(-0.78)	(-0.65)	(-0.76)	(-0.60)	(-0.70)	(-0.89)	(-0.74)	(-0.67)	(-0.63)

Table IV – *Continued*

Panel F: dependent variable is ln(Q3), Q3=(MV Assets)/(BV Total Assets)

	Oil						Gas					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
Observations	210	210	210	210	210	210	210	210	210	210	210	210
Delta_Production(Total)	-0.193						0.167					
	(-1.14)						(1.05)					
Delta_Production(Total)*HV_Dummy	0.212						-0.124					
	(0.99)						(-0.53)					
Delta_Production(Linear)		-0.123						0.219				
		(-0.91)						(1.18)				
Delta_Production(Linear)*HV_Dummy		0.199						-0.193				
		(1.20)						(-0.90)				
Delta_Production(Nonlinear)			0.060						-0.152			
			(1.56)						(-0.53)			
Delta_Production(Nonlinear)*HV_Dummy			-0.090						0.198			
			(-1.54)						(0.65)			
Delta_Reserve(Total)				0.324						-1.521		
				(0.32)						(-1.47)		
Delta_Reserve(Total)*HV_Dummy				-0.840						-1.285		
				(-0.74)						(-.90)		
Delta_Reserve(Linear)					-0.910						-0.396	
					(-0.50)						(-0.39)	
Delta_Reserve(Linear)*HV_Dummy					1.132						-1.426	
					(0.85)						(-0.89)	
Delta_Reserve(Nonlinear)						0.683						-2.862
						(0.85)						(-1.51)
Delta_Reserve(Nonlinear)*HV_Dummy						-1.781*						1.980
						(-2.15)						(1.10)
HV_Dummy	0.054	0.077	0.113	0.119	0.087	0.124	0.037	0.041	-0.013	0.017	0.011	-0.015
	(0.49)	(0.81)	(1.23)	(1.18)	(0.95)	(1.34)	(0.26)	(0.33)	(-0.10)	(0.12)	(0.09)	(-0.14)
Log(asset)	-0.60*	-0.062**	-0.062**	-0.062**	-0.062**	-0.62**	-0.065**	-0.064**	-0.062**	-0.052*	-0.057*	-0.060*
	(-2.55)	(-2.63)	(-2.67)	(-2.65)	(-2.62)	(-2.66)	(-3.07)	(-3.03)	(-2.66)	(-2.20)	(-2.51)	(-2.57)
ROA	0.025**	0.025**	0.025**	0.025**	0.025**	0.025**	0.025**	0.025**	0.025**	0.024**	0.025*	0.025**
	(2.64)	(2.58)	(2.59)	(2.62)	(2.58)	(2.58)	(2.61)	(2.58)	(2.64)	(2.58)	(2.56)	(2.59)
Inv_Growth	0.596	0.568	0.580	0.587	0.591	0.578	0.550	0.565	0.588	0.705	0.630	0.613
	(1.60)	(1.49)	(1.60)	(1.58)	(1.58)	(1.60)	(1.63)	(1.72)	(1.62)	(1.88)	(1.72)	(1.71)
Leverage	0.015*	0.015*	0.015*	0.015*	0.015*	0.015*	0.015*	0.014*	0.014*	0.013*	0.015*	0.013*
	(2.44)	(2.39)	(2.42)	(2.42)	(2.28)	(2.37)	(2.39)	(2.23)	(2.18)	(2.21)	(2.52)	(2.02)
Dividend dummy	0.094	0.094	0.093	0.092	0.093	0.090	0.095	0.096	0.093	0.073	0.090	0.075
	(0.92)	(0.93)	(0.90)	(0.91)	(0.94)	(0.87)	(0.94)	(0.96)	(0.90)	(0.70)	(0.88)	(0.72)
Production cost	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.48)	(-0.45)	(-0.51)	(-0.52)	(-0.49)	(-0.49)	(-0.53)	(-0.50)	(-0.53)	(-0.51)	(-0.56)	(-0.53)

REFERENCE LIST

Allayannis, George, and James Weston, 2001, The use of foreign currency derivatives and firm market value, *Review of Financial Studies* 14, 243–276.

Brown, Gregory, 2001, Managing foreign exchange risk with derivatives, *Journal of Financial Economics* 60, 401–448.

Carter, David, Daniel Rogers, and Betty Simkins, 2006, Does fuel hedging make economic sense? The case of the U.S. airline industry, *Financial Management* 35, 53-86

Coles, Jeffrey, Michael Lemmon, and Felix Meschke, 2003, Structural models and endogeneity in corporate finance: The link between managerial ownership and corporate performance,Working paper, Arizona State University.

DeMarzo, Peter, and Darrell Duffie, 1995, Corporate incentives for hedging and hedge accounting, *Review of Financial Studies* 8, 743–771.

Froot, Kenneth, David Scharfstein, and Jeremy Stein, 1993, Risk management: Coordinating corporate investment and financing policies, *Journal of Finance* 48, 1629–1658.

Géczy, Christopher, Bernadette Minton, and Catherine Schrand, 1997, Why firms use currency derivatives, *Journal of Finance* 52, 323–354.

Graham, John, and Daniel Rogers, 2002, Do firms hedge in response to tax incentives? *Journal of Finance* 57, 815–839.

Guay, Wayne, and S. P. Kothari, 2003, How much do firms hedge with derivatives? *Journal of Financial Economics* 80, 423–461.

Haushalter, David, 2000, Financing policy, basis risk, and corporate hedging: Evidence from oil and gas producers, *Journal of Finance* 55, 107–152.

Jin, Yanbo and Philippe Jorion, 2006, Firm Value and Hedging: Evidence from U.S. Oil and Gas Producers, *Journal of Finance* 61, 893–919.

Leland, Hayne, 1998, Agency cost, risk management, and capital structure, *Journal of Finance* 53, 1213–1243.

Liang, K. Y. and Zeger, S. L. ,1986, Longitudinal data analysis using generalized linear models. *Biometrika* 73, 13-22.

Mayers, David, and Clifford Smith, 1982, On the corporate demand for insurance, *Journal of Business* 55, 281–296.

Mian, Shehzad, 1996, Evidence on corporate hedging policy, *Journal of Financial and Quantitative Analysis* 31, 419–439.

Modigliani, F.; Miller, M., 1958, The Cost of Capital, Corporation Finance and the Theory of Investment, American Economic Review 48 (3): 261–297

Nance, Deana, Clifford Smith, and Charles Smithson, 1993, On the determinants of corporate hedging, *Journal of Finance* 48, 267–284.

Smith, Clifford, and Ren´e Stulz, 1985, The determinants of firms’ hedging policies, *Journal of Financial and Quantitative Analysis* 20, 391–405.

Stulz, Ren´e, 1984, Optimal hedging policies, *Journal of Financial and Quantitative Analysis* 19, 127–140.

Tufano, Peter, 1996, Who manages risk? An empirical examination of risk management practices in the gold mining industry, *Journal of Finance* 51, 1097–1137.