Convexity of CFO compensation, risk-taking, and corporate hedging

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Abstract

We study how risk management incentives of the CFO, beyond and above those of the CEO, significantly affect a firm's hedging policy. We employ hand-collected firm-level data on hedging with derivatives and manager-level data on compensation for a sample of US oil and gas firms between 2009 and 2019. Our results show that the convexity of the CFO's payoff negatively affects the hedging likelihood, the amount of expected production hedged, and the hedged portion of a firm's current reserves. When the CFO and the CEO have different hedging incentives, the convexity of the CFO's payoff prevails over that of the CEO. Overall, this evidence confirms the stronger role of the CFO relative to the CEO on developing a firm's hedging strategy.

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1. Introduction

The identity and attributes of the firm's top management are critical determinants of a firm's strategy and organizational outcome (Hambrick and Mason, 1984; Hambrick, 2007; Quigley and Hambrick, 2015). The Chief Executive Officer (CEO), in particular, plays a prominent role among all senior corporate executives, and an extensive literature has examined their role as the key decision-maker on corporate strategy and performance (e.g., Bertrand and Schoar, 2003; Malmendier and Tate, 2005; Pérez-González, 2006; Bennedsen et al., 2007; Bloom et al., 2013; Custódio and Metzger, 2014; Bernile et al., 2017; Bennedsen et al., 2020; among others). While the CEO is the highest-ranking executive, the second most important firm's senior manager is likely to be the Chief Financial Officer (CFO) (Zorn, 2004; Uhde et al., 2017). Responsibilities of the CFO have risen over the last decades, and they now extend beyond their original role of supervising financial reporting and planning (Hoitash et al., 2016). Not only the CFO advises the CEO and is in charge of external financial communication, but they have a crucial role in capital budgeting, cash management, capital structure, and financial risk management related choices (Schopohl et al., 2021). Therefore, the CFO has progressed into the "second-in-command" and is now directly involved in shaping and executing a firm's corporate strategy (Zorn, 2004; Indjejikian and Matejka, 2009; Huang and Kisgen, 2013; Datta and Datta, 2014; Uhde et al., 2017).

Despite their relevance in modern corporations, literature has paid far less attention to the contribution of the CFO, relative to the CEO, and has largely "ignored [their] central role as a key decision maker" (Uhde et al., 2017; Gupta et al., 2020). This is somewhat surprising because it is established that CFOs and CEOs have different managerial personalities. Kaplan and Sorensen (2012) study the behavioral features of CEOs and CFOs, based on a sample of candidates for these positions. Their results show that CFOs and CEOs are "diametrically opposite." CFOs show a lower general ability score, are more interpersonal, detail-focused, and analytical. In contrast, CEOs score higher in general ability, they are more aimed at execution, have a more strategic focus, and are more charismatic (Kaplan and Sorensen, 2012). Graham et al. (2013) administer

a psychometric test to senior executives and show that CFOs have a less optimistic view and are more risk-averse than CEOs.

Due to their specialized expertise and technical competency, one of the CFO's most sophisticated areas of responsibility is risk management (Copeland, 2001; Hoitash et al., 2016). According to the IBM Institute for Business Values 2010 global survey on more than 1,900 CFOs from around the world, almost 80% of respondents classifies managing and mitigating enterprise risk as "very" or "critically important" (IBM Institute for Business Values, 2010), up from 40% of them in the previous 2006 survey. According to the 2016 McKinsey Global Survey on the role of the CFO,[1] garnering responses from more than 500 CFOs worldwide, risk management is the first among the nonfinancial accounting-related activities that report directly to them. Hedging marketable risks is widespread among nonfinancial firms. Recent academic surveys of CFOs (Giambona et al., 2018; Bodnar et al., 2019) show that nonfinancial firms extensively manage corporate exposures, and this evidence holds worldwide (see Bodnar et al., 1998, for the US; Bodnar and Gebhardt, 1999, for Germany; Mallin et al., 2001, for the UK; Bodnar et al., 2013, for Italy; among others). Almost 90% of the surveyed CFOs in Giambona et al. (2018) indicate that hedging increases a firm's cash flows, and nearly 80% conclude that it is ultimately value-increasing. The evidence that hedgers present higher performance and are worth more is also well-established in the corporate finance literature (Carter et al., 2006; Allayannis et al., 2012; Pérez-González and Yun, 2013; Gilje and Taillard, 2017).

With few exceptions, most of the literature investigating the relationship between managerial attributes and preferences and hedging decisions looks at the incentives of the CEO, viewed as the ultimate decision-maker (e.g., Kumar and Rabinovitch, 2013; Croci et al., 2017). However, a firm's risk management policy is primarily the result of the CFO's strategic choices. Motivated by the survey evidence above, we argue that financial risk management is a suitable laboratory to study the predominant role of the CFO over that of the CEO. This should be especially true in industries where marketable risks are deemed to very materially affect a firm's future cash flows. Therefore, in this paper, we study how CFO's managerial preferences (incremental to the CEO's incentives) affect a

[1] https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/are-todays-cfos-ready-for-tomorrows-demands-on-finance.

firm's hedging policy. We exploit the well-established causal relationship between the convexity of a manager's compensation policy and risk aversion (Bakke et al., 2016) to investigate how CFO's risk management incentives (beyond and above those of the CEO) significantly affect a firm's hedging decisions. To this purpose, we focus on US firms operating in the oil and gas industry between 2009 and 2019, and we show that the CFO's relative fraction of equity underlying stock options over their total equity is negatively associated with the hedging likelihood. Moreover, a higher CFO's payoff convexity is negatively related to the fraction of expected annual production hedged, and the fraction of a firm's oil and gas reserves hedged. This evidence holds when the CFO is analyzed in isolation from the CEO, when the CFO is combined with the CEO, and when the different CFO and CEO incentives are separately taken into account. Interestingly, when the CFO has a higher payoff convexity and, at the same time, the CEO has a lower convexity, the firm is less likely to hedge and hedges quantitatively less. We interpret this evidence as a stronger impact of the CFO relative to the CEO on a firm's hedging decision, consistently with the survey evidence presented above.

This study contributes to two strands of literature. The first set of studies analyzes how managerial risk aversion impacts a firm's hedging policy. The second is the narrow literature studying the incremental effect of CFO preferences, beyond those of the CEO, on a firm's policies.

Managerial preferences significantly affect a firm's hedging. Risk-averse managers have the incentive to hedge in full when their utility is concave in the firm's value, and such incentives reverse when their utility function gets convex (Stulz, 1984; Smith and Stulz, 1985). Since Executive Stock Options (ESOs) are convexity-increasing instruments, the theory predicts a negative relation between ESOs and hedging. Early empirical studies confirm the negative and significant correlation betweenESOs and hedging. Tufano (1996) studies hedging practices in the North American gold mining industry and finds that managers holding more (less) options manage less (more) gold price risk. Haushalter (2000) focuses on the oil and gas industry and confirms a negative relation between options holdings and both the decision and the extent of hedging, i.e. the quantity of production hedged. Géczy et al. (1997) analyze currency derivatives usage by Fortune 500 firms and do not find a statistically significant relationship between

managerial option ownership and derivative usage likelihood. However, a spurious correlation may blur causality between option pay and managerial risk aversion, as empirical measures of risk aversion and option pay are endogenously determined. Croci et al. (2017) also study whether managerial attributes and preferences impact a firm's hedging in the oil and gas industry. In their study, the degree of convexity in managerial compensation is insignificant.

A causal relationship between managerial pay and hedging is provided by Bakke et al. (2016). They exploit a quasi-natural experiment, i.e., a new accounting regulation mandating firms to expense ESOs at fair value. Since the new regulation significantly reduces management's option pay but is exogenous to hedging, the resulting significant increase in hedging relative to similar untreated firms confirms the causal relationship. The same piece of evidence, but directly from the field, is provided by Bodnar et al. (2009). They perform a psychometric test on 681 CFOs of nonfinancial firms globally distributed and directly estimate their degree of risk aversion. The results confirm that firm with more risk-averse managers hedge more, and the link between risk aversion and hedging propensity is stronger when executives are compensated with stock and options. Summing up, while it is accepted that ESOs have an impact in increasing managerial risk tolerance, the relative importance of CFO's incentives over those of the CEO is still an uninvestigated area.

We also contribute to the stream of literature studying the relative importance of CFO preferences and characteristics, beyond those of the CEO, on corporate policies. Only a few studies consider the incremental role of the CFO, and this dearth of evidence is "particularly troubling when it comes to corporate financial decisions, which is an area where the CFO wields substantial influence" (Gupta et al., 2020). In their seminal paper, Bertrand and Schoar (2003) study how individual managers affect a firm's decision making and outcomes. Interestingly, CFO fixed effects matter more for financial decisions, particularly when explaining leverage, cash holdings, and interest coverage ratios. Similarly, Frank and Goyal (2007) find that CFO dominates CEO-effect in explaining a firm's leverage. Chava and Purnanandam (2010) note that both CEO and CFO's risk-taking incentives affect corporate decisions, but at different stages of the decision-making process. CFOs are relevant, but only for more technical financial

choices, such as those related to capital structure, where their expertise matters more. Dittmar and Duchin (2016) examine how prior employment of CEOs and CFOs affect a firm's investment and financing decisions. Firms operated by a CEO who experienced financial distress in the past are more conservative. For financing decisions (but not for investing decisions), the joint impact of CEO and CFO experience is strongly significant, suggesting an incremental role of the CFO on a firm's capital structure. Florackis and Sainani (2018) investigate the effect of CFOs on firm cash decisions. They characterize "strong" and "weak" CFOs based on an index of managerial ability to influence financial policies. Firms with "strong" CFOs hold less cash than firms with "weak" CFOs, and the effect goes beyond that of the CEO. Similarly, Mobbs (2018) shows that firms where the CFO is on the board have fewer financial constraints and less cash. Recently, Ferris and Sainani (2021) focus on M&As and find that CFO's influence is significant throughout the whole process. Their impact is higher when the CFO is paired with a less influential CEO, or one with few characteristics in common. In sum, as a firm's hedging is likely the result of a CFO's decisions, risk management is a suitable area of investigation to isolate the relative impact of the CFO over the CEO on a firm's decision-making.

Our paper is related to a few studies which look at the impact of CFO's attributes and compensation policy on firms' derivative usage. Géczy et al. (2007) characterize corporate speculators, administering a survey to 1,928 publicly traded nonfinancial firms (with a response rate of 19%). Their results show that CFOs of firms speculating with interest rate and FX derivatives have a higher (and significant) wealth delta and a higher (but not significant) wealth vega, suggesting a link between CFO's compensation and their firm's trading with derivatives. Géczy et al. (2007) also conclude that CFOs (and not CEOs) are ultimately responsible for forming a view that reflects on a firm's derivatives position. Chernenko and Faulkender (2011) study firms' usage of interest rate swaps and find that firms with more performance-sensitive compensation schemes metrics (especially for the CFO) use more interest rate swaps, but the same metrics are generally insignificant in explaining the direction of swap activity. This evidence suggests a speculative component of a firm's derivative usage. Our paper is tangential to these studies, as it focuses on hedging. We examine the risk management decisions of firms in the context of the oil and gas sector (SIC code 1311). This sector has been largely

employed in hedging studies, as it allows to isolate a homogeneous common risk (commodity price risk) and provides high-quality and granular information on hedging with derivatives. Within this context, and as a novelty in the literature, we aim to explicitly disentangle hedging incentives of the CFO from those of the CEO, and show how the former are stronger determinants of the firm's hedging policy.

The remainder of the paper is organized as follows. The following section presents our data, describes the variables, and discusses the characteristics of the sample. Section 3 presents the univariate evidence, the multivariate setting, and discusses potential causal challenges. Finally, section 4 concludes.

2. Data, variables, and sample description

2.1 Data

Our initial sample consists of US-listed firms belonging to the SIC code 1311 (Crude Petroleum and Natural Gas) from 2009 to 2019. Limiting the analysis to only one industry is customary when studying hedging decisions. For example, papers studying risk management from a user perspective generally look at airline firms (e.g., Carter et al., 2006; Treanor et al., 2014; Rampini et al., 2014), while studies on commodity producers examine either gold miners (e.g., Tufano, 1996; Tufano, 1998; Adam and Fernando, 2006; Adam, 2009; Adam et al., 2017), or the oil and gas industry (e.g., Haushalter, 2000; Jin and Jorion, 2006; Bakke et al., 2016; Croci et al., 2017; Gilje and Taillard, 2017) (see Carter et al., 2017, for a review). Industry-specific analyses allow to focus on risk-homogeneous firms and attenuate endogeneity concerns from omitted firm-specific characteristics. Our study chooses the oil and gas industry for three reasons.

First, not only do all firms face the same commodity price risk, but this risk is material. Oil and gas prices are volatile, as both the supply and the demand are inelastic, and the price determinants are outside the firm's control. As an example, the period covered by this study encompasses the 2014-2016 collapse in oil prices, one of the largest since World War II (World Bank Group, 2018). Between mid-2014 and early 2016, the WTI delivered in Cushing, Oklahoma, went down from about $106 (June 30, 2014) to $26 (February 11, 2016), i.e., a 75% drop (data from St. Louis Fed). Second, the high

volatility of oil and gas prices translates into a significant variation of revenues and high cash flow volatility of affected firms (Bakke et al., 2016). According to S&P, the energy sector showed the highest concentration of global bankruptcies in 2015 and 2016, accounting for more than 50% of defaults in both years (i.e., 142 energy firms) (S&P Global, 2016, 2017). In other words, oil price risk is economically important. The third reason for choosing this industry is data availability. Most firms disclose detailed information (i.e., in tabular form) on hedging activity, including quantity (i.e., the fraction of production hedged) and instruments employed.

We manually collect most of the data from EDGAR, the Electronic Data Gathering, Analysis and Retrieval system provided by the SEC. Therefore, we first require 10-Ks to be available on EDGAR for inclusion in the sample. The initial search leads to a sample of 316 firms and 2,103 firm-year observations. As in Jin and Jorion (2006), we exclude firm-year observations for which no oil or natural gas production was reported (425 observations). Moreover, we exclude firm-year observations for firms that choose not to disclose hedging data in tabular form (22 observations), as they do not allow us to quantify their hedged exposure (Croci et al., 2017). Finally, we follow Jin and Jorion (2006) and Bakke et al. (2016), and we only consider directional contracts (such as swaps and options), discarding basis spreads and other non-directional contracts. The final sample is comprised of 247 unique firms and 1,524 firm-year observations.

We merge this dataset with manually-gathered biographical information and compensation data of CFOs and CEOs obtained from the firm's annual proxy statement (DEF-14A). Therefore, we require DEF-14As to be available in EDGAR and the biographies of both CEOs and CFOs to provide enough information to construct all our variables. This step reduces our sample to 1,152 firm-year observations (182 unique firms). We identify the CFO and the CEO in charge during each fiscal year. In case of a change in the midst of a fiscal year, we retain the manager in charge for most of the year. The short bio allows us to extract information on age, gender, and tenure. Then, we collect information on the total number of shares beneficially owned by each executive (from the "Beneficial (or Security) Ownership" table), the number of shares underlying ESOs (both exercisable and not, from the "Outstanding Equity Awards at Fiscal Year-End" table), and cash compensation (cash salary and bonuses, from the "Summary Compensation"

table). We finally collect firm-specific financial controls from Refinitiv Eikon. The final sample usable for our empirical investigation is an unbalanced panel of 142 firms and 778 firm-year observations.

2.2 Variables

2.2.1 Dependent variables

Our dependent variables measure a firm's hedging activity. The first variable (*Hedger*) is a dummy equal to 1 if the firm hedges a portion of next year's production with financial derivatives, and 0 otherwise. *Hedger* serves as a first approximation of a firm's hedging decision. Tabular information on derivative instruments also enables us to measure the extent of hedging, i.e., the fraction of production hedged (*FPH*). *FPH* will be our second hedging variable. Following Bajo et al. (2021), we focus on derivative contracts for oil, natural gas (NG) and natural gas liquids (NGLs) with a maturity of one year or less. We convert NG in barrels of oil equivalents and assimilate NGLs to oil (as in Jin and Jorion, 2006). All derivative positions open at the end of each fiscal year are tallied up and scaled by next year's total production (Jin and Jorion, 2006). Assuming that the estimated future production is a proxy for actual production (Bajo et al., 2021), this variable represents the portion of the expected output that the firm decides to hedge each year.

While *Hedger* and *FPH* are our two main hedging variables throughout the paper, using actual future production rather than expected future production (not reported in 10-Ks) might lead to measurement error (Bakke et al., 2016). Therefore, following Jin and Jorion (2006) and Bakke et al. (2016), we also include the fraction of actual reserves hedged (*FRH*) as a second hedge ratio. In the Appendix, we provide an example of how *FPH* and *FRH* are computed.

2.2.2 Independent variables

Theoretical models (Stulz, 1984; Smith and Stulz, 1985) suggest that the convexity of a manager's compensation increases their sensitivity to stock returns volatility. In other words, a more convex compensation has the effect of making the decision-maker less risk-averse. As stock options increase convexity, they reduce

managerial hedging propensity (Bakke et al., 2016). We capture compensation-linked risk aversion similarly to Tufano (1996) and Haushalter (2000). For each CFO (and CEO), we compute the ratio between the number of shares underlying options (both exercisable and not) and the total number of shares beneficially owned by the manager, also including shares underlying options (*options/total shares*).[2] To control for diversification effects in compensation schemes, we use the market value of shares beneficially owned by the CFO (and the CEO), excluding shares underlying options (*MV(shares)*), and cash compensation (*Cash + bonus*).

To explore the interaction between CFO's and CEO's compensation-induced risk-taking, similarly to Ferris and Sainani (2021), we construct four dummy variables that capture incentive (mis)alignment. *CFO High_CEO High* (*CFO Low_CEO Low*) is a dummy variable equal to 1 if both the CFO and CEO have a fraction of options over total shares (*options/total shares*) above (below) the sample median. These two variables result in the same risk-taking incentives of both managers. On the contrary, *CFO High_CEO Low* (*CFO Low_CEO High*) is a dummy variable equal to 1 if the CFO has a fraction of options over total shares above (below) the sample median and the CEO has a fraction of option/total shares below (above) the sample median. These two variables will be of particular interest for our analysis, as they imply different risk-taking incentives. Hence, they will allow measuring the incremental effect of one manager over the other. At the CFO/CEO-level, we use *Age*, *Female*, and *Tenure* as controls.

Finally, we control for well-known firm-specific characteristics related to hedging (Smith and Stulz, 1985; Froot et al., 1993).[3] *Total assets* (WC02999) and *ROA* (WC08326) control for size and profitability, and *Leverage* (long-term debt, WC03251, plus short-term debt, WC03051, over total assets) and *Quick Ratio* (WC08101, cash and cash equivalents plus receivables over current liabilities) proxy financial constraints and liquidity. *Investment* controls for the firm's investment intensity (ratio of capital expenditures, WC04601, to total assets). Finally, a dummy variable detects firms that pay dividends (*Dividend*, WC09504) as a proxy for access to financial markets.

[2] We collate the number of shares underlying options (both exercisable and not) from the "Outstanding Equity Awards at Fiscal Year-End" table, and the number of shares beneficially owned by each executive from the "Beneficial (or Securities) Ownership" table. Both tables are part of the firm's proxy statement.
[3] Datastream/Worldscope mnemonics are reported in parentheses in the following ítems.

2.3 Sample description

Table 1 shows the yearly distribution of hedgers. The left-hand side of the table shows the number of firms and the percentage of hedgers by year. Except for 2014, where hedgers represent 65% of the sample, the fraction of hedgers floats between 70 and 90%, and the average over the 11-year period we consider is 76%. Conditional to hedging, firms choose to hedge about 50% of their annual production and 5% of their reserves (Table 1, last two columns). This evidence confirms that price risk is relevant among firms operating in the oil and gas industry, and hedging is strategic. The figures in Table 1 are in line with those presented in other studies on the same sector (Jin and Jorion, 2006; Bakke et al., 2016).

Please insert Table 1 here

Table 2 presents the descriptive statistics of all variables in the following order. The first panel includes CFO remuneration and biographic variables, the second panel shows the same variables for the CEO, and the third panel presents control variables at the firm level. We winsorize continuous variables (*FPH, FRH, options/total shares, MV(shares), Cash + bonus, Total assets, ROA, Leverage, Quick Ratio, Investment*) at the 5% and 95% level, as in Bakke et al. (2016).

Please insert Table 2 here

Interestingly, the option-based compensation of the average CFO in our sample is very relevant, as almost 30% of their total equity is represented by stocks underlying stock options. There is also significant variability in our data, as the median is about 20%, and the third quartile is 60%. This initial evidence suggests that the convexity of the CFO is an arguably relevant factor affecting their risk aversion and, ultimately, the firm's hedging policy. Also, the average market value of the CFO's stock endowment is about $4 million,

relative to the average cash compensation of only $0.5 million.[4] These figures confirm that stock and option-based compensations are preponderant also for the CFO (Indjejikian and Matějka, 2009; Chava and Purnanandam, 2010) and strongly impact their incentives and corporate decisions (Ge et al., 2011; Feng et al., 2011; Kim et al., 2011; Hoitash et al., 2012), not only in the US (Caglio et al., 2018). As expected, CEO's compensation is higher than that of the CFO. The average CEO in our sample has a market value of the firm's stocks (*MV(shares)*) of $42 million and cash compensation (*Cash + bonus*) of $0.9 million.[5] Interestingly, about 20% of the CEO's shares is underlying options, which is less than the corresponding figure for CFOs. The annual market value of shares and the cash compensation are both right-skewed and will be log-transformed in regression analysis.

On average, CFOs are younger than CEOs (the mean is about 51 years for the CFO and 57 for the CEO) and less tenured (6 years for the CFO, vs 9 years for the CFO). CEO figures are consistent with recent studies on the same industry (the average CEO age and tenure are 55.0 and 8.1 in Bakke et al., 2016, and 55.4 and 7.2 in Croci et al., 2017, respectively). As far as gender is concerned, there is almost no variation, as nearly 95% of the CFOs in our sample (and about all CEOs) are male. Female CFOs and CEOs are relatively rare in this male-dominated industry (in our sample, we have only 13 female CFOs and 2 female CEOs, for a total of 37 and 2 yearly observations).

Finally, over the whole time period, the average (median) firm has $5.81 billion ($1.92 billion) total assets, negative -3.4% ROA (positive in median, +1.5%), 116% (87%) quick ratio, and 33% (31%) leverage ratio. Firms in the sector have a high investment intensity, as the average CAPEX over total assets (*Investment*) suggests (25% in mean, 20% in median), and about one-third of them are dividend-paying.

3. Results

[4] These two numbers are not directly comparable, as the market value of stocks is accumulated over time and therefore depends on the manager's tenure. However, untabulated figures suggest that stocks awards represent about 50% of the anual CFO's pay.

[5] As for CFOs, when looking at the average annual decomposition of the total CEO compensation, we find that stock grants represent about 50% of the annual pay.

We now study the relationship between the convexity of CFO's compensation and the firm's hedging propensity. We proceed as follows. First, we compare hedgers to non-hedgers to provide preliminary univariate evidence on the significant difference in the convexity of CFO's (and CEO's) compensation characterizing the two subsamples. Second, we refine the univariate analysis and look at the relative impact of the CFO's incentives over those of the CEO. We compare the firm's hedging decision when the CFO and the CEO have a different hedging incentive, to investigate the relative impact of the CFO over the CEO (and vice-versa). We then study the hedging likelihood and the extent of hedging in a multivariate setting. Finally, to alleviate measurement error (Bakke et al., 2016), we repeat our analyses with the fraction hedged as the dependent variable.

3.1 Univariate results

We divide our sample between hedgers and non-hedgers according to the *Hedger* dummy. As previously shown (in Table 1), hedgers represent 76% of our sample (594 firm-year observations out of 778). Table 3 compares hedgers to non-hedgers relative to CFO and CEO compensation and biographical variables, as well as firm controls.

Please insert Table 3 here

The convexity of CFO pay is a strongly significant variable in discriminating hedgers from non-hedgers. The average *CFO options/total shares* is 26% for hedgers and 44% for non-hedgers, and the 18% negative difference is statistically significant at the 1% level. This means that CFOs of hedging firms have less convex compensation. Equivalently, CFOs with a more convex compensation (because of the higher percentage of stock options held) are less likely to hedge. This is an expected but interesting first piece of evidence. When looking at the same variable for the CEO, we note that the difference between hedgers and non-hedgers is much smaller. Hedging firms have an average *CEO options/total shares* of 21%, against 23% for non-hedgers. The difference is negative, as expected, but modest (only 2%), and statistically insignificant. Combined with the previous evidence, this figure supports the conjecture that CFOs' incentives have

a stronger impact than CEOs' on hedging. In sum, it seems that it is the compensation-induced risk aversion of the CFO, rather than that of the CEO, which matters on hedging.

Not only do CFOs of hedging firms have a less convex compensation, but they also have higher equity invested in the firm. The CFO's average market value of shares is $4.6 million for hedgers and $2.2 million for non-hedgers (the $2.4 million difference is statistically significant). This is also expected, as *MV(Shares)* is a proxy for a manager's under-diversification, and the less diversified the manager's wealth, the more utility they obtain from hedging. The same significant effect holds for the CEO ($45.4 million vs $33 million). Finally, a different degree of cash compensation characterizes CFOs (and CEOs) of hedgers and non-hedgers. CFOs (CEOs) of hedging firms have a higher cash compensation, and the $0.2 million ($0.4 million) difference is statistically significant. According to the theory, we would expect the opposite sign, as a higher cash compensation suggests that the manager is less invested in the firm and hence more diversified. However, we note that the difference is little relevant from an economic viewpoint. The average market value of CFO's (CEO's) stocks in our sample is $4 million ($42 million) (from Table 2), and a few hundred thousand dollars annual difference in cash represent a negligible fraction of such wealth.

Differences in tenure and gender of CFOs (and CEOs) are generally insignificant when comparing hedgers to non-hedgers. The only variable worth mentioning is the CEO age, as CEOs of hedging firms are slightly younger (57 vs 59 years). However, previous literature has shown that *Age* has a more complex effect on hedging, also impacting the hedging instrument (Croci et al., 2017).

To corroborate the first evidence provided by Table 3, we now carry out a more in-depth investigation. As in Ferris and Sainani (2021), we split our sample based on the relative compensation convexity of the CFO and the CEO. The first comparison is between the subsample of observations where both the CFO and the CEO have a higher convexity of their compensation (and therefore a lower hedging incentive) and the subsample of observations where both the CFO and the CEO have a lower convexity of their compensation (i.e., a higher hedging incentive). The higher or lower convexity of CFOs and CEOs is defined in terms of the respective sample median of *options/total shares*. In line with the previous univariate analysis, we expect that when both the CFO

and the CEO (jointly considered) have a more convex compensation, firms are less likely to hedge, and they hedge a smaller fraction of their future production or actual reserves. The first panel of Table 4 shows the results.

Please insert Table 4 here

The two subsamples are composed of 311 firm-year observations each (622 firm-year observations), meaning that for almost 80% of the sample, the hedging incentives of the CFO and the CEO coincide. This is not surprising, as a more or less option-based compensation scheme generally applies to both the CFO and the CEO of the same firm. When both the CFO and the CEO have a higher pay convexity, firms are 5.5% less likely to be hedgers. This difference is significant at the 10% level (Table 4, panel A). Also, on average, 38% of the expected production is hedged when both the CFO and the CEO have highly convex compensation, against 43% when the compensation is less convex (the 5%-difference is significant at the 5% level). The same evidence applies to *FRH* (3.3% against 4%).

More interesting to our research is analyzing the firm's hedging policy when the CFO and the CEO have different risk-taking incentives. To do so, we compare two subsamples. In the first subsample, the convexity of the CFO's compensation is higher, and the convexity of the CEO's compensation is lower In the second subsample, the convexity of the CFO's compensation is lower, and the convexity of the CEO's compensation is higher. Contrasting the two subsamples allows disentangling the relative importance of the incentive of the CFO (over those of the CEO) in affecting firm's hedging. Panel B of Table 4 shows the results of this analysis, based on two subsamples composed of 78 firm-year observations each (156 firm-year observations), about 20% of the sample.

The evidence is remarkable. When the CFO has a highly convex payoff (and the CEO has not), firms are 22% less likely to hedge relative to the subsample in which the CEO has a highly convex payoff (and the CFO has not). Since about 76% of the firms in our sample are hedgers, not only this 22%-difference is statistically significant, but it is

also economically important. This evidence corroborates the univariate evidence of Table 3, where the ratio *options/total shares* is markedly lower for hedgers than for non-hedgers when the CFO (rather than the CEO) is concerned. The relative incentives of the CFO seem to prevail over those of the CEO also when the average production is concerned (27.7% vs 34.9%). However, the difference is not significant, likely due to the small sample of 156 observations. Finally, the same evidence is found, and the statistical significance is recovered, when we consider the fraction of reserves hedged (2.4% vs 3.3%).

The same directional relationship is confirmed when we look at the sample pairwise correlations of our variables (Table 5). *CFO options/total shares* and *CEO options/total shares* are negatively correlated with *Hedger*, but only the former is significant (and the -24% correlation coefficient of *CFO options/total shares* is, in absolute value, much larger than the -3% correlation coefficient of *CFO options/total shar*es). The same negative correlation is reported between *CFO options/total shares* and the extent of hedging, i.e., *FPH* and *FRH* (and, again, more sizeable than the negative correlation between *CEO options/total shares* and the extent of hedging).

Please insert Table 5 here

Taken together, these findings suggest a stronger effect of CFO's incentives in shaping a firm's hedging policy. To confirm this evidence in a multivariate setting, in the next subsection, we regress the firm's hedging decision and hedging extent on CFO and CEO's compensation, and biographical variables and firm controls.

3.2 Multivariate results

3.2.1 Hedging likelihood

We first investigate the effect of CFO's and CEO's characteristics on the hedging likelihood (Table 6). To this aim, we run a linear probability model where the dependent

variable is the dummy *Hedger*.[6] Standard errors are clustered at the firm level, and all models include year fixed effects.

Please insert Table 6 here

In the first model of Table 6, we only look at the CFO. We regress *Hedger* on the convexity of CFO payoff (*CFO options/total shar*es), CFO compensation variables (*CFO MV(shares)*, *CFO Cash+bonus*), CFO attributes (*age*, *female*, and *tenure*), and firm controls. Then, we augment model 1 with CEO variables (model 2), hence investigating the joint effect of CFO and CEO traits on the firm's hedging decision. In line with the previous evidence, the convexity of a CFO's payoff negatively affects the hedging likelihood in both models. A 1%-increase of the proportion of shares underlying options relative to the total shares held by the CFO yields a 24 (26) basis points decrease of the hedging likelihood in model 1 (model 2). Notably, the same variable for the CEO (*CEO options/total shares*) is not significant in model 2, when the convexity of the CFO and CEO's payoff is jointly considered. Other compensation variables at the CFO and CEO level are generally not significant. Finally, the control variables have the expected sign and are in line with the predictions of the hedging literature. The hedging likelihood is positively related to size, profitability, leverage, and investment intensity, and negatively associated with liquidity. Dividend-paying firms hedge no different than their non-dividend-paying counterparties.

In models 3 and 4, we run the same regressions as before, but we aim to disentangle the CFO's incremental effect (over that of the CEO) on the hedging likelihood. In other words, we wish to test whether CFO incentives remain significant at different levels of the CEO's incentives. Model 3 (model 4) only considers the subsample of firm-year observations where the convexity of the CEO's compensation is high (low), i.e. above (below) the sample median. Therefore, only half of the sample observations

[6] We use a linear probability model as it allows to immediately interpret the economic relevance of our coefficients. However, we also repeat the analysis using logit models. The evidence is robust and qualitatively unchanged. For brevity, we do not report it in the paper.

(389 out of 778) are employed in each regression. The relevance of the CFO's incentives is confirmed in both models. Interestingly, when the CEO has a less convex compensation (model 4), the incentives of the CFO are strongly significant and economically relevant. A 1%-increase of *CFO options/total shares* in this subsample decreases the firm's hedging probability by 34 basis points. Therefore, when the intensity of CFO's and CEO's incentives is different, the impact of the CFO is stronger.

Motivated by this evidence, in model 5 of Table 6 we explore the effect of the interaction between CFOs' and CEOs' compensation-linked risk-taking incentives on the hedging likelihood with four dummies. Two dummies (*CFO High_CEO Low* and *CFO Low_CEO High*) detect incentive misalignment, and two dummies (*CFO High_CEO High* and *CFO Low_CEO Low*) detect incentive alignment. More specifically, *CFO High_CEO Low* (*CFO Low_CEO High*) indicates observations for which the CFO has a fraction of options over total shares (*CFO options/total shares*) above (below) the sample median and the CEO has a fraction of options over total shares (*CEO options/total shares*) below (above) the sample median. When the incentives of CFO and CEO are both above (below) the median, *CFO High_CEO High* (*CFO Low_CEO Low*) takes the value of 1. The latter variable is omitted in model 5, as it is subsumed in the constant. As before, this analysis points toward the relevance of CFOs on hedging, especially when their incentives are not aligned with those of the CEO. *CFO High_CEO High* is unsurprisingly negative and significant, but so is *CFO High_CEO Low*, while *CFO Low_CEO High* is insignificant. This means that relative to the case when the incentive of both the CFO and the CEO are low (baseline dummy, i.e., the constant), a high convexity of the CFO's payoff (relative to that of the CEO) significantly reduces the hedging likelihood. On the contrary, low convexity of the CFO's payoff (relative to that of the CEO) is insignificant. A higher convexity of the CFO's payoff paired with a lower convexity of the CEO's payoff yields a 15% reduction of a firm's hedging likelihood.

3.2.2 Hedging expected production

We now turn our attention to the effect of CFO's and CEO's characteristics on the extent of hedging. As already mentioned, this is possible, as firms in the oil and gas industry report with great detail the quantity underlying the derivative positions employed

for hedging. In Table 7, we run tobit regressions where the dependent variable is the fraction of the following year's (expected) production hedged (i.e., *FPH*). We choose a tobit model as the dependent variable is left-censored at zero for about 24% of the sample (i.e., for non-hedgers). As before, we include year fixed effects, and we cluster standard errors at the firm level.

The structure of Table 7 replicates the one of Table 6. In particular, the first two models investigate whether the negative effect of CFO's payoff convexity also persists on the extent of hedging, alone (model 1) and together with CEO attributes. Then, models 3 and 4 explore the relative strength of CFO's incentives over those of the CEO through a subsample analysis, i.e., when the convexity of the CEO's payoff is higher or lower than the median in our sample. Finally, the last model replicates the interaction analysis already presented.

Please insert Table 7 here

In both models 1 and 2 of Table 7, *CFO options/total shares* is negative and significant, although the statistical significance is weaker (at the 10% level) in model 2. This confirms that CFO's incentives are also important on the quantity of (expected) production hedged. A 1%-increase in the fraction of stocks underlying options held by the CFO generates a 0.24% (0.18%) decrease of the expected annual production hedged in model 1 (model 2).

Looking at the two complementary subsamples in models 3 and 4, i.e., firm-year observations for which the CEO has a higher or lower convexity of their payoff, respectively, we also find that the CFO incrementally matters. In both subsamples, an increase in *CFO options/total shares* has the effect of reducing the quantity of production hedged, and the sensitivity is stronger when the incentives of the CFO and the CEO differ. When the CEO compensation is less convex, a 1%-increase in *CFO options/total shares* generates a strongly significant 0.33%-decrease of the quantity hedged.

Finally, in model 5 of Table 7, we replicate our investigation on the effect of aligned and misaligned hedging incentives on the fraction of expected production hedged.

Relative to the constant, when both the CFO and the CEO have a higher payoff convexity (*CFO High_CEO High*), the firm hedges less. Again, this evidence is expected. More interesting is to investigate the relative effect of the CFO's and CEO's incentives. As we also noted in Table 6, *CFO Low_CEO High* is not significant. On the contrary, *CFO High_CEO Low* yield a 14% significant decrease of the annual production hedged. If we consider the sample average (from Table 1) of *FPH* (about 51% for hedgers), this effect represents an economically relevant 27% change.

3.2.3 Hedging reserves

The fraction of expected annual production hedged is subject to a potential discrepancy between the actual next year's production and the firm's expectation when it places the hedge, which is unobservable. In other words, the "perfect foresight" assumption might be systematically biased. To circumvent this issue, as in Bakke et al. (2016), we also use the fraction of a firm's total reserves that is hedged. Total reserves are contemporaneous to the moment when the firm places the hedge, and they are also far less volatile over time.

In Table 8, we replicate the same multivariate analysis (tobit regressions) as in Table 7, using *FRH* rather than *FPH* as our dependent variable.

Please insert Table 8 here

The evidence is qualitatively very similar to what is already shown in Table 7. *CFO options/total shares* is negative and significant in model 1 (CFO alone), model 2 (CFO and CEO), models 3 (subsample with higher CEO's payoff convexity), model 4 (subsample with lower CEO's payoff convexity), and model 5 (with dummies indicating the aligned and misaligned incentives of the CFO and the CEO). The coefficients of the relevant variables are smaller in absolute value than those of Table 7. This depends on the fact that the average total reserves being hedged from the hedgers in our sample is 4.6% (from Table 1).

3.2.4 Change of CFO

Our previous analyses cannot rule out concerns on the potentially endogenous relationship between CFO remuneration and a firm's hedging policy. One could argue that unobservable firm-level characteristics have explanatory power on both compensation and hedging policy. To tackle this potential issue, we follow Boubaker et al. (2020) and Michaely et al. (2016), and focus on firms that experienced both a change in the CFO and a change in the CFO's payoff convexity within our sample period. Retaining only firms which underwent a transition (i.e., a new CFO takes office, and the convexity of their payoff is markedly different from that of the old CFO) allows us to avoid the overlap between firm attributes and compensation characteristics. Therefore, we can control for the effect of unobserved firm characteristics on hedging choices.

We first restrict our sample to firms that experienced at least one CFO change. This filter reduces the number of usable firms to 65 and the number of firm-year observations to 483. Then, we only consider firms for which we observe a significant change in the compensation policy between the departing and the incumbent CFO. To define this "significant change," we look at transitions from a high (low) to a low (high) level of *CFO options/total shares*. More precisely, we only retain in our sample firms granting the incumbent CFO a fraction of *CFO options/total shares* above (below) the sample median, and for which the fraction of *CFO options/total shares* for the old CEO is below (above) the sample median. We use the restricted sample (65 firms, 483 observations) for computing medians. This approach is consistent with the incentive variables we have used in our previous multivariate analysis (Ferris and Sainani, 2021), and follows Bajo et al. (2021). The final sample for this analysis comprises 20 firms and 141 firm-year observations.

Table 9 shows the results of a linear probability model for the hedging likelihood (panel A), a tobit regression for *FPH* (panel B), and a tobit regression for *FRH* (panel C). We do not report control variables for brevity. As before, standard errors are clustered at the firm level, and all models include year fixed effects.

Please insert Table 9 here

Panel A of Table 9 shows that the incentives of the CFO retain their negative and significant effect on the hedging probability. This conclusion holds when considering only the CFO (model 1), both the CFO and the CEO (model 2), two subsamples according to the lower or higher CEO payoff convexity (model 3 and model 4, respectively), and when using dummies to detect the different incentives of the CFO and the CEO (model 5).[7]

Panel B of Table 9 reports the coefficients of a tobit regression for the fraction of expected production hedged. The general evidence is in line with the results in Table 7, as CFO's convexity negatively affects the extent of hedging (models 1 and 2), even if only at the 10% confidence level. The variable *CFO options/total shares* loses significance in models 3 and 4, when the two subsamples are considered. This is somewhat expected, since we only have about 70 observations in each subsample. In model 5, we recover the statistical significance (at the 5% level) of the dummy *CFO High_CEO Low*, which remarkably confirms the relevant role of the CFO (relative to the CEO) and their incentives on the fraction of production hedged. A 1%-increase of the fraction of stocks underlying options, in this case, reduces the hedge ratio by 15 basis points.

Finally, Panel C replicates the results of Table 8 for the fraction of reserves hedged. The results are qualitatively similar to those reported in Table 8. As for Panel B, the small number of observations affects the explanatory power of the models. However, especially in model 5, the relative role of CFO's incentives on hedging a firm's reserves is confirmed.

4. Conclusion

Due to the specialized expertise and technical competency it requires, risk management is one of the CFO's most sophisticated areas of responsibility. Surveys of professionals clearly indicate that risk management is the first among the several nonfinancial accounting-related activities that report directly to the CFO. Despite this

[7] In model 5 (for all three panels of Table 9) we compute *CFO High_CEO Low, CFO High_CEO Low* and *CFO High_CEO Low* according to the median of the subsample we use in this análisis (141 observations).

evidence, most of the literature investigating the relationship between managerial preferences and a firm's hedging policy looks at the incentives of the CEO, usually viewed as the ultimate decision-maker in this area.

In this paper, we exploit the well-established causal relationship between the convexity of a manager's compensation and risk aversion to investigate how CFO's risk management incentives significantly affect a firm's hedging policy, and how the impact of the CFO goes beyond and above that of the CEO. We use a sample of US oil and gas firms between 2009 and 2019, and we show that the CFO's relative fraction of equity underlying stock options over their total equity is negatively associated with the hedging likelihood, the amount of expected annual production hedged, and the fraction of a firm's current reserves hedged. This evidence holds when the CFO is analyzed in isolation from the CEO, when both the CFO and the CEO are considered, and when their different incentives are separately taken into account. In particular, when the CFO has a higher payoff convexity and, at the same time, the CEO has a lower convexity, the firm is less likely to hedge and hedges quantitatively less. These results survive when we restrict our sample to firms undergoing a transition in both the CFO and their compensation structure. This evidence confirms that the CFO and their incentives, rather than the CEO, ultimately matters in developing a firm's hedging strategy.

Overall, our study contributes to the literature analyzing how managerial risk aversion affects a firm's hedging policy, and in particular to the narrower area investigating the incremental effect of CFO preferences, beyond those of the CEO, on a firm's policy and decision-making.

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Year	Full sample			Hedgers only		
	Hedger = 0	Hedger = 1	Total	% Hedgers	% Production Hedged	% Reserves Hedged
2009	21	59	80	73.8%	55.1%	4.8%
2010	23	60	83	72.3%	49.4%	4.0%
2011	23	59	82	72.0%	42.9%	3.5%
2012	22	60	82	73.2%	46.8%	4.3%
2013	18	60	78	76.9%	54.8%	5.1%
2014	27	51	78	65.4%	50.3%	4.2%
2015	18	53	71	74.6%	43.7%	4.4%
2016	12	52	64	81.3%	54.0%	5.6%
2017	5	53	58	91.4%	52.3%	4.8%
2018	8	47	55	85.5%	53.9%	5.0%
2019	7	40	47	85.1%	53.4%	5.0%
Total	**184**	**594**	**778**	**76.3%**	**50.5%**	**4.6%**

Table 1 – *Hedging sample*. The table reports the yearly distribution for the full sample of 778 firm-year observations (142 unique firms). The first three columns report the distribution of firms by year, distinguishing between hedgers and non-hedgers. The last three columns report the descriptive statistics on the percentage of hedgers for each year, and the yearly averages for the fraction of production and reserves that is hedged. All variables are defined in the Appendix.

	N	Mean	SD	Min	Q1	Median	Q3	Max
Chief Financial Officer								
CFO options/total shares, %	778	29.88	32.15	0.00	0.00	18.81	55.63	93.14
CFO MV(shares), $ mln	778	4.04	5.30	0.03	0.45	1.91	5.23	20.10
CFO Cash+bonus, $ mln	778	0.50	0.26	0.14	0.31	0.45	0.60	1.12
CFO age, years	778	50.61	8.03	30.00	45.00	51.00	56.00	71.00
CFO tenure, years	778	5.30	5.10	0.00	2.00	4.00	7.00	30.00
CFO female, %	778	4.76	21.30	0.00	0.00	0.00	0.00	100.00
Chief Executive Officer								
CEO options/total shares, %	778	21.93	26.39	0.00	0.00	9.68	38.93	79.99
CEO MV(shares), $ mln	778	42.43	75.61	0.28	3.80	11.79	34.57	310.66
CEO Cash+bonus, $ mln	778	0.94	0.65	0.11	0.50	0.82	1.13	2.71
CEO age, years	778	57.48	8.35	33.00	53.00	57.00	62.00	89.00
CEO tenure, years	778	8.65	9.42	0.00	2.00	6.00	12.00	52.00
CEO female, %	778	0.26	5.07	0.00	0.00	0.00	0.00	100.00
Firm								
Total Assets, $ bln	778	5.81	8.86	0.03	0.41	1.92	6.79	32.93
ROA, %	778	-3.39	16.14	-49.81	-7.25	1.53	6.68	15.25
Quick Ratio, %	778	115.94	84.95	29.00	59.00	87.00	142.00	358.00
Investment, %	778	24.82	18.45	3.21	12.17	19.58	30.91	72.59
Leverage, %	778	33.54	22.87	0.00	18.75	31.15	44.31	89.16
Dividend, %	778	28.92	45.37	0.00	0.00	0.00	100.00	100.00

Table 2 – *Descriptive statistics.* Descriptive statistics. The table illustrates descriptive statistics of our sample data. The first group refers to compensation and biographical information for the CFO. The second group refers to compensation and biographical information for the CEO. The third group contains summary statistics of firm-specific financial data. All variables are defined in the Appendix. All continuous variables have been winsorized at 5% and 95%, as in Bakke et al. (2016).

	Hedger = 1	Mean	Hedger = 0	Mean	Difference	t-statistic
CFO options/total shares, %	594	25.58	184	43.74	-18.16	-5.99 ***
CFO MV(shares), $ mln	594	4.61	184	2.23	2.38	6.26 ***
CFO Cash+bonus, $ mln	594	0.53	184	0.37	0.16	7.96 ***
CFO age, years	594	50.44	184	51.17	-0.73	-1.08
CFO tenure, years	594	5.10	184	5.94	-0.84	-1.65
CFO female, %	594	3.87	184	7.61	-3.74	-1.77 *
CEO options/total shares, %	594	21.47	184	23.43	-1.96	-0.84
CEO MV(shares), $ mln	594	45.38	184	32.93	12.45	2.05 **
CEO Cash+bonus, $ mln	594	1.04	184	0.64	0.41	8.19 ***
CEO age, years	594	57.00	184	59.04	-2.04	-2.60 ***
CEO tenure, years	594	8.31	184	9.73	-1.42	-1.61
CEO female, %	594	0.17	184	0.54	-0.38	-0.66
Total Assets, $ bln	594	6.66	184	3.07	3.59	5.29 ***
ROA, %	594	-1.46	184	-9.60	8.14	5.01 ***
Quick Ratio, %	594	101.43	184	162.79	-61.36	-6.67 ***
Investment, %	594	26.35	184	19.87	6.48	4.16 ***
Leverage, %	594	36.73	184	23.25	13.48	6.19 ***
Dividend, %	594	31.48	184	20.65	10.83	3.05 ***

Table 3 – *Univariate analysis*, *hedgers vs non-hedgers*. The table reports descriptive statistics for the sample of firms (total of 778 firm-year observations) considering two subsamples of hedgers and non-hedgers. The last column indicates the results of a t-test with significance of the difference of means at 1%, 5% and 10% level denoted as ***, **, *, respectively. All variables are defined in the Appendix.

	CFO High & CEO High	Mean	CFO Low & CEO Low	Mean	Difference	t-statistic
Hedger, %	311	76.21	311	81.67	-5.47	-1.67 *
FPH, %	311	37.63	311	43.05	-5.41	-2.11 **
FRH, %	311	3.28	311	4.04	-0.76	-2.98 ***
CFO MV(shares), $ mln	311	3.65	311	4.68	-1.03	-2.37 **
CFO Cash+bonus, $ mln	311	0.51	311	0.49	0.02	1.08
CFO age, years	311	51.22	311	50.25	0.96	1.48
CFO tenure, years	311	4.61	311	5.51	-0.89	-2.36 **
CFO female, %	311	5.79	311	3.54	2.25	1.33
CEO MV(shares), $ mln	311	21.41	311	59.20	-37.79	-6.95 ***
CEO Cash+bonus, $ mln	311	0.96	311	0.96	0.00	0.05
CEO age, years	311	57.61	311	56.74	0.88	1.37
CEO tenure, years	311	7.12	311	9.71	-2.59	-3.48 ***
CEO female, %	311	0.00	311	0.32	-0.32	-1.00
Total Assets, $ bln	311	7.88	311	3.95	3.94	5.74 ***
ROA, %	311	-2.88	311	-1.76	-1.12	-0.92
Quick Ratio, %	311	113.61	311	121.06	-7.44	-1.08
Investment, %	311	23.57	311	25.22	-1.65	-1.16
Leverage, %	311	31.65	311	35.36	-3.71	-2.10 **
Dividend, %	311	35.05	311	27.01	8.04	2.17 **

Panel B, Misaligned Incentives

	CFO High & CEO Low	Mean	CFO Low & CEO High	Mean	Difference	t-statistic
Hedger, %	78	55.13	78	76.92	-21.79	-2.93 ***
FPH, %	78	27.71	78	34.90	-7.18	-1.43
FRH, %	78	2.43	78	3.27	-0.84	-1.82 *
CFO MV(shares), $ mln	78	2.85	78	4.28	-1.43	-1.87 *
CFO Cash+bonus, $ mln	78	0.46	78	0.52	-0.06	-1.59
CFO age, years	78	49.04	78	51.23	-2.19	-1.80 *
CFO tenure, years	78	6.99	78	5.51	1.47	1.48
CFO female, %	78	7.69	78	2.56	5.13	1.45
CEO MV(shares), $ mln	78	84.67	78	17.16	67.51	4.83 ***
CEO Cash+bonus, $ mln	78	0.80	78	0.93	-0.13	-1.38
CEO age, years	78	60.46	78	56.97	3.49	2.31 **
CEO tenure, years	78	13.19	78	5.97	7.22	5.06 ***
CEO female, %	78	0.00	78	1.28	-1.28	-1.00
Total Assets, $ bln	78	5.07	78	5.76	-0.69	-0.46
ROA, %	78	-6.78	78	-8.51	1.73	0.56
Quick Ratio, %	78	116.95	78	103.82	13.13	1.00
Investment, %	78	24.99	78	28.03	-3.04	-0.90
Leverage, %	78	35.70	78	31.72	3.98	0.96
Dividend, %	78	17.95	78	23.08	-5.13	-0.79

Table 4 – *Univariate analysis, CFO and CEO risk-taking incentives*. The table reports descriptive statistics for the sample of firms (total of 778 firm-year observations), considering two subsamples according to (mis)alignment of risk-taking incentives between CFOs and CEOs. In panel A, we focus on the part of the sample in which risk-taking incentives of CFOs and CEOs are aligned. Then, we compare two subsamples where (a) both CFO and CEO have a value of *options/total shares* which is above the median of the overall sample (CFO High & CEO High) and (b) both CFO and CEO have a value of *options/total shares* which is below the median of the overall sample (CFO Low & CEO Low). In panel B, we focus on the part of the sample in which risk-taking incentives of CFOs and CEOs are misaligned. Then, we compare the two subsamples where (c) the CFO has a value of *options/total shares* which is above the median of the overall sample, and the CEO has a value of *options/total shares* which is below the median of the overall sample (CFO High & CEO Low) (d) the CFO has a value of *options/total shares* which is below the median of the overall sample, and the CEO has a value of *options/total shares* which is above the median of the overall sample (CFO Low & CEO High). In both panels, the last column indicates the results of a t-test with significance of the difference of means at 1%, 5% and 10% level denoted as ***, **, *, respectively. All variables are defined in the Appendix.

		#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
#1	Hedger, %	1									
#2	FPH, %	**0.667*** **	1								
#3	FRH, %	**0.617*** **	**0.867*** **	1							
#4	CFO options/total shares, %	**-0.240*** **	**-0.200*** **	**-0.212*** **	1						
#5	CFO MV(shares), $ mln	**0.191*** **	**0.069***	**0.076** **	**-0.201*** **	1					
#6	CFO Cash+bonus, $ mln	**0.265*** **	**0.170*** **	**0.154*** **	**-0.011**	**0.342*** **	1				
#7	CFO age, years	-0.039	**-0.136*** **	**-0.130*** **	0.013	0.060*	**0.098*** **	1			
#8	CFO tenure, years	-0.070*	**-0.145*** **	**-0.120*** **	-0.036	**0.367*** **	**0.153*** **	**0.293*** **	1		
#9	CFO female, %	**-0.075** **	**-0.065***	-0.05	**0.129*** **	**-0.107*** **	**-0.086** **	**-0.097*** **	0.013	1	
#10	CEO options/total shares, %	**-0.032**	**-0.090** **	**-0.105*** **	**0.657*** **	**-0.095*** **	0.081**	0.01	**-0.130*** **	0.075**	1
#11	CEO MV(shares), $ mln	0.070*	0.012	0.027	**-0.128*** **	**0.425*** **	**0.225*** **	-0.015	**0.108*** **	-0.061*	**-0.270*** **
#12	CEO Cash+bonus, $ mln	**0.267*** **	**0.162*** **	**0.146*** **	**-0.032**	**0.289*** **	**0.793*** **	0.056	**0.079** **	**-0.075** **	0.052
#13	CEO age, years	**-0.104*** **	**-0.186*** **	**-0.159*** **	**0.091** **	**0.075** **	0.060*	**0.195*** **	**0.352*** **	**0.088** **	-0.05
#14	CEO tenure, years	-0.064*	**-0.159*** **	**-0.192*** **	-0.015	0.094***	**0.112*** **	0.045	**0.481*** **	**0.128*** **	**-0.217*** **
#15	CEO female, %	-0.031	-0.04	-0.029	-0.041	0.008	**0.124*** **	-0.001	-0.008	-0.011	-0.017
#16	Total Assets, $ bln	**0.172*** **	0.027	0.018	**0.162*** **	**0.389*** **	**0.438*** **	0.015	0.05	0.008	**0.290*** **
#17	ROA, %	**0.214*** **	**0.150*** **	**0.089** **	**-0.035**	**0.215*** **	**0.130*** **	**0.061***	**0.089** **	0.007	0.029
#18	Quick Ratio, %	**-0.307*** **	**-0.222*** **	**-0.138*** **	**0.096*** **	-0.013	**-0.102*** **	-0.032	-0.031	0.028	-0.012
#19	Investment, %	**0.149*** **	**0.089** **	**0.106*** **	**-0.090** **	0.016	0.038	**-0.138*** **	**-0.096*** **	0.053	**-0.075** **
#20	Leverage, %	**0.251*** **	**0.260*** **	**0.240*** **	**-0.107*** **	**-0.133*** **	**0.091** **	0.019	-0.016	**-0.063***	**-0.124*** **
#21	Dividend, %	**0.101*** **	-0.066*	-0.066*	0.061*	**0.335*** **	**0.184*** **	**0.080** **	0.056	**-0.063***	**0.202*** **

		#11	#12	#13	#14	#15	#16	#17	#18	#19	#20	#21
#11	CEO MV(shares), $ mln	1										
#12	CEO Cash+bonus, $ mln	**0.283*** **	1									
#13	CEO age, years	**0.097*** **	0.004	1								
#14	CEO tenure, years	**0.380*** **	**0.139*** **	**0.450*** **	1							
#15	CEO female, %	0.014	0.027	-0.042	-0.039	1						
#16	Total Assets, $ bln	**0.225*** **	**0.471*** **	**0.067***	-0.004	**0.062***	1					
#17	ROA, %	**0.144*** **	**0.153*** **	**0.083*** **	0.059*	**-0.067***	**0.152*** **	1				
#18	Quick Ratio, %	-0.031	**-0.113*** **	-0.008	**-0.077*** **	0.025	**-0.120*** **	0.066*	1			
#19	Investment, %	0.018	0.023	**-0.140*** **	-0.04	0.052	**-0.190*** **	**0.165*** **	-0.037	1		
#20	Leverage, %	-0.005	**0.101*** **	**-0.076*** **	**0.118*** **	-0.035	**-0.114*** **	**-0.280*** **	**-0.343*** **	-0.048	1	
#21	Dividend, %	**0.148*** **	**0.222*** **	**0.079*** **	-0.043	0.024	**0.605*** **	**0.199*** **	0.046	**-0.234*** **	**-0.200*** **	1

Table 5 – *Correlation table*. The table shows the results of pairwise correlations with significance at the 10%, 5% and 1% denoted as *, **. ***, respectively. All variables are defined in the Appendix.

VARIABLES	(1) CFO	(2) CFO/CEO	(3) CEO options upper median	(4) CEO options lower median	(5) Interaction updown median
CFO options/total shares	-0.241***	-0.261**	-0.185*	-0.336***	
	(0.0753)	(0.101)	(0.0994)	(0.111)	
CEO options/total shares		0.0229			
		(0.109)			
CFO High_CEO Low					-0.146**
					(0.0714)
CFO Low_CEO High					-0.0585
					(0.0409)
CFO High_CEO High					-0.0866*
					(0.0448)
CFO MV(shares)	-0.0118	0.0109	0.0340	-0.0237	0.0387
	(0.0335)	(0.0367)	(0.0552)	(0.0389)	(0.0359)
CFO Cash+bonus	-0.0821	-0.0383	-0.147	0.195	-0.0753
	(0.121)	(0.158)	(0.233)	(0.205)	(0.163)
CFO age	-0.0891	-0.0811	-0.254*	0.00315	-0.0770
	(0.112)	(0.111)	(0.149)	(0.126)	(0.110)
CFO female	-0.0393	-0.0305	0.0168	-0.0399	-0.0518
	(0.0842)	(0.0831)	(0.134)	(0.0823)	(0.0857)
CFO tenure	-0.0157	-0.0158	0.0466	-0.0332	-0.0247
	(0.0265)	(0.0275)	(0.0410)	(0.0267)	(0.0263)
CEO MV(shares)		-0.0318*	-0.0375	-0.0232	-0.0314*
		(0.0179)	(0.0343)	(0.0200)	(0.0184)
CEO Cash+bonus		-0.0272	0.0738	-0.0959	-0.0199
		(0.0944)	(0.137)	(0.136)	(0.0994)
CEO age		-0.0551	0.00506	-0.132	-0.0634
		(0.140)	(0.243)	(0.159)	(0.140)
CEO female		-0.256*	-0.0649	-0.540***	-0.214
		(0.136)	(0.182)	(0.189)	(0.166)
CEO tenure		0.00563	0.0560	-0.0338	0.00702
		(0.0259)	(0.0368)	(0.0277)	(0.0263)
Total Assets	0.113***	0.118***	0.108***	0.123***	0.113***
	(0.0182)	(0.0194)	(0.0223)	(0.0264)	(0.0203)
ROA	0.438***	0.437***	0.380**	0.445**	0.446***
	(0.125)	(0.121)	(0.151)	(0.175)	(0.117)
Quick ratio	-0.0546**	-0.0491**	-0.0541*	-0.0374	-0.0599***
	(0.0227)	(0.0230)	(0.0294)	(0.0304)	(0.0221)
Investment	0.360***	0.362***	0.292*	0.359***	0.380***
	(0.0960)	(0.0987)	(0.151)	(0.0992)	(0.100)
Leverage	0.368***	0.374***	0.481***	0.236**	0.395***
	(0.0954)	(0.0938)	(0.119)	(0.112)	(0.0990)

Dividend	-0.0690	-0.0654	-0.0790	-0.0453	-0.0769
	(0.0635)	(0.0643)	(0.0767)	(0.0806)	(0.0660)
Constant	1.226***	1.463**	1.658	1.521*	1.450**
	(0.433)	(0.662)	(1.055)	(0.777)	(0.678)
Observations	778	778	389	389	778
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.423	0.429	0.442	0.463	0.411

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 – *Probability to hedge.* The table shows estimates of a pooled OLS model where the dependent variable is a dummy variable equal to 1 if the firm hedges with financial derivatives, and zero otherwise. Model 1 considers only CFO-level variables. Model 2 adds CEO-level variables. Models 3 and 4 split the sample according to the value of *options/total shares* awarded to the CEO being above (model 3) and below (model 4) the median. Model 5 considers variables indicating the (mis)alignment of risk-taking incentives between CFOs and CEOs. Heteroskedasticity-robust standard errors are clustered at firm level and are reported in parentheses. All models include year-fixed effects. ∗∗∗, ∗∗ and ∗ denote statistical significance at the 1, 5, and 10 percent level, respectively. All variables are defined in the Appendix.

VARIABLES	(1) CFO	(2) CFO/CEO	(3) CEO options upper median	(4) CEO options lower median	(5) Interaction updown median
CFO options/total shares	-0.235***	-0.184*	-0.223**	-0.327***	
	(0.0755)	(0.0974)	(0.106)	(0.107)	
CEO options/total shares		-0.117			
		(0.115)			
CFO High_CEO Low					-0.142**
					(0.0635)
CFO Low_CEO High					-0.0867
					(0.0540)
CFO High_CEO High					-0.0870*
					(0.0508)
CFO MV(shares)	-0.0119	0.00648	-0.0272	-0.00233	0.0270
	(0.0309)	(0.0327)	(0.0509)	(0.0382)	(0.0333)
CFO Cash+bonus	-0.0854	0.0895	-0.186	0.428**	0.0509
	(0.136)	(0.153)	(0.219)	(0.196)	(0.158)
CFO age	-0.230*	-0.227*	-0.418**	-0.0142	-0.222*
	(0.136)	(0.130)	(0.182)	(0.130)	(0.129)
CFO female	-0.0637	-0.0366	-0.0151	-0.0197	-0.0724
	(0.0709)	(0.0691)	(0.0833)	(0.0980)	(0.0777)
CFO tenure	-0.0455	-0.0208	0.0669*	-0.0705**	-0.0248
	(0.0293)	(0.0270)	(0.0382)	(0.0296)	(0.0268)
CEO MV(shares)		-0.0294	-0.00471	-0.0168	-0.0208
		(0.0187)	(0.0379)	(0.0202)	(0.0188)
CEO Cash+bonus		-0.0984	0.116	-0.272**	-0.0861
		(0.0941)	(0.139)	(0.118)	(0.0998)
CEO age		-0.196	-0.123	-0.277*	-0.197
		(0.140)	(0.230)	(0.145)	(0.140)
CEO female		-0.429***	-0.180	-1.522***	-0.358***
		(0.0985)	(0.161)	(0.193)	(0.124)
CEO tenure		-0.0390	-0.000997	-0.0788***	-0.0386
		(0.0258)	(0.0384)	(0.0264)	(0.0259)
Total Assets	0.106***	0.112***	0.0792***	0.135***	0.103***
	(0.0184)	(0.0198)	(0.0263)	(0.0233)	(0.0204)
ROA	0.518***	0.562***	0.614***	0.461***	0.543***
	(0.138)	(0.129)	(0.190)	(0.156)	(0.127)
Quick ratio	-0.0428*	-0.0459*	-0.0578	-0.0297	-0.0526**
	(0.0235)	(0.0237)	(0.0385)	(0.0256)	(0.0234)
Investment	0.212**	0.187*	0.0487	0.208*	0.207**

	(0.0993)	(0.0995)	(0.144)	(0.124)	(0.101)
Leverage	0.452***	0.472***	0.614***	0.372***	0.491***
	(0.104)	(0.101)	(0.137)	(0.114)	(0.106)
Dividend	-0.162**	-0.142**	-0.144*	-0.0945	-0.165***
	(0.0629)	(0.0603)	(0.0867)	(0.0659)	(0.0637)
Constant	1.441***	2.319***	2.536**	1.876**	2.249***
	(0.515)	(0.677)	(1.044)	(0.756)	(0.681)
Observations	778	778	389	389	778
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Pseudo R-Squared	0.379	0.404	0.387	0.522	0.389

Table 7 – *Fraction of production hedged.* The table shows estimates of a pooled Tobit model where the dependent variable is the fraction of production hedged. Heteroskedasticity-robust standard errors are clustered at firm level and are reported in parentheses. All models include year-fixed effects. ∗∗∗, ∗∗ and ∗ denote statistical significance at the 1, 5, and 10 percent level, respectively. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)
	CFO	CFO/CEO	CEO options upper median	CEO options lower median	Interaction updown median
CFO options/total shares	-0.0237***	-0.0221**	-0.0188**	-0.0398***	
	(0.00755)	(0.00968)	(0.00939)	(0.0118)	
CEO options/total shares		-0.00550			
		(0.0112)			
CFO High_CEO Low					-0.0162**
					(0.00676)
CFO Low_CEO High					-0.00781
					(0.00520)
CFO High_CEO High					-0.00936*
					(0.00526)
CFO MV(shares)	0.000224	0.000826	0.000530	-0.000307	0.00302
	(0.00314)	(0.00307)	(0.00449)	(0.00389)	(0.00314)
CFO Cash+bonus	-0.00749	0.00641	-0.0180	0.0347*	0.00297
	(0.0134)	(0.0146)	(0.0213)	(0.0201)	(0.0152)
CFO age	-0.0214	-0.0234*	-0.0346*	-0.00879	-0.0229*
	(0.0142)	(0.0139)	(0.0180)	(0.0165)	(0.0138)
CFO female	-0.00317	-0.000467	0.00277	0.000231	-0.00361
	(0.00734)	(0.00692)	(0.00818)	(0.0101)	(0.00708)
CFO tenure	-0.00367	-0.000133	0.00598	-0.00361	-0.000662
	(0.00325)	(0.00297)	(0.00383)	(0.00342)	(0.00290)
CEO MV(shares)		-0.00125	-0.00186	0.000578	-0.000716
		(0.00218)	(0.00369)	(0.00250)	(0.00220)
CEO Cash+bonus		-0.00608	0.0140	-0.0218*	-0.00521
		(0.00917)	(0.0122)	(0.0118)	(0.00966)
CEO age		-0.0106	-0.00580	-0.0148	-0.0108
		(0.0153)	(0.0229)	(0.0173)	(0.0154)
CEO female		-0.0394**	-0.00487	-0.178***	-0.0340*
		(0.0165)	(0.0152)	(0.0224)	(0.0199)
CEO tenure		-0.00620**	-0.00207	-0.0108***	-0.00615**
		(0.00258)	(0.00331)	(0.00327)	(0.00261)
Total Assets	0.00961***	0.00959***	0.00721***	0.0122***	0.00883***
	(0.00192)	(0.00215)	(0.00254)	(0.00270)	(0.00220)
ROA	0.0370***	0.0403***	0.0411**	0.0260	0.0390***
	(0.0143)	(0.0133)	(0.0172)	(0.0178)	(0.0129)
Quick ratio	-0.000824	-0.00125	-0.00290	0.000313	-0.00202
	(0.00274)	(0.00273)	(0.00363)	(0.00308)	(0.00271)
Investment	0.0296**	0.0273**	0.0119	0.0330**	0.0290**
	(0.0117)	(0.0118)	(0.0139)	(0.0154)	(0.0121)
Leverage	0.0431***	0.0464***	0.0535***	0.0401***	0.0481***
	(0.0100)	(0.00980)	(0.0129)	(0.0121)	(0.0102)
Dividend	-0.0137**	-0.0123**	-0.0181**	-0.00328	-0.0142**
	(0.00625)	(0.00587)	(0.00770)	(0.00711)	(0.00620)
Constant	0.121**	0.181***	0.192*	0.142*	0.175**

	(0.0551)	(0.0692)	(0.101)	(0.0843)	(0.0693)
Observations	778	778	389	389	778
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.335	0.360	0.350	0.466	0.347

Table 8 – *Robustness, fraction of reserves hedged.* The table shows estimates of a pooled Tobit model where the dependent variable is the fraction of reserves hedged. Heteroskedasticity-robust standard errors are clustered at firm level and are reported in parentheses. All models include year-fixed effects. ∗∗∗, ∗∗ and ∗ denote statistical significance at the 1, 5, and 10 percent level, respectively. All variables are defined in the Appendix

Panel A. Dependent variable: *Hedger*

	(1)	(2)	(3)	(4)	(5)
	CFO	CFO/CEO	CEO options upper median	CEO options lower median	Interaction updown median
CFO options/total shares	-0.332***	-0.305**	-0.336*	-0.493***	
	(0.110)	(0.130)	(0.173)	(0.146)	
CEO options/total shares		-0.00639			
		(0.200)			
CFO High_CEO Low					-0.184***
					(0.0592)
CFO Low_CEO High					-0.143
					(0.0916)
CFO High_CEO High					-0.209**
					(0.0825)
Constant	1.772**	4.045**	-1.557	5.212***	4.634**
	(0.824)	(1.667)	(2.845)	(1.364)	(1.655)
Observations	141	141	70	71	141
CFO controls	Yes	Yes	Yes	Yes	Yes
CEO controls	No	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.444	0.449	0.514	0.375	0.448

Panel B. Dependent variable: *FPH*

	(1)	(2)	(3)	(4)	(5)
	CFO	CFO/CEO	CEO options upper median	CEO options lower median	Interaction updown median
CFO options/total shares	-0.270*	-0.257*	-0.171	-0.0946	
	(0.156)	(0.134)	(0.216)	(0.196)	
CEO options/total shares		-0.0778			
		(0.241)			
CFO High_CEO Low					-0.153**
					(0.0738)
CFO Low_CEO High					-0.116
					(0.103)
CFO High_CEO High					-0.240**
					(0.107)
Constant	1.024	1.022	-4.742*	2.477*	1.504
	(0.747)	(1.625)	(2.591)	(1.430)	(1.633)

Observations	141	141	70	71	141
CFO controls	Yes	Yes	Yes	Yes	Yes
CEO controls	No	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.573	0.576	0.747	0.630	0.587

Panel C. Dependent variable: *FRH*

	(1)	(2)	(3)	(4)	(5)
	CFO	CFO/CEO	CEO options upper median	CEO options lower median	Interaction updown median
CFO options/total shares	-0.0234	-0.0235*	-0.00214	-0.0266	
	(0.0146)	(0.0129)	(0.0166)	(0.0194)	
CEO options/total shares		-0.00186			
		(0.0217)			
CFO High_CEO Low					-0.0196**
					(0.00757)
CFO Low_CEO High					-0.0137
					(0.0105)
CFO High_CEO High					-0.0167
					(0.0119)
Constant	0.138**	0.148	-0.425*	0.287*	0.187
	(0.0654)	(0.158)	(0.220)	(0.170)	(0.158)
Observations	141	141	70	71	141
CFO controls	Yes	Yes	Yes	Yes	Yes
CEO controls	No	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.509	0.513	0.775	0.503	0.523

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9 – *Endogeneity, change in CFO and change in compensation policy*. The table shows estimates for a subsample of firms in which both a change in CFO and a significant change in the level of ESOs occurred. We first keep those firm that experienced a at least one CFO change (65 firms) during the sample period. Then, we further restrict our sample to those firms that distributed to the incumbent CFO *options/total shares* above (below) the median of the variable for the sample of firms for which there is a change in CFO, while the previous CFO was awarded *options/total shares* below (above) the median of the variable for the same sample (20 firms). Panel A reports results for the hedging decision. Panel B reports results for the fraction of production hedged. Panel C reports results for the fraction of reserves hedged. Model 1 considers only CFO-level variables. Model 2 adds CEO-level variables. Models 3 and 4 split the sample according to the value of *options/total shares* awarded to the CEO being above (model 3) and

below (model 4) the median of the final sample of 141 observations. Model 5 considers variables indicating the (mis)alignment of risk-taking incentives between CFOs and CEOs. Heteroskedasticity-robust standard errors are clustered at firm level and are reported in parentheses. All models include year-fixed effects. ***, ** and * denote statistical significance at the 1, 5, and 10 percent level, respectively. All variables are defined in the Appendix.

Appendix

APPENDIX A. Computation of FPH and FRH.

We provide an example of the computation of *FPH* and *FRH* for Continental resources Inc., in the fiscal year 2009. The tables reported in the 10-K are replicated below. Commas (,) indicate thousands and periods (.) indicate decimals.

Production hedged. Derivatives contracts outstanding on December 31, 2009 are reported in the following tables:

Crude Oil

			Floors		Ceilings	
Period and Type of Contract	**Volume in MBbls**	**Swaps Weighted Average**	**Range**	**Weighted Average**	**Range**	**Weighted Average**
January 2010 – June 2010						
Swaps	905	$80.50				
Collars	453	—	$ 70.00	$ 70.00	$ 95.00	$ 95.00
July 2010 – December 2010						
Collars	644	—	$ 75.00	$ 75.00	$ 96.75	$ 96.75
January 2011 – December 2011						
Collars	1,278	—	$ 75.00	$ 75.00	$ 89.00	$ 89.00

Natural gas

Period and Type of Contract	**Volume in MMMBtus**	**Swaps Weighted Average**
January 2010 – March 2010		
Swaps	2,700	$ 6.18
April 2010 – June 2010		
Swaps	2,710	$ 6.18

July 2010 – September 2010			
Swaps	2,720	$	6.18
October 2010 – December 2010			
Swaps	2,720	$	6,.8
Natural Gas Basis Centerpoint East			
Period and Type of Contract	**Volume in MMMBtus**	**Swaps Weighted Average**	
January 2010 – December 2010			
Swaps	7,200	$	(0.62)

First, only derivatives positions for the next fiscal year (2010) are considered. Then, all hedged volumes are summed up and converted in thousands of barrels of oil equivalent (MBOE). The company has hedged 905 MBbls of future oil production in swaps, and 1097 MBbls in collars.

The total volumes for natural gas are 18,050 MMMBtus. MMBtus (Million British Thermal Units) are converted into Mcf (thousand cubic feet), by dividing the number by 1.037[1] (resulting in 17,405,978.8 Mcf). Then, the result is converted in MMcf (millions cubic feet) and divided by 6[2] to obtain the volume expressed in MBOE (17,405.98/6 = 2900,99 MBOE). The total volume hedged of oil and natural gas is: (905 + 1097 + 2900,99) = 4902.996

Total production. The following table reports production figures for the company at fiscal year end:

	Year Ended December 31,		
	2010	**2009**	**2008**
Net production volumes:			
Crude oil (MBbls)			
North Dakota Bakken	4,45	2,257	1,145
Arkoma Woodford	9	13	8
Total Company	11,820	10,022	9,147

[1] The conversion factor between MMBtus and Mcfs is provided by the United States Energy Information Administration: https://www.eia.gov/tools/faqs/faq.php?id=45&t=8.

[2] For this industry, the standard assumption is that 6 Mcf of NG produce the same amount of energy of one barrel of oil (Bajo et al., 2021).

Natural gas (MMcf)			
North Dakota Bakken	3,994	1,729	720
Arkoma Woodford	8,726	9,152	5,407
Total Company	23,943	21,606	17,151
Crude oil equivalents (MBoe)			
Total Company	**15,811**	13,623	12,006

The total production in 2010 is 15,811 MBOE. Thus, the fraction of production that was hedged (*FPH*) in 2009 is given by: (4902.996 MBOE / 15,811 MBOE) * 100 = 31.01%.

Reserves. FRH is computed similarly to *FPH*, but with the value of proved reserves at the end of the fiscal year. Reserves are reported in the following table:

	December 31, 2009			
	Crude oil (MBbls)	**Natural Gas (MMcf)**	**Total (MBoe)**	**P-V 10 (in thousands)**
Proved developed producing	83,745	169,556	112,004	$ 1,797,923
Proved developed non-producing	1,525	226	1,563	$ 10,689
Proved undeveloped	88,01	334,298	143,726	$ 437,328
Total proved reserves	173,280	504,080	257,293	$ 2,245,940
Standardized measure				$ 1,841,540

The sum of total reserves at the end of 2009 is 257,293 MBOE. Therefore, the fraction of reserves hedged (*FRH*) is (4902.996 MBOE / 257,293 MBOE) * 100 = 1,9%.

APPENDIX B. Variables definition.

Variable Name	Definition
Hedger	Dummy variable equal to one if the firm hedges with financial derivatives, and zero otherwise.
FPH	Volume of oil and gas production hedged with financial derivatives, over next year's total production (MBOE).
FRH	Volume of oil and gas production hedged with financial derivatives, over actual reserves (MBOE).
CFO options/total shares	Number of shares underlying options (exercisable and non exercisable) / (total number of shares beneficially owned by the CFO + number of shares underlying options (exercisable and non exercisable)).
CFO MV(shares)	Log of the market value of shares (in $ million) beneficially owned by the CFO.
CFO Cash+bonus	Log of salary plus bonus (in $ million) of the CFO.
CFO age	Age of the CFO.
CFO tenure	Total amount of years in the position of CFO.
CFO female	Dummy variable equal to one if the CFO is female, and zero otherwise.
CEO options/total shares	Number of shares underlying options (exercisable and non exercisable) / (total number of shares beneficially owned by the CEO + number of shares underlying options (exercisable and non exercisable)).
CEO MV(shares)	Log of the market value of shares (in $ million) beneficially owned by the CEO.
CEO Cash+bonus	Log of salary plus bonus (in $ million) of the CEO.
CEO age	Age of the CEO.

CEO tenure	Total amount of years in the position of CEO.
CEO female	Dummy variable equal to one if the CEO is female, and zero otherwise.
CFO High_CEO Low	Dummy equal to one if the CFO has a fraction of option/total shares which is above the median and the CEO has a fraction of option/total shares which is below the median of the overall sample, and zero otherwise.
CFO Low_CEO High	Dummy equal to one if the CFO has a fraction of option/total shares which is below the median and the CEO has a fraction of option/total shares which is above the median of the overall sample, and zero otherwise.
CFO High_CEO High	Dummy equal to one if both the CFO and the CEO are awarded a fraction of option/total shares which is above the median, and zero otherwise.
Total Assets	Log of total assets (in $ billion).
ROA	Return on Assets.
Quick Ratio	Cash and cash equivalents over current liabilities.
Investment	Capital expenditures over total assets.
Leverage	Short term debt plus long-term debt over total assets.
Dividend	Dummy variable equal to one if the firm is a dividend payer, and zero otherwise.