The Determinants of Corporate Hedging Policies

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Abstract

The objective of this paper is to estimate the determinants for corporate hedging activities in oil and gas industry. We found that managerial incentive plays an important role in corporate hedging decisions. Firms whose managers possess greater equity ownership and fewer stock options in their compensation package tend to hedge more extensively. In addition, firm size, financial leverage, and geographic diversification significantly affect corporate hedging policies.

Keywords: risk management, hedging, executive compensation

1. Introduction

In a perfect Modigliani and Miller world assuming no information asymmetries, taxes or transaction costs, there would almost be no justification for corporations to engage in hedging. Shareholders could hedge against risk exposures on their own at the same costs. However, in practice, many corporations adopt at least some financial engineering instruments to control their exposures to interest rates, foreign exchange rates, and commodity prices. The discrepancy between theories and corporate practice poses one important question: why firms manage risks? Managerial risk aversion could provide a rationale for corporate risk management. This hypothesis, based on agency theory, conjectures that the hedging demand is induced by managerial risk aversion. Managers typically have a significant amount of their wealth invested in the firm they manage. Salary, bonus, and stock options are all tied to the performance of the firm. Risk-averse managers know that they will suffer from adverse consequences of operations in their companies, so they will direct their firms to engage in risk management if they find that the cost of hedging on their own account is higher than the cost of hedging at the corporate level. This theory predicts that the nature of executive compensation plan can influence a firm's risk management activities.

Following this line of research, in this paper we examine the determinants of corporate hedging activities with a focus on the interaction between executive compensation and level of hedging activities. Typically, managers are compensated by their companies in three ways: direct cash payment including salary and cash bonus; firm-specific managerial wealth, i.e., managerial equity holdings and contingent incentive compensation plan such as stock options. We use a tobit model to analyze the association between executive compensation, managerial equity ownership, stock options and the level of hedging while controlling for certain firm characteristics including level of cash and cash equivalent, financial leverage, and firm size. All else equal, managers who hold more shares of their companies will have greater incentive to manage the firms' risk. Meawhile, Stulz (1996) and Smith and Stulz (1985) argued that the incorporation of option-based compensation increases the incentives for managers to take risk because greater risk and higher price volatility can boost the value of their stock options. Therefore, firms that rely heavily on contingent compensation may hedge less than firms that mainly rely on salary and other non-contingent methods of payment.

Previous studies by Tufano (1996) and Haushalter (2000) also attempted to test the managerial incentive hypothesis. Tufano (1996) examines the hedging behavior of 48 gold mining companies and found that the only important determinant of the hedging decisions was the nature of the managerial compensation contract, particularly managers' equity ownership invested in their companies. However, Haushalter (2000) reports mixed evidence for this hypothesis. Our study contributes to the current literature by complementing previous empirical studies and shedding more light on the determinants and mechanism of hedging policy design. The remainder of the paper is organized as follows: Section 1 introduces the hypotheses; definitions of variables adopted in the tobit model are presented in Section 2.

The subsequent section presents univariate analysis and compares firm characteristics between companies with different hedging intensity. The results of the tobit model estimate are discussed in Section 4, and finally Section 5 summarizes the findings.

2. Data and Variables

We use oil and gas producers as our sample firms and the sample period is 2003 and 2004. Oil and gas producers face the same risk exposure to the fluctuation of oil and gas prices, and they have a wide range of financial instruments, including forward agreements, futures contracts, options or swaps, to achieve their hedging goals. Therefore, this industry has embraced risk management and provides an interesting sample for studying hedging practices at the corporate level.We identify 102 U.S. oil and gas producers in 2003 and 2004 from Compustat. To make sure that the firms in our sample are true oil and gas producers, we exclude firms fully involved in midstream and downstream operations in the petroleum industry, including oil/gas gathering, treating, transmission, and marketing. Firms with zero oil and gas production are also excluded from the sample. The dependent variable and independent variables are discussed below.

2.1. Dependent variable: Fraction of production hedged

We use hedged percentage of annual oil and gas production as the dependent variable. We convert gas production denominated in thousand cubic feet (mcf) into barrels of oil equivalent (BOE), and add gas production and oil production together to determine the total annual production denominated in a thousand barrels of oil equivalent (MBOE). Then we calculated the fraction of annual production hedged against price fluctuation based on the hedging positions disclosed in companies' annual reports. Oil and gas producers have a wide range of financial instruments to achieve hedging goals. Futures contracts, forwards contracts, options and swaps are commonly used to lock in a fixed sales price or to curb downside risk. We consider all these contracts as hedging tools when we determine the dependent variable. The distribution of the dependent variable – level of hedging, is illustrated in Figure 1. Sample firms did not hedge in 80 firm years, and hedge in the rest 123 firm years. Hedgers were the majority in both 2003 and 2004.

2.2. Independent variables

Stulz (1984), and Smith and Stulz (1985) argued that managerial risk aversion plays an important role in corporate hedging decisions. Managers, as economic agents, try to maximize their lifetime utility, and they tend to have poorly diversified portfolios, unfavorable circumstances of their companies will adversely affect their personal wealth. Therefore managers have strong incentive to manage risk at the corporate level. Smith and Stulz's model predicts that managers' compensation plan can influence their companies' hedging activities. Therefore, we use variables for different components of executive compensation package to measure the magnitude of managerial risk aversion.

2.2.1. Number of exercisable options. We use the number of options held by officers and directors that are exercisable within 60 days as a proxy for managerial option holdings. The incorporation of option-based provisions in managers' compensation packages increases managers' incentive to take risk, because lower risk would reduce the value of their stock options. Consequently, increasing managers' option-based compensation decreases their incentive to hedge. Therefore, we expect a negative correlation between this variable and the extent of hedging.

2.2.2. CEO compensation. We use the log of the total value of CEO's salary and bonus as a measure for management's cash payment. Knopf, Nam and Thornton (2002) argued that cash payment is actually a diversifiable wealth. Managers can invest their cash payment in various investment instruments, and hence effectively diversify their personal portfolio and reduce the risk of their wealth. The presence of a diversified outside portfolio would mitigate managers' risk aversion, i.e., more cash payment could lead to less hedging. Therefore there would be a negative association between hedging intensity and cash payment.

2.2.3. Managerial equity ownership. Besides a discussion about the effect of stock options on hedging, Smith and Stulz's (1985) model also predicts that managers with greater equity ownership would prefer more risk management. We used the log of the market value of the firm's common stocks owned by officers and directors as the variable for managerial equity ownership. The market value of the common shares ownership is calculated as the number of common shares held by managers and directors as a group multiplied by year-end share price. The purpose of including this variable is to test whether firms whose managers and directors collectively own greater equity interests tend to manage risk more extensively.

2.2.4. Fraction of blockholders' equity ownership. To test whether hedging is an outgrowth of poorly-diversified managers holding large equity stakes, rather than large equity stakes alone, we control for the presence of outside blockholders using the fraction of outstanding common stock held by outside blockholders.

Outside blockholders are defined as investors who own at least five percent of the common shares outstanding and at the same time, they are not officers or directors in the company. Tufano (1996) argued that outside blockholders are primarily well-diversified institutional investors, and hence they are less likely to act like risk-averse poorly diversified investors (e.g., managers). Companies with greater blockholder equity ownership should be less likely to hedge (if at all) extensively.

2.2.5. CEO age. Holding constant the amount of wealth they have invested in the firm, managers who are more risk averse would be more likely to manage risk. Unfortunately, there is no direct measure of the degree of risk aversion by managers. Age might serve as a proxy for risk aversion. We collected CEO's ages from annual reports and proxy statements. Older individuals tend to be more risk averse than younger individuals, therefore, firms may hedge more when their decision-making officers are growing older. There are some different arguments about the age effect. Tufano (1996) argued that it is hard for older people to understand and implement the modern finance theories about sophisticated derivatives and hedging strategies, therefore, firms with older officers may hedge less. The sign of the correlation coefficient of CEO's age is expected to be negative.

2.2.6. CEO tenure. DeMarzo and Duffie (1995) argued that new managers who have less well-developed reputations are more likely to adopt new ideas like derivative-based risk management strategies in order to more accurately signal their management quality. If this hypothesis holds, firms whose managers have shorter tenures on the job would be more inclined to manage risk. Tenure is defined as years in the position. We collect information on the tenure of CEOs for sample firms from their proxy statements and annual reports. We expect a negative association between CEO's tenure and the extent of hedging.

2.2.7. Firm size. Bodnar et.al. (1998) argued that large firms enjoy greater economy of scale in hedging, and upfront fixed costs set high threshold for small companies to initiate hedging programs. Many small firms do not even have a risk management program. While, large firms with established risk management programs, talents equipped with sophisticated knowledge about financial engineering, and close networks on the capital market, might find it easier to design and implement cost-efficient hedging strategies and tend to hedge more. In comparison, small firms might hedge less extensively. So, the level of hedging should be positively correlated with firm size. Firm size is measured as the logarithm of the book value of total assets.

2.2.8. Oil and gas production mix. Most firms in the petroleum industry produce both oil and natural gas at the same time, however, oil and gas markets exhibit different characteristics. For example, the price of natural gas shows greater volatility than that of price of oil because demand for natural gas shifts quickly to weather conditions. Due to the magnitude of energy price risk exposure on the natural gas markets and oil markets and how each differs, firms with different operational weight on oil and gas production may have different propensity to hedge. In order to control for the differences between firms operating primarily in the oil industry versus those operating primarily in the gas industry, we use the ratio of oil production to total oil and gas production as a control variable in the regression.

Instead of managing risk with the financial instruments, firms could pursue alternative activities that substitute for financial risk management strategies. For example, firms could adopt conservative financial policies such as maintaining low leverage or carrying large cash balance to protect themselves from shortage of liquidity; they could explore and extract oil and gas in different countries to achieve geographic diversification; or they could be engaged in multiple lines of business. Greater use of these substitute risk management activities should be associated with less hedging. So we control for cash balance, financial leverage, and the degree of diversification in the tobit regression.

2.2.9. Cash balance. Cash balance is measured as the ratio of cash and marketable securities to the book value of total assets. According to the pecking order theory, cash provides a valuable source of funds for investments when current internally generated funds fall short and external financing is costly. Cash reserve is an effective way of self-insurance and a good substitute for managing risk with financial contracts. Therefore, large cash balance leads to lower extent of hedging.

2.2.10. Leverage. Leverage is defined as the net debt, which is the book value of debt minus cash, divided by the book value of total assets. The oil and gas industry requires large capital injection to start new projects and maintain normal exploration and production activities, securing enough stable cash flows are crucial for the survival of oil and gas companies. Kaplan and Zingales (1997) showed that the likelihood of a firm being financially constrained increases with its leverage and Whited (1992) showed that highly levered firms face high premiums for external funds. To save financing costs and financial distress costs, highly levered oil and gas companies could hedge their production to reduce the variability of internally generated cash flows.

In this way, they might lower their external financing needs and probability of financial distress, and avoid underinvestment problem (see Smith and Stulz, 1985; Froot, Scharfstein and Stein, 1993; Stulz, 1996; Leland, 1998). Therefore, we expect a positive correlation between leverage and the level of hedging.

2.2.11. Business diversification. Firms can diversify their assets in two ways: business segmentation and geographic diversification. Oil and gas producers can reduce their hedging demand by engaging in multiple business segments other than oil and gas production. For example, oil and gas producers can also participate in processing and/or marketing of oil and natural gas. In this way, firms can diversify their assets and, to some extent, reduce the risk of the whole company. When the petroleum industry underperforms, the company may still survive with the better performance of subsidiaries operated in different industries. The degree of business diversification is measured as the percentage of firm's total assets engaged outside the petroleum industry, and data of this variable are collected from segment reports of Compustat. Business diversification is predicted to be negatively correlated with the level of hedging.

2.2.12. Geographic diversification. Many U.S. oil and gas companies extract oil and gas in different regions besides North America. The operation condition, production cost, and profit margin differ across production locations. Some producers believe that multinational operations provide an endogenous mechanism to reduce the financial risk of the whole company, the hedge demand of these producers thus would be lower. We define geographic diversification as the percentage of total assets engaged in oil and gas production outside North America. A higher value of geographic diversification indicates fewer domestic operations and more foreign operations. The hedging demand of firms with greater geographic diversification tends to be lower.

A summary of the specifications of all the independent variables and control variables, the predicted sign of the coefficient for each variable, and the data source is provided in Table 1.

3. Univariate Analysis

3.1. Descriptive statistics

Table 2 contains descriptive statistics for all the sample firms. The statistics for the dependent variable suggest substantial variation in the hedging policies of oil and gas producers. Some firms never hedge their production, while several firms hedge more than 75 percent of their production. On average, firms hedged 27 percent of production in 2003, and 25 percent in 2004. There is also a great variability in managerial options compensation and equity ownership structure across firms. Some firms have no option-based compensation plan, however, managers in a few firms can collectively own more than eight million exercisable stock options. The average percentage of common shares collectively owned by blockholders is 17 percent with a range between zero and 73 percent. On average, oil and gas companies in our sample maintain a cash reserve of 10 percent of the firms' total asset, and the leverage ratio is 19 percent. The statistics for geographic and business diversification imply that most of U.S. oil and gas producers only operate in the domestic market, North America, and are not actively engaged in international operations or multiple business segments.

3.2. Comparison of firm characteristics between groups with different extent of hedging activities

Table 3 shows the comparison of the firm characteristics between firms with different hedging intensity during 2003 and 2004. In this table, firms are classified into three groups according to the extent of their hedging activities: firms with no risk management (hedge percentage = 0), firms with medium hedging activities (0 < hedge percentage < 42 percent), and firms hedge extensively (hedge percentage > 42 percent). The table reports the results (*p*-values) of *t*-test for the differences between the means of all the variables for these groups, as well as a nonparametric signed-rank test of the differences between the medians of all the variables for these groups. In Table 3, a comparison between the statistics for the non-hedge group and medium hedge group suggests that firms employing no risk management are significantly different from medium hedgers for most of the variables. It seems that, compared with medium hedgers, non-hedgers are smaller in size, pay less salary and bonus to their CEOs, carry more cash and borrow less debt, their managers and blockholders own less equity ownership, meanwhile, their managers are older. These observations are consistent with our prediction. In addition, the *p*-value of the *t*-test indicates that there is no significant difference between the means of the number of managerial options for the two groups. However, the signed-rank test suggests that managers in non-hedging firms own significantly fewer stock options than the managers in firms with medium hedging activities.

In Table 3, we also compare firm characteristics between firms employing moderate hedging activities and firms employing extensive risk management. It seems that there is no significant difference between the two groups in managerial compensation and equity ownership structure. Extensive hedgers are significantly different from medium hedgers only in cash balance and financial leverage, i.e., firms hedging more extensively tend to keep less cash reserve and use more debt.

The signed-rank test suggests that extensive hedging firms have significantly larger firm size than medium hedging firms, however, the *p*-value of the *t*-test shows no significant difference between the average firm sizes of the two groups.

4. Multivariate Analysis

4.1. Methodology

As shown in Figure 1, there are a significant number of observations with zero hedge percentage, this distribution characteristic implies that the observed value of the dependent variable is left censored at zero, therefore we apply a cross-sectional tobit model with censored data[a]. The estimated *p*-values will be calculated based on a *Chi*-square distribution. The fraction of production hedged is regressed on variables for managerial cash compensation, option holdings, and equity ownership structure. At the same time, we control for CEO age, CEO tenure, leverage, cash reserve, oil and gas production mix, firm size, and business and geographic diversification. Regression results for the pooled sample and each of the 2003 and 2004 samples are reported in Table 4. Due to a pooled time-series, cross-sectional regression may violate the assumption of independent errors, and *t*-statistics may be overstated. To avoid misspecification, we re-estimate the regression model using annual data, and these regression results are presented in Table 4 as well.

4.2. Results and Discussions

The results in Table 4 are generally consistent with our hypotheses. In this section, we examine the independent variables individually.

4.2.1. Managerial risk aversion variables

First, the result of regression with pooled data shows that managerial option holdings are negatively associated with the extent of hedging, and the correlation coefficient is significant at the one percent level. This result is consistent with the theoretical prediction of Smith and Stulz (1985). Risk and volatility can increase the value of stock options. If companies awarded more stock options to their managers, managers could maximize the value of their stock options by keeping risk exposure at the corporate level, therefore, more option-based compensation would lead to lower hedging demand.

Second, the extent of hedging is negatively associated with managers' cash payment in the regression with pooled data. This result does not support the hypothesis that managers who receive more cash payments from their companies would hedge more because they have their personal wealth tied to the performance of the company. However, this evidence supports the prediction by Knopf, Nam and Thornton (2002): cash payments are diversifiable wealth. Managers can use the cash payments to purchase various financial instruments, effectively diversify their personal portfolio and reduce their personal risk exposure; consequently, more cash payments to managers reduce the level of hedging activities at the corporate level.

Third, the results from tobit regression indicate that the level of hedging is positively correlated with managerial equity ownership and negatively correlated with the share holdings of outside blockholders. If managers own greater equity ownership in their companies, adverse consequence of the firms' operation will translate into greater loss of the managers' wealth, therefore managers would have stronger incentive to manage risk extensively. Compared with managers, outside blockholders are considered to be better diversified. Blockholders, primarily institutional investors, add the oil and gas companies into their portfolios as an attempt to be rewarded for taking the risk exposure in this industry. From this perspective, hedging would not provide benefit to blockholders and their incentive to hedge should be low. Consequently, the presence of powerful blockholders would reduce the hedging intensity. The sign of the coefficient for this variable is consistent with our theoretical prediction, but the coefficient is not significant.

The regression results from the annual data of 2003 and 2004 show that the coefficient of each variable is generally close to the coefficient in the regression with pooled data. However, the significance level of some variables changes in the regressions with annual data. The negative correlation between managerial option holdings and the extent of hedging is significant at the five percent level for both 2003 and 2004. Among the three proxies for managerial incentive: number of managerial stock options, managerial cash compensation, and equity ownership, managerial stock options appear to be the only variable which is consistently significant in the regression specifications with pooled data as well as annual data. This is strong evidence that option-based compensation plays an important role in corporate hedging decisions. More option awards to the management lead to less risk management activities.

[a] We also applied an Ordinary Least Square (OLS) regression with the same model specification as the tobit regression. The coefficient estimates and the significance level of the coefficients using the OLS regression do not differ materially from those generated from the tobit regression.

The coefficient estimate for CEO compensation is only significant for 2004, however, the coefficient is consistently negative for both 2003 and 2004, and it suggests that more cash payment to managers leads to less hedge. Similarly, the coefficient of managerial equity ownership is only significant for 2003, but the sign of the coefficient estimates are always positive and consistent with our prediction.

4.2.2. Control variables.

As to the control variables, the regression result with pooled data shows that the level of hedging is negatively associated with the age of managers and geographic diversification, and is positively associated with financial leverage and firm size. The negative correlation between the level of hedging and CEO's age is inconsistent with the notion that age is a measure of risk aversion, however, this observation is more consistent with the signaling hypothesis of DeMarzo and Duffie (1995): young managers would have less well-developed reputations than older managers, and seek to more accurately signal their quality through hedging.

The positive correlation between leverage and hedging intensity is significant in both the pooled and annual regressions, and this correlation is relatively easy to understand. Hedge could be beneficial for highly levered firms to stabilize their internally generated cash flow and reduce various costs associated with the variability of cash flows (e.g., financial distress costs, expected taxes and underinvestment problem, please see Smith and Stulz (1985), Froot, Scharfstein and Stein (1993), Stulz (1996), and Leland (1998)). Therefore, firms who borrow more should be more likely to hedge. Tufano (1996) and Haulshalter (2000) argued that firm size is a measure for financing cost because: small companies are likely to face greater informational asymmetry with public investors, and external financing is more costly for small firms, thus small firms tend to hedge more in order to stabilize their internally generated cash flows and reduce financing needs. With this hypothesis, the level of hedging is predicted to be negatively correlated with firm size. However, our results do not support this argument. Instead, it seems that large firms tend to hedge more than small firms because large firms enjoy greater economies of scale.

In addition, it seems that geographic diversification significantly and negatively affect the level of hedging, i.e., oil and gas producers having more of their assets engaged in operation in different countries tend to hedge less. One reason is that oil and gas producers face different operation conditions, production cost, and profit margin across production locations. The multinational operations may provide an endogenous mechanism to reduce the financial risk of the whole company, therefore the hedge demand of these producers would be lower. Geographic diversification variable could also be a measure for basis risk. Basis risk arises when the settlement price of the hedging instrument is different from the spot price of the asset being hedged. Ederington (1979) showed that a lower correlation between the change in the price of the asset being hedged and the change in the price of the asset underlying the hedging instruments reduced the effectiveness of hedging in reducing risk, and consequently firms would hedge less extensively. Production location can have a significant impact on the basis risk for oil and gas producers as the spot prices of oil and gas can vary substantially across regions. Companies with production in regions where oil and gas prices have a lower correlation with prices of the underlying assets of exchange-traded derivatives face greater basis risk when these firms use the exchange-traded derivative as hedging vehicles. If a U.S. oil and gas producer has more production outside North America, the firm may face greater basis risk, which reduces the effectiveness of the financial contracts adopted for hedging, and consequently, the firm hedges less.

In the annual regressions, geographic diversification is negatively associated with hedging intensity and its coefficient is significant for 2004, while the coefficient of business diversification changes sign and it is insignificant. If we exclude the variable for geographic diversification from the regression specification, the coefficient estimated for the variable of business diversification is negative, this observation, to some extent, implies that engaging in multiple lines of business provides an endogenous mechanism to reduce risk of the whole company and hence reduces the hedging demand of the company. The regression results for both business segmentation and geographic diversification provide an opportunity to compare the influence of the two types of diversification. It seems that business segmentation is a less efficient substitute for hedging with financial contracts than geographic diversification.

The regression result for the variable of oil and gas production mix is also noteworthy. The coefficient of the variable for oil and gas production mix is not significant, but the sign of the coefficient is consistently negative for both the annual regression and pooled regression. Haushaulter (2000) also documented this observation. It seems that firms who are primarily natural gas producers hedge more than firms mainly engaged in oil production because natural gas price is more volatile than oil price.

5. Summary and Conclusions

In this paper, we adopt a unique dataset to test conformance of corporate risk management practices with existing theory by analyzing 102 U.S. oil and gas producers with a sample period between 2003 and 2004. The regression results confirm the theory that managers have an incentive to take actions to manage risk exposure when they are averse to risk, and the method of compensating managers can affect the incentive for them to hedge against variations in the firm's income. Firms with managers possessing greater equity ownership and less option holdings in their compensation plan hedge more extensively.

The significant negative relationship between managers' stock options and corporate hedging activities implies that some of the reasons managers might hedge (or not) have more to do with their own compensation than with increasing stockholder wealth. Many companies nowadays compensate their mangers through stock options and hope to link pay with stock price performance, in this way, firms can align managers' incentives more closely with those of other shareholders. Our findings imply that managers may divert corporate resources to lower down the risk exposure of their own personal wealth without maximizing firm value for shareholders. And awarding more stock options may encourage managers to move away from an optimal level of risk management. This may lead to agency cost and managerial incentive need to be taken into consideration when designing risk management strategies. In addition, we find that large firms and firms whose managers are newer on their jobs seem to hedge more. U.S. oil and gas producers who carry more cash reserve, lower financial leverage, and explore and produce oil and gas in other countries besides North America seem to hedge less.

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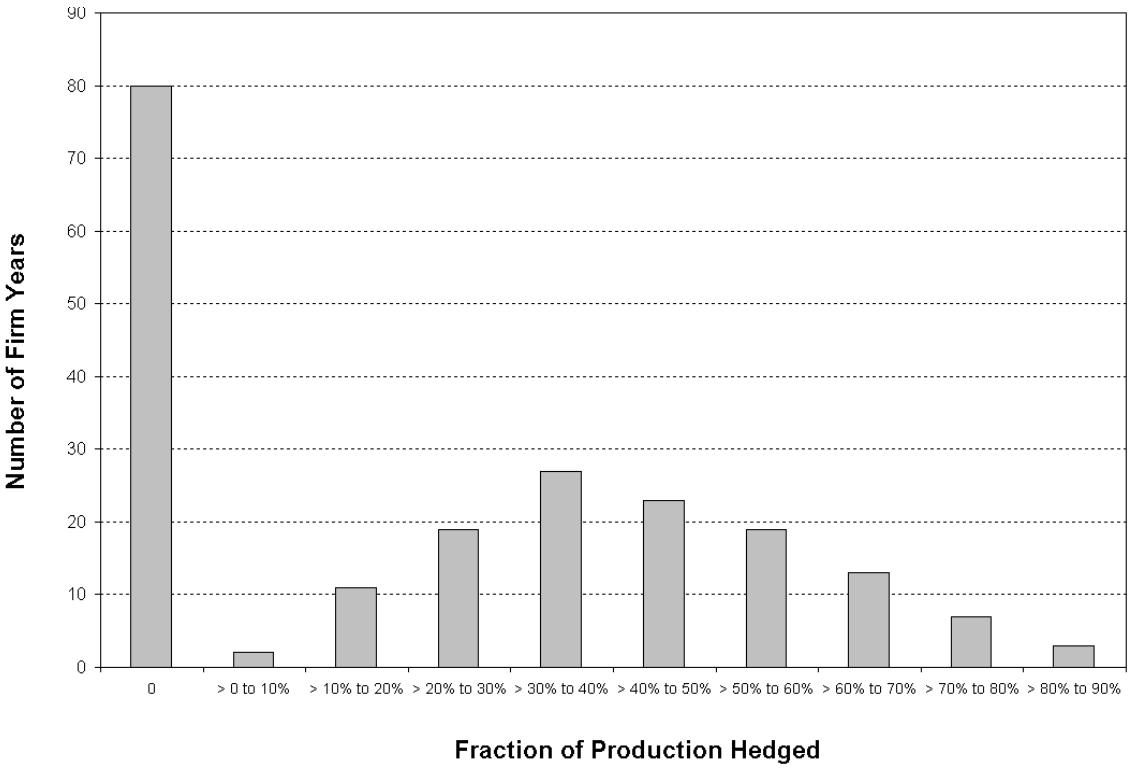
Figure 1: The Distribution of the Dependent Variable - Fraction of Annual Production Hedged.



Note: This figure is based on the hedging activities of 102 U.S. oil and gas. Fraction of Production Hedged is defined as the fraction of total annual oil and gas production (denominated in thousand barrels of oil equivalent, (MBOE)) hedged against price fluctuations. Gas denominated in thousand cubic feet is converted to barrels of oil equivalent at a rate of six thousand cubic feet per barrel.

Table 1: Variable Definitions and Summary of Hypotheses

Variable	Specification [information source]	Hypothesis Prediction
Number of exercisable options owned by managers (in MM)	Number of options held by managers and directors as a group that are exercisable within 60 days [Proxy Statement and Annual Report]	-
CEO compensation ($MM)	Log of CEO's salary plus bonus compensation [Proxy Statement and Annual Report]	-
Managerial equity ownership	Log of: Number of shares owned by officers and directors * Year-end market price per share [[Proxy Statement, Annual Report, and Compustat]	+
Fraction of blockholders' equity ownership	Percentage of common shares owned by outside five percent blockholders. [Proxy Statement and Annual Report]	-
CEO age	CEO's age [Proxy Statement and Annual Report]	+
CEO tenure	Number of years in CEO position [Proxy Statement and Annual Report]	+
Cash balance	Value of cash and cash equivalents divided by total assets [Compustat]	-
Leverage	Ratio of (total debt – cash and cash equivalents) to total assets [Compustat]	+
Firm size	Log of book value of total assets [Compustat]	+
Oil and gas production mix	Log of the fraction of oil production in total oil and gas production [Annual Report]	-
Business diversification	One minus percentage of assets engaged in oil and gas exploration and extraction. [Compustat segment reporting and Annual Report]	-
Geographic diversification	Percentage of assets engaged in operations outside North America [Compustat segment reporting and Annual Report]	-

Note: This table presents the definitions of all the independent variables for the analysis of the hedging policies of 102 U.S. oil and gas producers. The sources of data are indicated in the table.

Table 2: Oil and Gas Producer Sample Characteristics

Variable	N	Mean	Median	Minimum	Maximum	Standard Deviation
Fraction of production hedged:						
2003	102	0.272	0.271	0	0.873	0.256
2004	101	0.246	0.260	0	0.761	0.248
All firm years	203	0.259	0.262	0	0.873	0.252
Independent variables:						
Number of exercisable options owned by managers (in MM)	199	0.853	0.480	0	8.454	1.248
CEO compensation ($MM)	198	12.868	12.892	9.393	15.579	1.026
Managerial equity ownership	201	16.584	16.752	10.605	20.461	1.884
Fraction of blockholders' equity ownership	203	0.169	0.115	0	0.734	0.184
CEO age	203	54.182	53	40	78	8.315
CEO tenure	203	9.567	7	1	36	7.826
Cash balance	202	0.101	0.027	0.0003	0.922	0.169
Leverage	203	0.191	0.236	-0.922	1.629	0.344
Firm size	202	5.094	5.093	-1.492	10.210	2.333
Oil and gas production mix	193	-0.633	-0.702	-6.987	6.015	1.794
Business diversification	200	0.060	0	0	1	0.168
Geographic diversification	195	0.100	0	0	1	0.240

Notes: This table presents descriptive statistics for firm characteristic variables for 102 U.S. oil and gas producers in the years 2003 and 2004. The fraction of production hedged is defined as the fraction of total annual oil and gas production (MBOE) hedged against price fluctuations. The other variables in the table are defined in Table 1.

Table 3: Firm Characteristics of U.S. Oil and Gas Producers, Conditioned on the Level of Hedging during 2003 and 2004.

	Value of Firm-Year Characteristics by Level of Hedging												*p*-Value			
	None				Medium				Extensive				None vs. Medium		Medium vs. Extensive	
Variable	*N*	Mean	Median	Std. Dev.	*N*	Mean	Median	Std. Dev.	*N*	Mean	Median	Std. Dev.	*t*-test	Signed Rank	*t*-test	Signed Rank
Fraction of production hedged	80	0	0	0	62	0.28	0.30	0.09	62	0.57	0.55	0.11				
No. of exercisable options owned by managers	77	0.78	0.14	1.49	62	0.81	0.55	0.81	61	0.98	0.55	1.28	0.875	**0.002**	0.375	0.838
CEO compensation	76	12.25	12.17	1.05	62	13.19	13.19	0.85	61	13.30	13.36	0.76	**0.000**	**0.000**	0.482	0.576
Managerial equity ownership	80	15.50	15.43	1.72	61	17.10	17.41	1.67	61	17.49	17.57	1.58	**0.001**	**0.000**	0.195	0.274
Fraction of blockholders' equity ownership	80	0.15	0.06	0.21	62	0.18	0.13	0.17	62	0.19	0.16	0.15	**0.309**	**0.013**	0.797	0.634
CEO age	80	56.64	55	9.86	62	53.35	53	6.78	62	51.84	51.50	6.55	**0.027**	**0.061**	0.208	0.199
CEO tenure	80	11.38	9	8.61	62	9.18	6	7.28	62	7.56	6	6.74	0.109	0.145	0.203	0.138
Cash balance	79	0.19	0.09	0.23	62	0.05	0.03	0.08	62	0.03	0.02	0.03	**0.000**	**0.000**	**0.013**	**0.031**
Leverage	80	-0.01	-0.01	0.37	62	0.27	0.25	0.29	62	0.37	0.35	0.20	**0.000**	**0.000**	**0.020**	**0.001**
Firm size	79	3.28	3.31	1.96	62	6.02	5.82	1.96	62	6.50	6.39	1.44	**0.000**	**0.000**	0.125	**0.081**
Oil and gas production mix	70	-0.41	-0.88	2.47	62	-0.68	-0.73	1.31	62	-0.86	-0.63	1.20	0.444	0.647	0.437	0.834
Business diversification	77	0.09	0	0.22	62	0.06	0	0.15	62	0.04	0	0.10	0.314	0.441	0.415	0.902
Geographic diversification	75	0.15	0	0.33	62	0.09	0	0.17	59	0.05	0	0.13	0.208	0.556	0.159	0.125

Note: (1). This table compares the characteristics of 102 U.S. oil and gas producers conditioned on the level of hedging.

(2). For each firm year, a company is classified as a non-hedger if it does not hedge during the year, a medium hedger if it hedges between zero and 42 percent of the year's production, and an extensive hedger if it hedges 42 percent or more of annual production.

(3). Wilcoxon signed rank test (Signed Rank) is provided to compare firm characteristics between different hedging groups: non-hedgers, medium hedgers, and extensive hedgers.

(4). p-values significant at the 0.10 level are in bold.

Table 4: Tobit Regression — Analysis of Hedging Policy

Variable	Pooled Data	Annual Data	
		2003	2004
Intercept	0.4582	0.0990	0.6764
No. of exercisable options owned by managers	-0.038 ***	-0.039 **	-0.036 **
CEO compensation	-0.0570 *	-0.0306	-0.0829 **
Managerial equity ownership	0.0276 **	0.0365 *	0.0269
Fraction of blockholders' equity ownership	-0.0298	-0.0110	-0.0218
CEO age	-0.0047 **	-0.0050*	-0.0045
CEO tenure	0.0015	-0.0004	0.0029
Cash balance	0.0029	0.1777	-0.0761
Leverage	0.1851 ***	0.2449 **	0.1575*
Firm size	0.0657 ***	0.0454 *	0.0821 ***
Oil and gas production mix	-0.0093	-0.0033	-0.0165
Business diversification	-0.0036	0.0022	0.0160
Geographic diversification	-0.1968 **	-0.1906	-0.2130 *
Number of observations	174	86	87
p-value of F-stat	0.000	0.000	0.000
Adjusted R-squared	0.424	0.388	0.400

Note: (1). The dependent variable is the fraction of the firm's annual oil and gas production that is hedged.
(2). The coefficients are estimated using a one-sided tobit model with left censoring at zero.
(3). The pooled sample consists of 102 oil and gas producers during the period 2003 to 2004.
(4). Coefficients significant at the 0.10, 0.05 and 0.01 level or higher are marked with *, ** and *** respectively.