The Causal Effect of Option Pay on Corporate Risk

Management: Evidence from the Oil and Gas Industry [[1]](#footnote-1)\*

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Abstract

We revisit the contentious relation between option compensation and managerial risk-taking by studying how changes triggered by the elimination of favorable accounting treatment for executive stock option grants (FAS 123R) affected hedging behavior in the oil and gas industry. We hypothesize that a decrease in sensitivity of CEO wealth to stock return volatility (vega) decreases CEO risk-taking incentives, causing affected firms to hedge more. We use the FAS 123R compliance requirement to identify changes in CEO compensation vega that are exogenous to corporate hedging policy. Using a differences-in-differences approach that we apply to a hand-collected dataset of oil and gas firms with detailed hedging data, we find that firms that used options to pay their CEOs before FAS 123R dramatically increase their average hedging intensity following the change, compared to similar firms that (a) did not use options to pay their CEOs or (b) expensed their executive stock options voluntarily prior to FAS 123R. Our findings provide support for the view that compensation convexity positively affects managerial risk taking incentives.

*JEL Classification:* G30; G32; G38; G39

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1. **Introduction**

The notion that an increase in the convexity of the wealth-to-performance relation helps overcome managerial risk aversion and mitigate underinvestment forms the fundamental premise underlying the inclusion of stock options in managerial compensation. However, despite a considerable literature, the basic question of whether stock option compensation alters managerial attitudes toward risk-taking remains unresolved. We re-examine this issue utilizing the natural experiment created by the 2005 U.S. Securities Exchange Commission (SEC) mandate that firms comply with FAS 123R – which fundamentally altered the expensing of stock option awards and induced significant cutback in options grants. To our knowledge, ours is the first study to use an exogenous change in expensing executive stock option grants to provide empirical evidence of a causal relation between stock option compensation and corporate risk management.

 In this paper we study the effects of the exogenous change in CEO wealth sensitivity to stock return volatility (vega) on corporate risk management, using the quasi-natural experimental setting created by the issuance of FAS 123R and a differences-in-differences (DID) methodology. Specifically, we examine the causal effect of CEO compensation vega on corporate hedging. The new regulation on expensing executive stock options took away the special accounting treatment of stock options, resulting in a cutback in option pay among firms which paid their CEOs with options prior to this regulation (see Brown and Lee, 2011). We hypothesize that the change in expensing of executive stock options decreases the use of options in CEO pay packages which, in turn, reduces the sensitivity of CEO wealth to stock return volatility. As a result of the reduction in CEO compensation vega, we expect the risk-taking appetite of the CEO to decrease, causing an increase in corporate hedging.

Our main hypothesis is best tested in an industry where cash flow volatility is high enough to make risk management important. We therefore use a unique hand-collected dataset with detailed disclosed data on the hedging positions of firms from the oil and gas industry during 2003 to 2007, the years around the FAS 123R compliance date. Our sample firms are independent exploration and production firms that are undiversified in terms of physical assets.[[2]](#footnote-2) The data on firm's hedged positions were hand collected from 10-K forms filed by listed companies with the SEC. As in Tufano (1996), Haushalter (2000) and Kumar and Rabinovitch (2012), we develop a firm-wide measure of the level of risk management, or hedging intensity, based on the delta of the firm's derivatives portfolio.

We use a differences-in-differences (DID) analytical approach which, as noted by Angrist and Krueger (1999), is well placed to identify the effects of a sharp change in compensation policy such as FAS 123R on risk management. The main reason is that the relationship between compensation and risk management is naturally endogenous. Firms with risk-averse boards may choose to compensate managers with fewer options and simultaneously encourage the use of derivatives to mitigate commodity risk. Thus, any empirically documented association between option compensation and hedging is usually spurious. In this paper the change in compensation that arises from the regulatory change does not change the risk management incentives of companies.

In our tests, we define fiscal year 2005 as the beginning of the post-123R period, given that FAS 123R became effective as of the beginning of the first interim or annual reporting period that begins after December 15, 2005. We use this change of regulation because the resulting decrease in CEO compensation vega is exogenous to corporate hedging. We compare the changes in corporate hedging intensity of treatment firms to those of control firms in pre-123R and post-123R periods. In doing so, we minimize the possibility that cross-sectional or time-series effects bias our results, by using a short window (two years in both the pre- and post-event periods) around the implementation of FAS 123R. We construct two sets of control firms. The first set includes firms that did not use options in their CEO compensation packages in 2003 and 2004. These firms are not affected by the issuance of FAS 123R. The second set of control firms are firms that voluntarily used the fair-value method to account for stock options in 2004, i.e., before FAS 123R went into effect. These firms are also unaffected by the new regulation on expensing option grants. We show that before the issuance of FAS 123R our treatment firms are similar to our control firms in terms of different firm characteristics.

In our analysis we also control for changes in the sensitivity of CEO wealth to stock price, or delta. Higher delta is seen as aligning the incentives of managers with the interests of shareholders. Higher delta results in managers working harder or more effectively because managers share gains and losses with shareholders. However, the sensitivity of CEO compensation to stock price that ties managers' wealth to stock prices decreases the willingness of risk-averse managers to bear risk. As a result, a higher CEO delta provides the manager with incentive to avoid risk and thus hedge more. The cutback in the use of option pay following the issuance of FAS 123R also decreases delta. A firm can avoid this reduction in delta by increasing other compensation alternatives that are sensitive to stock price. Although in our analysis we control for changes in CEO delta, firms in our treatment group replaced stock options with restricted stock and longer-term incentive plans resulting in CEO delta after FAS 123R that is not statistically different from delta before FAS 123R .

As expected we find a sharp reduction in compensation convexity (vega) following the adoption of FAS 123R. We observe no statistically significant change in pay-performance sensitivity (delta). The reduction in vega is not surprising since FAS 123R made option pay less favorable, and what we observe is a shift to stock-based compensation that resulted in higher deltas post FAS 123R. The results from our DID regressions show that for both control groups, FAS 123R induced declines in CEO vega, thereby also validating that our natural experiment operates primarily through a large negative shock to vega. It also points to the fact that despite our relatively small sample, our DID technique has enough power to uncover significant effects of the policy change. On the other hand, the shock has an insignificant effect on delta, indicating that the overall increases in delta were similar for both treated and control group and not caused by FAS 123R. It also validates our DID technique as it shows that variables we expect should not be affected by the policy change are insignificant.

 We observe a sharp effect of the decline in vega induced by FAS 123R on corporate hedging. In our basic specification without controls, the DID estimator is 0.136 for control group 1, which means that hedging increased by 13.6% of production in treated firms relative to control firms, an increase of about 60% relative to pre-treatment averages of 22% of production hedged. The results are quantitatively similar for hedging as a percentage of reserves. Taken together these findings suggest that the decline in vega that was a direct result of FAS 123R caused increased hedging in our sample of oil and gas exploration firms.[[3]](#footnote-3) Our findings are robust to a variety of controls and verification that the key identifying assumption behind our DID estimation technique -- that the parallel trends assumption is satisfied – holds for our sample.[[4]](#footnote-4)

 While being the first to establish the causal effect of option compensation on corporate hedging, our study builds on the findings in two recent papers, by Chava and Purnanandam (2010) and Hayes, Lemmon and Qiu (2012), that also use FAS 123R as a natural experiment to study the relation between compensation convexity and corporate risk taking. Chava and Purnanandam (2010) study the relationship between managerial risk-taking incentives and corporate financial policies around FAS 123R and show that the reduced CEO risk-taking incentives after FAS 123R resulted in reduced leverage, higher cash balances and greater earnings management. [[5]](#footnote-5) In contrast, Hayes, Lemmon and Qiu (2012) find no relation between a FAS 123R-induced reduction in vega and changes in five proxies of corporate risk-taking -- R&D expenditure, capital expenditure, leverage, cash holdings and firm risk. In contrast to both Chava and Purnanandam (2010) and Hayes, Lemmon and Qiu (2012), we conduct a DID estimation by exploiting the cross-sectional differences in the FAS 123R impact across our sample firms to guard against systematic changes in unobservable variables that are correlated with corporate policies.[[6]](#footnote-6) While we find results consistent with Hayes, Lemmon and Qiu (2012) when we run specifications similar to theirs,[[7]](#footnote-7) our finding of an economically significant causal relation between a reduction in compensation convexity and a reduction in corporate hedging deviates sharply from the overall implication of their study that compensation convexity does not causally affect managerial risk-taking. One possible explanation for the disparity in results between Hayes, Lemmon and Qiu (2012) and our study is that firms can change their hedging policy literally overnight, whereas changes in the financial and investment policies studied by Hayes, Lemmon and Qiu (2012) are likely to take much more time to take effect fully.[[8]](#footnote-8)

Our paper is also related to Lewellen (2006) who finds evidence of a negative relation between managerial option ownership and debt financing, which would suggest that option ownership causes managers to become more risk averse. On the other hand, Tufano (1996), Knopf, Nam and Thornton (2002) and Rajgopal and Shevlin (2002) provide evidence of a positive relation between the convexity of CEO compensation and corporate risk taking. However, these studies do not establish a clear causal relationship between compensation and risk taking, especially in light of the growing awareness that managerial compensation, and corporate financing and investment policies, are jointly determined. This endogeneity issue is highlighted especially by Coles, Daniel and Naveen (2006), who use simultaneous regressions to show that the causality goes both ways, with investment policy, debt policy, and stock price volatility also affecting the choice of vega in the managerial compensation scheme. The findings of Coles, Daniel and Naveen (2006) reinforce the importance of identifying exogenous changes to be able to tease out causal relationships, as we do in this study.

Our paper also contributes to the larger compensation literature that is interested in exploring whether executive option pay enhances managers’ risk taking incentives. The 1990s experienced an explosion in the use of stock options in executive pay packages (see Murphy, 1999), and equity-based pay has represented a significant proportion of executive compensation ever since. Option pay as a form of equity-based pay helps to align interests of executives with those of the shareholders to mitigate the agency problems due to the separation of ownership and control in public firms (see Jensen and Meckling, 1976). However, there are also some undesirable outcomes associated with option pay. Executives who receive large option grants may also develop symptoms of managerial myopia and participate in accounting fraud.[[9]](#footnote-9)

Another potential concern about the incentives provided by stock options pertains to whether they induce risk taking by managers beyond the level desirable for shareholders. Options are granted to managers because, unlike diversified shareholders, their undiversified wealth portfolios and firm-specific human capital can make managers risk averse, leading them to forgo risky positive net present value (NPV) projects. The convex payoff of stock options is supposed to provide managers with incentives to take more risk. While there is some evidence that managers do appear to respond to such incentives (see, e.g., Guay, 1999; Cohen et al., 2000; Knopf et al., 2002; Rajgopal and Shevlin, 2002; Chen et al., 2006; Coles et al., 2006; Brockman et al., 2009; Dong et al., 2010), the theoretical literature on this issue is inconclusive. Whether stock options can induce more risk taking depends on characteristics of options (moneyness) and the utility function, risk aversion, and outside wealth of managers (see, e.g., Lambert et al., 1991; Carpenter, 2000; Ju et al., 2003; Ross, 2004; Tian, 2004; Braido and Ferreira, 2006). More importantly, empirical measures of executive risk taking behavior and option pay are usually endogenously determined. Thus, drawing a causal inference between option pay and risk taking incentives is not straightforward. Using hedging behavior of oil and gas companies to measure CEO risk appetite and FAS 123R as an exogenous shock to the use of options to draw a causal inference, we establish that convexity of CEO pay provided by option grants increases the risk appetite of managers.

Finally, our study contributes to the corporate hedging literature that examines the relation between hedging and managerial compensation, by providing strong support for the prediction of Smith and Stulz (1985) of a negative relation between CEO stock option compensation and corporate hedging. While Tufano (1996) also finds evidence of such a negative relation in his study of the hedging practices of gold mining firms, subsequent studies have been unable to confirm his findings in other settings. Géczy, Minton, and Schrand (1997) revisit Tufano’s (1996) findings in the context of a sample of firms that use currency derivatives for hedging, and find evidence that contradicts the Smith and Stulz (1985) prediction of a negative effect of option compensation on hedging. Géczy, Minton, and Schrand (1997) raise the possibility that their contrary evidence may be due to the confounding effect of a positive relation between R&D expenditure and option compensation, which is mitigated in our setting by a sample drawn from the same industry and with relatively low R&D expenditure. Nonetheless, Haushalter (2000) revisits this question using a sample of oil and gas producing firms like in our study, and also fails to confirm Tufano’s (1996) findings. While documenting a positive relation between option compensation and the fraction of production hedged, Haushalter (2000) notes that his data does not enable a refinement of his analysis because of his inability to calculate the vega and delta of a manager’s exercisable options like we do in ours. Additionally, none of the aforementioned studies is undertaken in the context of a natural experimental setting like ours that helps to robustly address endogeneity issues.

In the next section, we review the effect of FAS 123R and discuss in Section 3 how we build our identification strategy. Section 4 discusses our data and methodology and Section 5 presents our empirical results. Section 6 concludes.

1. **FAS 123 R and the Accounting Treatment of Executive Stock Options**

 The natural experiment we use to identify the causal effect of CEO wealth to stock return volatility (vega) on corporate risk management is a significant change in the accounting regulation governing how executive options are expensed. After decades of debates over whether the value of executive stock options should be charged against earnings, in 2004, the FASB issued a revised version of FAS 123R that required the use of fair values in the income statements. The accounting rules for executive stock options prior to FAS 123R were established by FAS 123. FAS 123 offered firms two alternative ways to expense executive stock options. First, it allowed firms to use the ‘intrinsic value’ method prescribed by *Accounting Principles Board Opinion No. 25* (APB 25), provided the information about the fair value of options as of the grant date was disclosed in a financial statement footnote.[[10]](#footnote-10) Under the intrinsic value method, firms could avoid option expense by granting options with exercise prices equal to or above the grant-date market price of the underlying stock. Second, firms could also use the ‘fair-value’ approach which instructed companies to record option expense based on the option’s grant date ‘fair market value. Although FAS 123 encouraged the ‘fair-value method’ it was not required. As a result not surprisingly, nearly all firms followed the intrinsic value method, and issued at-the-money options as they could issue option pay without having to record any expenses on the income statement.

The paucity of executive stock option expensing came under regulatory scrutiny after Enron, WorldCom, and other major accounting scandals. Investors argued that the intrinsic-value method resulted in financial statements that did not reflect the economic cost of stock options. It was also suggested that lack of expensing contributed to the stock option grant explosion in the 1990s (Murphy, 2002; Hall and Murphy, 2003). To address these concerns the FASB issued an exposure draft in March 2004 followed by a final standard, FAS 123R, in December 2004, which required firms to expense option grants using the fair-value method. For large public corporations this new regulation became effective for financial reporting in fiscal years commencing after December 15, 2005. The main accounting difference imposed by FAS 123R relates to the expensing of fixed stock options, in which the exercise price and the number of shares are known at the grant date. Under FAS 123R, companies are required to expense all employee stock options using the fair value method. Other equity – based compensation was largely unaffected by this regulatory change.[[11]](#footnote-11) FAS 123R also did not affect the tax treatment of executive stock options.

In sum, the main consequence of the regulation change was to reduce the attractiveness of issuing executive stock options for the vast majority of firms, i.e., those firms that previously elected the intrinsic value method. It is no surprise, therefore, that option usage declined significantly following the issuance of FAS 123R. Brown and Lee (2011) find that the median firm issued 36% fewer options after FAS 123R. Consistent with Lemmon et al. (2012), we find that this results in a significant decrease in the CEO’s sensitivity to option volatility (vega) after the regulatory change. Thus, the event had a large impact on CEO compensation and created significant potential to impact CEO risk-taking incentives.

It is common for firms to lobby for or against regulatory change – and such lobbying activity may be correlated with outcome variables. Such political economy concerns have the potential to reduce the effectiveness of the natural experiment in identifying causal effects and may lead to biased estimation. However, we argue that such concerns are unlikely to be critical in our setting for two reasons. First, most firms had incentives to lobby against the adoption of FAS 123R. In fact, in 1993, strong lobbying against a contemplated regulatory reform similar to FAS 123R led to a drastic watering down of the proposed change. Second, even if some firms had incentives to lobby in favor of the reform (i.e., one could make a case that both our control groups would potentially obtain competitive benefits from FAS 123R by its elimination of the favorable accounting of options compensation availed of firms in the treatment group) it is difficult to imagine that any such incentive would be correlated with their hedging strategies.

1. **Identification Strategy**

 Most studies that attempt to link executive compensation with hedging suffer from endogenity caused by omitted variables, selection and simultaneity. Knopf, Nam and Thornton (2002), Rogers (2002), Rajgopal and Shevlin (2002) and Chen, Jin and Wen (2010) all find a significant association between executive compensation and corporate hedging. However, none of the above studies are able to convincingly draw a causal inference. For instance, CEOs compensation, corporate hedging and many other important corporate decisions are made simultaneously making it hard to tease out causal interpretations. In addition, many firm characteristics such as the strength of corporate governance and unobservable CEO characteristics could affect both how a firm sets the CEOs compensation and the choice of hedging. Omitting or relying on poor proxies for these variables in hedging regressions can significantly bias the coefficient estimates and lead to unreliable inference. Further, in the managerial labor market, CEOs optimally select firms that are offer compensation contracts that are compatible with CEO attributes. An example of this is that CEO risk aversion may determine both the hedging decisions as well as which firm the CEO chooses to join. This selection bias may also lead to an endogenous relationship between and corporate hedging and CEO compensation. To overcome these challenges and make causal claims one requires a different empirical approach.

 The implementation of regulation FAS 123R in 2005 allows us to take advantage of a source of exogenous variation in executive compensation contracts, more specifically in CEOs option pay. That is in response to FAS 123R, firms significantly reduced the number of options granted to executives thus reducing the convexity of the contracts (vegas). In others words, this event constitutes an exogenous shock to CEO willingness to take risks due to this marked reduction in vegas. Importantly, as we explain in greater detail in the previous section, this shock is exogenous to hedging. This allows us to identify the causal effect of executive stock option grants on corporate hedging.

 However, as the shock to executive compensation contracts may have coincided with other factors that impact hedging it is not sufficient to compare hedging before and after the regulation event. For instance, hedging may be affected by unobservable shocks during the event period to management’s expectation of future oil price volatility. It is therefore critical to carefully disentangle the effects of such shocks that might impact hedging from the effect of the changes in vega. To do this we implement a difference-in-differences (DID) empirical design.

 Intuitively, DID compares the effect on an event (regulation FAS 123R in this study) on a group that is affected by the event (the treated group) to a group that is unaffected (the control group). To find the effect of the event on hedging we can subtract the firm’s hedge ratio before the event from the firm’s hedge ratio after the event. This difference gives the change in hedging during the event window. However, other variables that hedge ratios may also have changed during the event window. Therefore, we need a control group to control for common shocks that can affect hedging. To achieve this subtract hedge ratios before the event from hedge ratios after the event for both treated and control groups. This difference tells us how the event affects each group individually. The effect of the event on the control group gives us the counterfactual: if it were not for the treatment (regulation FAS 123R) how would treated plants have performed during the event window. To get the second difference we compare the differences in the treated group to the differences in the control group. It is this second difference that allows us to control for common shocks that can affect both groups (i.e. the implementation of FAS 123R in this study). In sum, differencing in this manner eliminates any biases on the treatment group that may arise from any other common changes that could affect the treatment group during the event window other than the reform to the regulation governing option expensing (FAS 123R).

 More formally, let $h\_{it}$ be the hedge ratio of firm *i* at time *t* and let $d\_{t}$ be event dummy that is one after the event occurs and zero before. Let $z\_{it}$ be a vector of controls that contains factors that affect $h\_{it}$ that may have changed around the event. We estimate:

$$h\_{it}=α+βd\_{t}+z\_{it}δ+ε\_{it}$$

The identifying assumption is that $β=0$ in the absence of treatment, or equivalently assuming that $E\left(z\_{it},d\_{t}\left|ε\_{t}\right.\right)=0$. If there are important unobservable variables missing from $z\_{it} $then this assumption does not hold and the simple differences estimator $β$ is a biased estimate of the effect of the event on $h\_{it}$. As discussed above this is unlikely to hold in this study. To avoid this confounding affect on $β$ we split the sample into a treated group that is affected by $d\_{t}$ and a control group that is not.

 We identify two different control groups. The first group contains firms that did not pay any options to their executives in the pre-treatment period. This group is not affected by the regulation change as the executives of these firms are not impacted by the large changes in vegas induced by FAS 123R. [[12]](#footnote-12) The second control group are firms that had preemptively adopted FAS 123R prior to 2005 i.e. used fair-value method for expensing their executive stocks options in the pre-treatment period.[[13]](#footnote-13) Again this group is not impacted by the regulation change as they have already implemented the main provisions in the regulation change. With these two control groups in hand we estimate the full DID specification:

$$h\_{it}=α+βd\_{t}+ωT\_{i}+θd\_{t}T\_{i}+z\_{it}δ+ε\_{it}$$

 Here t indexes time, i indexes firms and $T\_{i}$ is an indicator variable that is one if the firm belongs to the treatment group and zero otherwise. The coefficient on the interaction term $θ$ gives the DID estimate of the effect of the FAS 123R on hedging, $h\_{it}$. FAS 123R noticeably reduced vegas in treated firms thus reducing the sensitivity of CEO wealth to stock return volatility. This is predicted to increase hedging behavior in treated firms relative to control firms. We therefore expect to observe that $θ>0$.

 Unbiased estimation of $θ$ is not affected by common trends in both the treated and control group, but trends that differentially affect treatment and control groups can induce bias in $θ$; this known as the parallel trends assumption. For instance, if treated firms are hit with an unobserved shock that coincides with the event and that also increases their incentives to hedge then this will bias our estimation of $θ$.

 To guard against the presence of differential trends we would ideally use matching estimators to find comparable firms in the control group for each treated firm. Unfortunately our hand collected sample is too small to make matching feasible. Instead we check that the treated and control firms have similar firm characteristics before the event. This ensures that treated and control firms are more likely to experience common trends around the event window – and the parallels trend assumption is less likely to be violated. To further ensure our estimates of $θ$ are consistent and robust we do a variety of tests including placebo tests, different control variables, two different control groups etc. We discuss all this in greater detail in the results section below.

1. **Data and Methodology**

Our analysis is based on a sample of oil and gas producing firms (SIC code 1311) between 2003 and 2006. SIC 1311 firms engage primarily in exploration and extraction of natural gas and crude petroleum. We choose SIC 1311 firms as these firms are relatively homogenous in their exposure to commodity prices and consequently similar in there hedging demands (i.e. they hedge by going short or by using fixed price contracts). This fact helps minimize the problem of omitted variables and/or spurious correlations that we would face if we did a cross-industry study. For instance, we exclude many large oil companies (ExxonMobil, Chevron Texaco, ConocoPhilips etc.) as they belong to SIC code 2911 (Petroleum Refining). These firms are vertically integrated and are more naturally hedged than pure-play SIC 1311 firms. Thus their hedging demands are more diverse and more difficult to estimate precisely.

Another reason we focus on the oil and gas industry is that firms in this industry are exemplary in disclosing detailed derivative activity to the public. Purnanandam (2008) discusses the difficulty in identifying contract specific information for commodity derivative holdings of U.S. corporations. The oil and gas industry is unique in that sense because they provide detailed information of each derivative contract – including the notional amount, derivative type, specific details of the underlying commodity, and maturity.

A third advantage of focusing on oil and gas firms stems from a lower likelihood that these firms use stock grants with performance-based vesting provisions, which introduce convexity in executive compensation without options and potentially confound the measurement of vega. Bettis, Bizjak, Coles, and Kalpathy (2010) note that the use of performance-based vesting conditions have been growing recently, especially in the aftermath of FAS 123R that eliminated the favorable accounting treatment of traditional option awards. Bettis et al. (2010) show that the use of performance-based vesting provisions is more common among complex firms, such as large, diversified firms and firms with higher investment in R&D and high stock volatility. The SIC 1311 oil and gas firms in our sample are far from this description, being characterized by low levels of diversification, complexity, and R&D investment.[[14]](#footnote-14)

To quantify hedging behavior we hand collect derivatives positions the firms’10-K reports on Edgar. Firms usually disclose derivative positions in item 7A. In the oil and gas industry in particular, firms typically report their use of oil and gas derivative contracts clearly (most times in tabulated format). We collect the contract type (forward, future, call, put swaps, etc.), the contract maturity, amount sold in the future (firms sometimes provide these figures on a per day basis and sometimes in aggregate), type of commodity (sweet, Brent, etc.) and price of the commodity in the agreement. As in Jin and Jorion (2006), we only consider directional positions and therefore ignore such things as basis spreads. After collecting the information of each derivative contract, we collect volatility and futures prices for all types of oil and gas commodities from Bloomberg. This information allows us to calculate delta for each of the derivative contracts. Deltas for futures, forwards, swaps, loans and other such contracts are assumed to be 1. For the other commodities, we use the Black and Scholes delta to estimate the sensitivity of a contract to movement in oil and gas prices.

We use two measures of hedging in our analysis. First, as in Tufano (1996), Haushalter (2000) and Kumar and Rabonovitch (2012), we measure the extent of derivatives usage by a hedge ratio for each firm *i* and time *t* () that is defined as follows:

$$Total Hedge Ratio \left(Production\right)= \frac{-Portfolio delta (derivative contracts)}{Expected production (one year head)}$$

The portfolio delta is the amount of oil and/or gas that the firm has effectively sold short, computed as the sum of the deltas of all of a firm’s derivatives positions in barrels of oil equivalent. Expected production is a firm’s expected oil and/or gas production over the next year in barrels of oil equivalent, which we proxy as in Jin and Jorion (2006) with actual production figures reported in the 10-K disclosures since production estimates are not available. Thus, this hedge ratio represents the fraction of a firm’s oil and gas production that is being hedged.

Since some measurement error may enter the computation of this hedge ratio due to deviations between actual production and the amount of oil and gas the firm expected to produce at the time it placed the hedge, we also calculate a second hedge ratio that reflects the fraction of a firm’s total oil and gas reserves that has been hedged, as in Jin and Jorion (2006). This ratio () is defined as follows:
$$Total Hedge Ratio \left(Reserves\right)= \frac{-Portfolio delta (derivative contracts)}{Reserves}$$

Fiscal year-end oil and gas reserve estimates in barrels of oil equivalent are hand collected from the firms’ financial statements. Thus, this hedge ratio represents the fraction of a firm’s oil and gas reserves that is being hedged.[[15]](#footnote-15)

Compensation data is primarily from ExecuComp; if the firm is not covered by ExecuComp we hand collect the data from the firm’s proxy statements. We collect the stock and option holdings for CEOs and use this to estimate the sensitivities of stock and option holdings to changes in stock price level (delta) and volatility (vega) following the methodology of Core and Guay (2002). We use the end of year stock price from Compustat as the underlying stock price in the Black-Scholes options pricing formula. The risk-free interest rate is the yield on the Treasury bond whose maturity is closest to the maturity of the stock option. We compute stock return volatility from weekly adjusted stock returns obtained from CRSP and Datastream. We calculate the delta of each executive’s compensation as the sum of the deltas of all outstanding options plus the delta of the executive’s shareholdings. We calculate the vega of the executive’s compensation as the sum of the vegas of all option holdings of the executive. Following Coles, Daniel and Naveen (2006), we assume the vega of shareholdings to be zero. The Appendix describes our delta and vega estimation procedure in detail. We use lagged compensation data in all our regressions.

Finally, we obtain financial data from Compustat and stock price data from CRSP. These data are used to calculate measures of firm size, cash holdings, investment growth, market-to-book ratio of assets, leverage, liquidity, dividend policy, and Altman’s (1968) Z-score. All variable definitions are provided in the Appendix. To ensure that outliers in the data do not drive our results, we winsorize all continuous variables at the 5th and 95th percentiles.[[16]](#footnote-16)

 We are able to locate 10K reports covering fiscal-years 2003 to 2006 with information that allows calculation of hedge ratios and available CEO compensation data for 154 firm-year observations.[[17]](#footnote-17) This includes 42 unique firms that have at least one year of data in each pre- and post- treatment periods. All the variables are measured at the end of each fiscal year. The first group contains firms that did not pay any options to their executives in the 2003 and 2004 (the pre-treatment period). We identify these firms using ExecuComp. The second control group contains firms that started using fair-value method prior to 2005 in accounting for executive option expenses. Similar to Carter et al. (2007) and Brown and Lee (2011), we identify firms within SIC code of 1311 that voluntarily expensed stock options based on Bear Stearns Equity Research dated December 16, 2004 (McConnell, Pegg, Senyek and Mott, 2004). This helped us identify seven firms (1) that began to expense stock options using the fair-value method in 2002 and (2) that have both ExecuComp and Compustat data in our pre- and post- treatment periods. The first and second control groups have ten and seven unique firms respectively with data available in at least one year in the pre and post-treatment periods. The first and second control groups consist of 36 and 26 firm-year observations respectively.

1. **Empirical Analysis**

Our sample of 154 firm-year observations from 2003 to 2006 is summarized in Table 1. The firms in our sample are relatively frequent hedgers. Roughly 82 percent of the sample firms hedge their oil or gas production. Firms sold short an average of about 24% of their oil and gas production or 2% of their reserves.

[Insert Table 1 here]

In Altman (1968) firms with Z-scores less than 1.81 are associated with a “high” probability of distress, whereas firms with Z-scores above 2.99 are in the “safe zone.” As can be seen in Panel A of Table 1 mean and median Z-scores in our sample are 2.55 and 2.35, respectively, the 25th and 75th percentiles are 1.604 and 3.063. Thus, despite the industry focus, the firms in our sample exhibit a wide range of probabilities of bankruptcy with approximately a third having Z-scores below 1.81.

In our sample, Apache Corporation is an example of a firm that did not include any options in their CEO pay in in 2002, 2003 and 2004. Although Apache’s CEO did receive options prior to 2002 he was not granted any options in the pre-FAS 123R period. It therefore satisfies our requirement to be included in the first control group. Apache also voluntarily started using the fair-value method to account for their executive equity-based pay prior to the FAS 123R implementation in 2005. Therefore, in our study, Apache Corporation is included in both control groups. The only other firm that is included in both control groups is Anadarko Petroleum Corporation. Devon Energy and Chesapeake Energy are examples of large firms in our sample that are included in both of the treated groups. However, generally the two control groups do not have much intersection and both include a mix of large and small companies.

Panels C and D compare the firm characteristics of the treated and control firms in our study. Note that both control groups are relatively small, but still give us enough observations and power to get significant results. An important observation is that treated and control groups are relatively similar. We do a paired t-test to test for differences in means between the two groups and find only a few differences at the ten-percent level. The most striking difference in firm characteristics between the two groups is the difference in vega for the first control and treated group comparison. This is by construction as firms in the first control group are required to have no CEO option pay in the pre-treatment period which results in a lower CEO vega. Other notable differences are that control firms are a bit bigger than treated firms, and that we observe some differences in Altman Z, cash and leverage.[[18]](#footnote-18) Overall this is comforting, because – as we elaborate later – the fact that the two groups are similar makes it less likely that unobserved differences between the groups are driving our results.[[19]](#footnote-19)

We now turn to investigate the impact of FAS 123R on executive compensation. In our analysis we focus on a short window (two years in both the pre and post-event periods) around the implementation of FAS 123R. The advantage of a short window is to improve the validity of our empirical strategy by guarding against spurious correlations that may be induced by other events that may differentially affect the hedging decisions of our treated and control firms. In addition, the use of a short window makes our study less subject to having biased standard errors due to the presence of serial correlation in our data (see Bertrand, Duflo and Mullainathan, 2004). Moreover, the short window should be sufficient to capture the major effects of FAS 123R on hedging decisions as hedging reacts fairly quickly to new developments.[[20]](#footnote-20)

[Insert Figure 1 here]

 Consistent with the finding of Hayes, Lemmon and Qiu (2012) the ratio of option pay to total pay as well as the convexity (vega) decline following the adoption of FAS 123R while pay-performance sensitivity (delta) increases (see Table 1: Panel B). The reduction in vega is predicted as FAS 123R made option pay less favorable. Thus, it is not surprising to see firms cut back on options (reducing vega). However, firms substituted options with other forms of performance-based pay that resulted in higher deltas post FAS 123R. To study this more carefully we do differences-in-differences (DID) regressions with CEO vega and delta on the left-hand side (see Table 2).[[21]](#footnote-21) The results suggest that for both control groups, FAS 123R induced declines in CEO vega (see the first panel of Figure 1 for an illustration).[[22]](#footnote-22) These results are comforting as it confirms that our natural experiment operates primarily through a large negative shock to vega. As we can see in second panel of Figure 1 this negative shock to vega is induced by declines in option pay ratios for treated firms. These results also underscore that despite our small sample our DID technique has enough power to uncover significant effects of the policy change. On the other hand the shock has little effect on delta. This insignificant result indicates that the overall increases in delta were similar for both treated and control group and not caused by FAS 123R. It also validates our DID technique as it shows that variables we expect should not be affected by the policy change are insignificant.[[23]](#footnote-23)

[Insert Table 2 here]

 Next, we look at if the decline in vega induced by FAS 123R affects corporate hedging. A simple examination of hedge ratios pre- and post-FAS 123R (see Table 1: Panels B-D) suggests that total hedge ratios mostly increased after 2005. To investigate this more rigorously we run DID regressions with both control groups. A DID technique is well placed to identify the effect of a sharp change in policy such as FAS 123R. The results are in Tables 3 and 4. The coefficient on the interaction term is positive and significant at the ten percent level for both hedge ratios. In the basic specification without control variables, the DID estimator is 0.136 for control group 1. This means that hedging increased by 13.6% of production in treated firms relative to control firms; this constitutes a roughly 60%% increase relative to pre-treatment averages of 22% of production hedged. The results are quantitatively similar for hedging as a percentage of reserves. Taken together these tests point to that the decline in vega that was a direct result of FAS 123R caused increased hedging in oil and gas exploration firms.[[24]](#footnote-24)

[Insert Table 3 here]

 The key identifying assumption behind the DID estimation technique is that the parallel trends assumption is satisfied. This says that in the absence of treatment both treated and control firms should experience parallel trends in the outcome variable. In other words the treatment effect (i.e. the DID estimator) should be zero. This means that treated and control firms should experience similar trends in hedging, but for FAS 123R.

[Insert Table 4 here]

 To assess if the parallel trends assumption is likely to hold in our setting we perform a variety of tests. First, we investigate trends in the outcome variables prior to 2005. As can be seen in Figure 2, treated and control firms exhibit similar trends in hedging prior to FAS 123R for *Hedge Ratio 1*. However, for *Hedge Ratio 2* we observe differential trends. Nevertheless, the differences in hedging between treated and control firms in 2003-2004 are minor compared with the large differentials induced by FAS 123R in 2005-2006. In Figure 2 we observe a large increase in hedge ratios for treated firms relative to control firms. Thus, the figure suggests that the FAS 123R caused higher hedging in treated firms.

[Insert Figure 2 here]

 Second, we compare the pre-treatment characteristics of treated and control firms. If treated and control firms are similar along these dimensions it is less likely that they experience differential trends around the event. In effect, this makes it less likely that unobservables could cause treated firms to increase their hedging activities in ways that are unrelated to the declines in vega. For instance, it is possible that a significant increase in oil and/or gas price volatility contributed to increased hedging activity from 2003-2004 to 2005-2006. We are not worried about this shift in volatility in so far as it affects the treated and control groups in the same way (this affect is differenced out). However, if our treated firms react more strongly to the change in oil and/or gas price volatility (a differential trend) then this could bias our results in favor of finding that FAS 123R increased hedging. Checking that our treatment and control are similar in the pre-treatment period makes it less likely that such biases would contaminate our findings. It is therefore reassuring as shown in Table 1: Panels C and D, that there are few differences between the both control groups and the respective treated groups.

 There is no real consensus on what variables to include in hedging regressions. We therefore canvas the literature for common explanatory variables and include them in our DID regressions to ensure our results are robust. We exclude vega from the specifications as vega are affected by the event (see Table 2). The results are in Tables 3 and 4. The DID estimator is largely unchanged compared to our simple specifications and it remains mostly significant at the 10% level.[[25]](#footnote-25) The fact that our results are quantitatively similar with additional covariates is comforting as large changes in our results would suggest that assignment to the treatment was not random. Even though including control variables reduces the error variance in our specifications, we are leery of relying on this specification with controls as our main result. This is because hedging is jointly determined with most of the control variables such as leverage, cash and dividend policy. Furthermore, our treated and control firms are similar in the pre-treatment period so the pure DID estimation should yield similar results to the full specification explored here.

 To make sure that the exclusion of vega is not biasing our results we run simple difference regressions. All variables are differences of the average values of the variables in the pre and post-treatment periods. The results can be found in Table 5. As we expect we find a significant negative coefficients on changes in vega. This implies that a reduction in vega increases hedging around the adoption of FAS 123R. The downside of this estimation is that the single difference does not control for parallel trends around the event.

[Insert Table 5 here]

 In the pre-FAS 123R period, 2003-2004, oil and natural gas price volatility were lower than in the post-FAS 123R period, 2005-2006 (0.57 and 3.36 versus 1.21 and 6.12, for natural gas and oil respectively).[[26]](#footnote-26) As mentioned earlier all of firms in our sample were affected by the increase in oil price volatility. Thus, the change in hedging behavior due to the volatility regime shift should be the same for both treated group firms and the control group firms. The DID method assures that this effect is differenced out. However, there is also a *differential* effect of changes in volatility that could possibly impact our results.

If a CEO is granted options as part of his compensation contract, an increase in the volatility of oil or natural gas prices will give him an incentive not to hedge because the value of his compensation package increases with the return volatility. In contrast, CEOs who did not receive options in their compensation (i.e., the first control group) would not be affected by this regime change in oil and gas price volatility. Therefore, the differential effect of the increase in oil and gas price volatility on hedging goes against the effect of the reduction in vega due to FAS 123R.

 This differential effect could result in treated firms reducing their hedges relative to the control group firms to ride the high volatility even if CEO vega declines post-FAS 123R. On the other hand, firms without option compensation will not reduce hedges when volatility picks up. This biases us against finding any result associated with FAS 123R. However, the documented increase in hedge ratios for the treated firms relative to the control firms after FAS 123R (Figures 2 and 3 and also Tables 3 and 4) indicates that the effect of reduction in vega is strong enough that it dominates the differential effect of change of volatility.

This differential effect can also help explain the drop in hedge ratios after FAS 123R for firms included in the second control group indicated in Figure 2 and 3. These firms have on average similar CEO vegas to the treated firms. Thus, the indirect effect of the increase in oil and gas price volatility causes the drop in their hedge ratios. However the strong effect of the drop in vega following FAS 123R on the treated firms overpowers the indirect effect of the regime shift in volatility and results in an increase in hedge ratios for the treated firms post 2005. Another explanation for the decrease in hedging for the control group firms after the regulation change is the slight increase in CEO vega of these firms. Firms in both control groups experience an increase in their CEOs vega after 2005 which is illustrated in Figure 1. This increase also results in lower incentives to hedge.

There could be other possible explanations why control firms hedge less post-FAS 123R. However, as the control group is designed to pick up any trends in hedging that would be present even without the regulation change, our main results are not dependent on what caused these downward trends. As long as the downward trends affected the treatment and control firms that same (i.e. the parallel trends assumption is satisfied), we can safely conclude that increase in hedging observed in the treated firms is due to the exogenous reduction in vega. Overall, this illustrates why our DID methodology is key of identifying the affect of FAS 123R on hedging.

Finally, we screen our entire sample to check for the possibility raised by Bettis et al. (2010) that firms may have substituted stock grants with performance-based vesting provisions to reintroduce convexity in compensation contracts following FAS 123R. The presence of performance-based vesting provisions in our sample is minimal, which is consistent with the finding of Bettis et al. (2010) that such provisions are more likely in the case of firms that are complex, i.e., unlike the firms in our sample. We find that six firms in our subsample of treated firms awarded a modest level of compensation spanning the FAS 123R implementation subject to performance-based vesting provisions. Having such provisions confined only to a few of our treated firms should create bias against finding our results. Nonetheless, in untabulated work we verify that our results persist when these firms are removed from the sample.

At first glance our results seem inconsistent with Hayes, Lemmon and Qiu (2012). Using FAS 123R they investigate changes in managerial risk-taking incentives on corporate financial policies such as leverage, cash, capital expenditure and R&D. However, when we replicate their specifications (see Table 6) we do find similar results. That is we find little evidence that the adoption of FAS 123R leads to significant changes in capital expenditures, leverage or cash during the event window.[[27]](#footnote-27) This is comforting since it assures that our results regarding hedging are not an artifact of our specialized industry sample.[[28]](#footnote-28)

[Insert Table 6 here]

Our findings of a causal effect of FAS 123R on hedging are likely due to the relative ease of changing hedging policies. In contrast changes to investment and leverage policies are likely to incur higher adjustment costs (see Cooper and Haltiwanger, 2006; and Strebulaev, 2007 respectively). Therefore in our relatively short event window these differences in adjustment costs may explain why the impact of FAS 123R manifests itself in hedging rather than in other slower moving corporate variables such as those studied by Hayes et.al (2012).

**6. Conclusions**

We use the natural experimental setting afforded by the issuance of FAS 123R, and a differences-in-differences methodology, to reexamine the unresolved question of whether a change in the convexity of managerial compensation causes a corresponding change in managerial risk-taking. We focus on the causal link between stock option compensation and corporate risk management. Consistent with other studies of the effect of FAS 123R on stock option issuance, we find a sharp reduction in compensation convexity (vega) following the adoption of FAS 123R. However, we also observe a significant decline in managerial risk taking (increase in corporate hedging) following the decline in vega induced by FAS 123R, which contrasts sharply with findings for other corporate financing and investment policies.

 Our findings contribute to the literature on managerial compensation by showing that managerial stock option compensation does have a positive effect on corporate risk taking. Our findings taken in conjunction with findings in previous studies provide new insights into why different studies of the same question may arrive at different conclusions, even after controlling for the endogeneity of managerial compensation and corporate financial policies. Our findings also contribute to the corporate risk management literature by providing support for one of the fundamental pillars of corporate hedging theory.

**Appendix: Definition of Variables**

This Appendix lists all the variables used in the paper, provides their definitions and explains how they are constructed. The principal data sources are Compustat, CRSP, ExecuComp, firms’ annual reports and 10-K forms. Market data is obtained from Datastream.

**Altman’s (1968) Z-score:** Defined as: 

where *X*1 = working capital (current assets – current liabilities)/total assets; *X*2 = retained earnings/total assets; *X*3 = earnings before interest and taxes/total assets; *X*4 = market value of equity/ book value of total debt; and *X*5 = sales/total assets.

**CEO compensation delta and vega:** CEO (aggregate) compensation delta is the change in the dollar value of the executive’s wealth derived from ownership of stock and stock options in the firm when the firm’s stock price changes by one percent. CEO (aggregate) compensation vega is the change in the dollar value of the executive’s wealth derived from ownership of stock and stock options in the firm when the annualized standard deviation of the firm’s stock price changes by 0.01. We calculate the (aggregate) delta of the executive’s compensation as the sum of the deltas of the options holdings and the delta of the stock holdings. We obtain the (aggregate) vega of the executive’s compensation as the sum of the vegas of the executive’s options holdings. Following Coles, Daniel and Naveen (2006) we disregard the vega of stock holdings. The delta and vega of options holdings are calculated based on the methodology in Guay (1999) and Core and Guay (2002).[[29]](#footnote-29)

The deltas of stock and options holdings are given by:

 Delta (stock holdings) = 0.01\**S*\*number of shares owned (A.1)

  (A.2)

where *Z* = (*ln* (*S/X*) + *T* (*r - d* + σ2/2))/(σ*T 0.5*)

*S* = underlying stock price

*X* = option exercise price

*T* = time to maturity of the option (number of years)

*r* = ln [1 + risk-free interest rate]

*d* = ln [1 + expected dividend rate on the stock]

σ = annualized stock return volatility

*N =* cumulative density function for normal distribution

The vega of options holdings is given by:

  (A.3)

where *N =* probability density function for normal distribution

ExecuComp provides details on compensation packages such as size, exercise price, and time to maturity for each of the current year’s option grants, but for previously granted options (exercisable or unexercisable), it merely gives aggregate size and realizable value (the potential gains from exercising all options at the fiscal-yearend price). Core and Guay’s method is used to estimate the exercise price and time to maturity for these options so that the formulae A.2 and A.3 can be applied.

First, we directly apply the above formula to calculate the delta and vega of each current-year option grant. The delta and vega of the portfolio of newly granted options are the sum of the delta and vega of each new grant.

Then, after removing newly granted options, if any, from the fiscal year-end option portfolio, we obtain a portfolio of previously granted options only. Some of these options are exercisable (vested) and others are unexercisable (unvested). We compute the delta and vega separately for the portfolio of exercisable options and the portfolio of unexercisable options. To find the exercise price, for each portfolio, we first divide the aggregate realizable value by the number of options in the portfolio, which gives the average of (stock price – exercise price). We then subtract this number from the stock price to arrive at the average exercise price.

To estimate time to maturity, for unexercisable options, we set the average time to maturity equal to one year less than the time to maturity of the current year’s options grants, or equal to 9 years if no grant was made in the current year; for exercisable options, we set the average time to maturity equal to 4 years less than the time to maturity of the current year’s options grants, or 6 years if no grant was made in the current year. Using the imputed average exercise price and average time to maturity, we can apply the formulae A.2 and A.3 to calculate the delta and vega of the two portfolios of previously granted options. The delta and vega of an executive’s entire option portfolio is the sum of the delta and vega of the portfolio of newly granted options, the portfolio of previously granted, unexercisable options, and the portfolio of previously granted, exercisable options.

**Dividend dummy:** Equals one if a firm paid cash dividends in the given year and is zero otherwise.

**Firm size:** The natural logarithm of the market value of assets. The market value of assets equals book value of assets minus book value of common stock plus market value of equity.

**Hedging dummy**: Equals one if a firm is hedging (using derivatives) in a specific time period and is zero otherwise.

**Hedge ratio:** The hedge ratio is the fraction of the firm’s expected oil and gas production (or reserves) that it has hedged, calculated as the ratio of the portfolio delta for derivatives contracts to expected production or reserves (in barrels of oil equivalent).

**Leverage:** Calculated as the book value of long-term debt divided by the sum of book values of preferred stock, common equity, and long-term debt.

**Market-to-book ratio of assets:** Market value of assets divided by book value of assets. The market value of assets equals the book value of assets minus the book value of common stock plus market value of equity.

**Portfolio delta:** Portfolio delta is the amount of oil and gas that the firm has effectively sold short, computed as the sum of the firm’s individual derivatives positions (in barrels of oil equivalent) weighted by their respective deltas.

**Production:** Amount of oil and gas produced by the firm during the year (in barrels of oil equivalent).

**Cash**: Measure of corporate liquidity defined by the ratio: (cash + cash equivalents) / total assets.

**Reserves:** Proven reserves of oil and gas (in barrels of oil equivalent) owned by the firm at the end of the fiscal year.

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**Figure 1. Average Vegas and Option Pay Ratios**

These figures look at the time trend in CEO vega and the ratio of option pay to total pay around the adoptions of FAS 123R. We plot the average vega and option pay/total pay for 2003-2006 for both control groups (and respective treated groups). Control group 1 are firms that did not pay options prior to FAS 123R. Control group 2 are firms that adopted the fair value method prior to FAS 123R. The pre-FAS period is 2003-2004; the post-FAS 123R period is 2005-2006. Vega is defined in Appendix.

**Figure 2. Average Total Hedge Ratios**

These figures look at the time trend in hedge ratios around the adoptions of FAS 123R. We plot the average hedge ratios for 2003-2006 for both control groups (and respective treated groups). Control group 1 are firms that did not pay options prior to FAS 123R. Control group 2 are firms that adopted the fair value method prior to FAS 123R. The pre-FAS period is 2003-2004; the post-FAS 123R period is 2005-2006. Hedge ratios are defined in Appendix.

**Table 1. Summary Statistics**

The Panel A contains summary statistics for the variables used in the analysis over the entire sample period. Panel B contains summary statistics for the variables pre- and post-FAS 123R. The sample consists of 154 firm-year observations from SIC code 1311 over fiscal years 2003 through 2006 surrounding the adoption of FAS 123R. FAS 123R became effective for all firms with fiscal years beginning after December 2005. The pre-FAS 123R period is defined as fiscal years from 2003-2004 and the post-FAS 123R period is defined as fiscal years from 2005-2006. Panel C contains summary statistics for the treated and control group where control firms are firms that had no option pay prior to the adoption of FAS 123R. Panel D contains summary statistics for the treated and control group where control firms are firms that expensed options using the fair-value method prior to the adoption of FAS 123R. Variables are defined in the Appendix. \* indicates that mean or median of the variable in, the pre– and post– periods (in Panel B), control groups and treated groups (in Panel C and D), are significantly different at 10% using t-test for means and Wilcoxon signed rank sum test for medians.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Panel A: Full Sample** |  |  |  |  |  |
|  | Mean | Standard Deviation | 25th Percentile | Median | 75th Percentile |
| Delta | 402.608 | 670.809 | 59.313 | 168.710 | 598.309 |
| Vega | 110.693 | 274.185 | 12.013 | 55.025 | 152.363 |
| Total Pay | 7,551.222 | 13,107.54 | 1539 | 3,650.94 | 6,809.03 |
| Option Pay | 1,752.464 | 5405.1 | 0 | 305.8505 | 1,384.905 |
| Stock Pay | 2,629.691 | 5,605.117 | 0 | 791 | 2100 |
| Equity Pay | 5,075.47 | 10,751.74 | 672.787 | 2,122.28 | 4,825.344 |
| Cash Pay | 2,153.839 | 4,277.482 | 600 | 1,265.83 | 2275 |
| Option Pay/Total Pay | 0.232 | 0.182 | 0.00 | 0.149 | 0.330 |
| Stock Pay/Total Pay | 0.348 | 0.252 | 0.00 | 0.242 | 0.455 |
| Equity Pay/Total Pay | 0.672 | 0.240 | 0.447 | 0.580 | 0.793 |
| Cash Pay | 0.285 | 0.240 | 0.209 | 0.424 | 0.556 |
| Hedge Ratio 1 | 0.236 | 0.393 | 0.011 | 0.086 | 0.344 |
| Hedge Ratio 2 | 0.022 | 0.032 | 0.001 | 0.009 | 0.030 |
| Hedge Dummy | 0.821 | 0.385 | 0 | 1 | 1 |
| Size | 7.893 | 1.297 | 7.001 | 7.604 | 8.802 |
| ROA | 0.077 | 0.067 | 0.046 | 0.073 | 0.105 |
| Investment Growth | 0.215 | 0.101 | 0.146 | 0.198 | 0.271 |
| Altman-Z | 2.547 | 1.303 | 1.604 | 2.350 | 3.063 |
| Leverage | 0.239 | 0.124 | 0.167 | 0.242 | 0.329 |
| Dividend | 0.546 | 0.499 | 0 | 1 | 1 |
| Cash | 0.046 | 0.085 | 0.003 | 0.012 | 0.049 |

**Table 1 -- *continued***

|  |  |
| --- | --- |
| **Panel B: Pre- and post- periods** |  |
|  | Pre-FAS 123R (2003-2004) | Post-FAS 123R (2005-2006) |
|  | Mean | Median | N | Mean | Median | N |
| Delta | 349.245 | 158.16 | 80 | 438.290\* | 171.917\* | 74 |
| Vega | 125.183 | 74.271 | 80 | 92.292\* | 45.224\* | 74 |
| Option Pay/Total Pay | 0.294 | 0.206 | 80 | 0.164\* | 0.116\* | 74 |
| Total Pay | 6,281.33 | 2,745.74 | 80 | 9,028.90\* | 4,543.97\* | 74 |
| Hedge Ratio 1 | 0.233 | 0.084 | 80 | 0.244 | 0.094 | 74 |
| Hedge Ratio 2 | 0.017 | 0.007 | 80 | 0.028\* | 0.015\* | 74 |
| Size | 7.649 | 7.405 | 80 | 8.192\* | 7.863\* | 74 |
| ROA | 0.073 | 0.073 | 80 | 0.081 | 0.081 | 74 |
| Investment Growth | 0.212 | 0.188 | 80 | 0.218 | 0.219\* | 74 |
| Altman-Z | 2.572 | 2.350 | 80 | 2.516 | 2.307 | 74 |
| Leverage | 0.254 | 0.246 | 80 | 0.222 | 0.236 | 74 |
| Dividend | 0.562 | 1 | 80 | 0.527 | 1 | 74 |
| Cash | 0.043 | 0.013 | 80 | 0.049 | 0.011 | 74 |

|  |
| --- |
| **Table 1 -- *continued*****Panel C: Control Group 1 – No options pay in Pre-FAS 123R** |
|  | Control Group | Treated Group |
|  | Mean | Median | N | Mean | Median | N |
| Delta | 292.913 | 139.437 | 36 | 440.265 | 182.494 | 118 |
| Vega | 27.420 | 0.000 | 36 | 139.758\* | 104.599\* | 118 |
| Option Pay/Total Pay | 0.024 | 0 | 36 | 0.284\* | 0.268\* | 118 |
| Total Pay | 4,952.77 | 3,814.53 | 36 | 8,548.30\* | 3,346.23 | 118 |
| Hedge Ratio 1 | 0.197 | 0.063 | 36 | 0.220 | 0.099 | 118 |
| Hedge Ratio 2 | 0.017 | 0.004 | 36 | 0.023 | 0.012\* | 118 |
| Size | 8.348 | 8.338 | 36 | 7.633\* | 7.901 | 118 |
| ROA | 0.078 | 0.082 | 36 | 0.081 | 0.078 | 118 |
| Investment Growth | 0.189 | 0.188 | 36 | 0.203 | 0.1865 | 118 |
| Altman-Z | 2.307 | 2.459 | 36 | 2.363 | 2.658 | 118 |
| Leverage | 0.217 | 0.187 | 36 | 0.236 | 0.251\* | 118 |
| Dividend | 0.666 | 1 | 36 | 0.531 | 1 | 118 |
| Cash | 0.022 | 0.009 | 36 | 0.054\* | 0.015\* | 118 |
| **Panel D: Control Group 2 - Expensed Option pay using fair-value method in Pre-FAS 123R** |
|  | Control Group | Treated Group |
|  | Mean | Median | N | Mean | Median | N |
| Delta | 290.672 | 116.719 | 26 | 436.908 | 176.912 | 128 |
| Vega | 110.263 | 86.757 | 26 | 110.827 | 39.363 | 128 |
| Option Pay/Total Pay | 0.246 | 0.239 | 26 | 0.218 | 0.118\* | 128 |
| Total Pay | 5,212.04 | 4,577.64 | 26 | 8,375.25 | 2,787.07 | 128 |
| Hedge Ratio 1 | 0.206 | 0.098 | 26 | 0.217 | 0.083 | 128 |
| Hedge Ratio 2 | 0.018 | 0.008 | 26 | 0.023 | 0.007 | 128 |
| Size | 8.459 | 8.091 | 26 | 7.937\* | 7.604 | 128 |
| ROA | 0.080 | 0.082 | 26 | 0.080 | 0.079 | 128 |
| Investment Growth | 0.188 | 0.185 | 26 | 0.204 | 0.189 | 128 |
| Altman-Z | 2.146 | 2.119 | 26 | 2.704\* | 2.505\* | 128 |
| Leverage | 0.244 | 0.240 | 26 | 0.227 | 0.241 | 128 |
| Dividend | 0.647 | 1 | 26 | 0.540 | 1 | 128 |
| Cash | 0.027 | 0.012 | 26 | 0.051 | 0.013 | 128 |

**Table 2. Differences-in-Differences Regressions: Vegas and Deltas**

This table contains the results of estimating differences-in-differences (DID) regressions to investigate to effect of FAS 123R on delta and vega. The dependent variable in all specifications is vega. *Post-FAS 123R* is an indicator variable equal to one if the observation is after the adoption of FAS 123R. *Treated* is an indicator variable that is one if the observation is part of the treated group. *Treated* is equal to zero if the firm if in the control group. *Control Group 1* are firms that did not have option pay prior to FAS 123R. *Control Group 2* are firms that adopted the fair value method prior to FAS 123R. *Treated \*Post-FAS 123R* is the DID estimate. The table reports p-values in parentheses. All p-values are computed with standard errors clustered at the firm level. The notation \*\*\*, \*\* and \* denote statistical significance at the 1%, 5% and 10% level, respectively. The variables are defined in the Appendix.

|  |  |  |
| --- | --- | --- |
|  | Control Group 1 | Control Group 2 |
|  | Delta | Vega | Delta | Vega |
| Post-FAS 123R | -205.151 | -22.995 | -149.705 | 16.541 |
| (0.176) | (0.564) | (0.310) | (0.714) |
| Treated | 111.421 | 143.652\*\*\* | 418.040\*\*\* | 52.448 |
| (0.349) | (0.000) | (0.001) | (0.187) |
| Treated \*Post-FAS 123R | 158.881 | -62.567\* | 72.810 | -109.447\*\* |
| (0.347) | (0.094) | (0.667) | (0.036) |
| Delta |  | 0.071\*\*\* |  | 0.085\*\*\* |
|  | (0.004) |  | (0.002) |
| Investment Growth | 2,391.744\*\*\* | 64.459 | 2,308.899\*\*\* | 67.437 |
| (0.001) | (0.667) | (0.001) | (0.677) |
| Size | 310.557\*\*\* | 41.461\*\*\* | 369.657\*\*\* | 39.514\*\* |
| (0.000) | (0.004) | (0.000) | (0.015) |
| Leverage | 414.705 | 160.966\* | 725.919\*\* | 299.039\*\* |
| (0.440) | (0.087) | (0.134) | (0.046) |
| ROA | -663.771 | -265.357 | -427.497 | -256.986 |
| (0.422) | (0.222) | (0.575) | (0.272) |
| Altman-Z | 57.025 | 33.393\*\* | 52.796 | 43.643\*\* |
| (0.371) | (0.048) | (0.365) | (0.016) |
| Cash | 1,146.886 | -157.243 | 1,423.936\*\* | -99.331 |
| (0.134) | (0.434) | (0.044) | (0.648) |
| Dividend | 186.486\* | 46.205\* | 107.841 | 27.370 |
| (0.053) | (0.071) | (0.230) | (0.320) |
| Constant | -2,911.423\*\*\* | -459.035\*\*\* | -3,641.213\*\*\* | -436.978\*\* |
| (0.000) | (0.001) | (0.000) | (0.012) |
| Adj-R2 | 0.448 | 0.4309 | 0.525 | 0.397 |
| N | 154 | 154 | 154 | 154 |

**Table 3. Differences-in-Differences Regressions: No option pay in Pre-FAS 123R**

**(Control Group 1)**

This table contains the results of estimating differences-in-differences (DID) regressions to investigate to effect of FAS 123R on corporate hedging. We take the average of each variable for each firm pre- and post-FAS 123R. *Post-FAS 123R* is an indicator variable equal to one if the observation is after the adoption of FAS 123R. *Treated* is an indicator variable that is one if the observation is part of the treated group i.e. firms that did not have option pay prior to the adoption of FAS 123R. *Treated* is equal to zero if the firm if in the control group i.e. did not pay options prior to FAS 123R. *Treated \*Post-FAS 123R* is the DID estimate. The table reports p-values in parentheses. All p-values are computed with standard errors clustered at the firm level. The notation \*\*\*, \*\* and \* denote statistical significance at the 1%, 5% and 10% level, respectively. The variables are defined in Appendix.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Hedge Ratio 1 | Hedge Ratio 1 | Hedge Ratio 2 | Hedge Ratio 2 |
| Post-FAS 123R | -0.050 | -0.060 | 0.004 | -0.001 |
| (0.489) | (0.580) | (0.672) | (0.975) |
| Treated | -0.023 | -0.068 | -0.002 | -0.001 |
| (0.671) | (0.396) | (0.706) | (0.848) |
| Treated \*Post-FAS 123R | 0.136\* | 0.191\* | 0.009 | 0.020\* |
| (0.098) | (0.096) | (0.174) | (0.094) |
| Delta |  | 0.001\* |  | 0.000 |
|  | (0.067) |  | (0.956) |
| Investment Growth |  | -0.888\*\*\* |  | -0.042 |
|  | (0.001) |  | (0.308) |
| Size |  | -0.038 |  | -0.002 |
|  | (0.233) |  | (0.618) |
| Leverage |  | 0.388 |  | -0.001 |
|  | (0.275) |  | (0.878) |
| ROA |  | -0.007 |  | -0.032 |
|  | (0.988) |  | (0.590) |
| Altman-Z |  | -0.038 |  | -0.003 |
|  | (0.356) |  | (0.448) |
| Cash |  | -0.995\*\* |  | -0.079 |
|  | (0.047) |  | (0.160) |
| Dividend |  | -0.106\* |  | -0.004 |
|  | (0.090) |  | (0.554) |
| Constant | 0.22\*\*\* | 0.87\*\* | 0.01\*\* | 0.05 |
| (0.001) | (0.013) | (0.034) | (0.107) |
| Adj-R2 | 0.031 | 0.171 | 0.028 | 0.068 |
| N | 154 | 154 | 154 | 154 |

**Table 4. Differences-in-Differences Regressions: Fair Value Method Prior to FAS 123R (Control Group 2)**

This table contains the results of estimating differences-in-differences regressions to investigate to effect of FAS 123R on corporate hedging. We take the average of each variable for each firm pre- and post-FAS 123R. *Post-FAS 123R* is an indicator variable equal to one if the observation is after the adoption of FAS 123R. *Treated* is an indicator variable that is one if the observation is part of the treated group i.e. firms that did not adopt the fair value method for valuing options prior to the adoption of FAS 123R. *Treated* is equal to zero if the firm if in the control group i.e. did preemptively adopt the fair value method prior to FAS 123R. *Treated \*Post-FAS 123R* is the DID estimate. The table reports p-values in parentheses. All p-values are computed with standard errors clustered at the firm level. The notation \*\*\*, \*\* and \* denote statistical significance at the 1%, 5% and 10% level, respectively. The variables are defined in Appendix.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Hedge Ratio 1 | Hedge Ratio 1 | Hedge Ratio 2 | Hedge Ratio 2 |
| Post-FAS 123R | -0.142 | -0.067 | -0.009 | -0.007 |
| (0.128) | (0.514) | (0.318) | (0.670) |
| Treated | -0.099 | -0.041 | -0.008 | -0.001 |
| (0.194) | (0.643) | (0.298) | (0.891) |
| Treated \*Post-FAS 123R | 0.224\*\* | 0.195\* | 0.021\*\*\* | 0.020\*\* |
| (0.023) | (0.083) | (0.009) | (0.019) |
| Delta |  | 0.000 |  | 0.000 |
|  | (0.189) |  | (0.576) |
| Investment Growth |  | -0.988\*\*\* |  | -0.031 |
|  | (0.002) |  | (0.463) |
| Size |  | -0.028 |  | 0.001 |
|  | (0.434) |  | (0.877) |
| Leverage |  | 0.459 |  | 0.012 |
|  | (0.177) |  | (0.749) |
| ROA |  | -0.005 |  | -0.028 |
|  | (0.992) |  | (0.636) |
| Altman-Z |  | -0.035 |  | -0.002 |
|  | (0.379) |  | (0.527) |
| Cash |  | -0.888\* |  | -0.0571 |
|  | (0.076) |  | (0.304) |
| Dividend |  | -0.097 |  | -0.004 |
|  | (0.123) |  | (0.555) |
| Constant | 0.27\*\*\* | 0.74\* | 0.02\*\*\* | 0.03 |
| (0.001) | (0.062) | (0.001) | (0.516) |
| Adj-R2 | 0.039 | 0.181 | 0.082 | 0.110 |
| N | 154 | 154 | 154 | 154 |

**Table 5. Changes around the regulation event**

This table contains the results of estimating difference regressions around the adoption of FAS 123R. All variables are the differences of the average pre and post-FAS 123R values. The table reports p-values in parentheses. All p-values are computed with standard errors clustered at the firm level. The notation \*\*\*, \*\* and \* denote statistical significance at the 1%, 5% and 10% level, respectively. The variables are defined in Appendix.

|  |  |  |
| --- | --- | --- |
|  | Hedge Ratio 1 | Hedge Ratio 2 |
| d(vega) | -0.001\* |  |  | -0.0001\*\* |
| (0.068) |  |  | (0.019) |
| d(delta) | -0.000 |  |  | -0.000 |
| (0.996) |  |  | (0.969) |
| d(InvGrowth) | -0.529\* |  |  | -0.019 |
| (0.066) |  |  | (0.472) |
| d(Size) | 0.047 |  |  | 0.004 |
| (0.184) |  |  | (0.185) |
| d(Leverage) | 0.769\*\* |  |  | 0.047 |
| (0.035) |  |  | (0.128) |
| d(ROA) | 0.174 |  |  | 0.010 |
| (0.622) |  |  | (0.765) |
| d(Altman-Z) | 0.008 |  |  | 0.001 |
| (0.816) |  |  | (0.896) |
| d(Cash) | -0.337 |  |  | -0.040 |
| (0.502) |  |  | (0.369) |
| d(Dividend) | -0.011 |  |  | -0.000 |
| (0.870) |  |  | (0.992) |
| Constant | -0.157 |  |  | -0.012 |
| (0.662) |  |  | (0.718) |
| Adj-R2 | 0.164 |  |  | 0.132 |
| N | 46 |  |  | 46 |
|  |

**Table 6. Differences-in-Differences Regressions: Changes in Investment and Financing Policies around FAS 123R**

This table contains the results of estimating differences-in-differences regressions to investigate to effect of FAS 123R on corporate investment and financing policies. We take the average of each variable for each firm pre- and post-FAS 123R. *Post-FAS 123R* is an indicator variable equal to one if the observation is after the adoption of FAS 123R. *Treated* is an indicator variable that is one if the observation is part of the treated group i.e. firms that did not have option pay prior to the adoption of FAS 123R. When using Control Group 1, *Treated* is equal to zero if the firm if in the control group i.e. did not pay options prior to FAS 123R. When using Control Group 2, *Treated* is equal to zero if the firm if in the control group i.e. did preemptively adopt the fair value method prior to FAS 123R. *Treated \*Post-FAS 123R* is the DID estimate. The table reports p-values in parentheses. All p-values are computed with standard errors clustered at the firm level. The notation \*\*\*, \*\* and \* denote statistical significance at the 1%, 5% and 10% level, respectively. The variables are defined in Appendix.

|  |  |  |
| --- | --- | --- |
|  | Control Group 1 | Control Group 2 |
|  | CAPEX | Leverage | Cash | CAPEX | Leverage | Cash |
| Post-FAS 123R | 0.003 | -0.066\*\* | -0.005 | 0.004\* | -0.043 | 0.011 |
| (0.770) | (0.019) | (0.791) | (0.057) | (0.127) | (0.555) |
| Treated | -0.013 | 0.014 | 0.004 | -0.021 | -0.029 | -0.122 |
| (0.106) | (0.511) | (0.785) | (0.338) | (0.231) | (0.453) |
| Treated \*Post-FAS 123R | 0.017 | 0.058\* | 0.019 | 0.013 | 0.031 | -0.000 |
| (0.134) | (0.071) | (0.386) | (0.651) | (0.338) | (0.989) |
| Delta | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.00001\* |
| (0.198) | (0.488) | (0.220) | (0.177) | (0.178) | (0.081) |
| Investment Growth |  | 0.091 | -0.252 |  | 0.076 | -0.260 |
|  | (0.722) | (0.145) |  | (0.771) | (0129) |
| Sales Growth | 0.090\*\*\* |  |  | 0.083\*\*\* |  |  |
| (0.002) |  |  | (0.001) |  |  |
| Size | -0.003 | -0.021\*\* | -0.009 | -0.031 | -0.029\*\*\* | -0.013\*\* |
| (0.210) | (0.011) | (0.113) | (0.174) | (0.003) | (0.049) |
| Leverage | 0.102 |  | -0.034\* | 0.137 |  | -0.014 |
| (0.764) |  | (0.078) | (0.719) |  | (0.817) |
| ROA | 0.051 | -0.159 | -0.220 | 0.043 | -0.180 | -0.229 |
| (0.329) | (0.266) | (0.210) | (0.410) | (0.223) | (0.018) |
| Altman-Z | -0.000 | -0.068\*\*\* | 0.035\*\*\* | -0.001 | -0.067\*\*\* | 0.037\*\*\* |
| (0.873) | (0.000) | (0.000) | (0.908) | (0.000) | (0.000) |
| Cash | -0.021\* | -0.074 |  | -0.022 | -0.032 |  |
| (0.075) | (0.591) |  | (0.651) | (0.817) |  |
| Dividend | -0.004\* | 0.007 | -0.017 | -0.002\* | 0.010 | -0.016 |
| (0.064) | (0.665) | (0.130) | (0.084) | (0.549) | (0.162) |
| Constant | 0.044 | 0.553\*\*\* | 0.109\* | 0.036 | 0.641\*\*\* | 0.142\*\* |
| (0.184) | (0.000) | (0.078) | (0.254) | (0.000) | (0.046) |
| Adj-R2 | 0.39 | 0.57 | 0.47 | 0.40 | 0.54 | 0.48 |
| N | 154 | 154 | 154 | 154 | 154 | 154 |

1. \* We have benefited from a valuable conversation with Jeff Coles. We thank Alex Dawotola, Seth Hoelscher, Jonathan Krummel, and Tim Lueking for help with data collection. We are responsible for all errors. [↑](#footnote-ref-1)
2. Our sample includes firms in the oil and gas industry with SIC code of 1311 in Compustat. [↑](#footnote-ref-2)
3. It is important to note that while we focus on CEO vega in our reported results, in unreported work we verify that FAS 123R had a similar effect on other executives’ compensation packages including CFOs. Therefore, our results capture the effect of changes not only in CEO vega but also in other executives’ vega on firm hedging activities. [↑](#footnote-ref-3)
4. We screen our sample to check the possibility raised by Bettis et al. (2010) that some firms may have offset a post-FAS 123R reduction in option compensation with performance-vesting stock grants that re-introduce convexity. The presence of performance-vesting compensation provisions in our sample is minimal. Additionally, such provisions are confined only to a few of our treated firms, which should bias against finding our results. Nonetheless, we verify that our results persist when these firms are removed from the sample. [↑](#footnote-ref-4)
5. Gormley, Matsa and Milbourn (2012) also study managerial compensation and corporate risk-taking but argue against using FAS 123R as a natural experiment since some firms voluntarily expensed stock options well in advance of FAS 123R, whereas we exploit this specific feature of our sample to create one of our control groups in our DID estimation. Using an alternate natural experiment -- the exogenous increase in business risk due to exposure to carcinogens – they obtain results that are consistent with Chava and Purnanandam (2010) by showing that managers with less convexity in their compensation contracts tend to reduce leverage and R&D while increasing cash holding after an increase in firm risk. [↑](#footnote-ref-5)
6. In the internet appendix, Hayes, Lemmon and Qiu (2012) use a control group similar to one of our two control groups to run a DID specification. [↑](#footnote-ref-6)
7. These results suggest that our sample is not systemically different from the larger sample studied by Hayes, Qiu and Lemmon (2012). [↑](#footnote-ref-7)
8. As observed in Cooper and Haltiwanger (2006) and Strebulaev (2007) this likely due to the sizable adjustment costs associated with changes in leverage and capital expenditure. [↑](#footnote-ref-8)
9. Studies such as Cheng and Warfield (2005); Bergstresser and Philippon (2006); Burns and Kedia (2006, 2008); Peng and Roell (2008); Denis et al. (2006) have showed that holding of stock options by managers is associated with manipulation of corporate earnings and accounting fraud aiming at boosting market valuations in the short run, allowing managers to exercise options at the inflated stock price. [↑](#footnote-ref-9)
10. Accounting Principles Board is the predecessor organization of the Financial Accounting Standards Board (FASB) which established Generally Accepted Accounting Standards (GAAP). [↑](#footnote-ref-10)
11. See Hayes, Lemmon and Qiu (2012) for a comprehensive assessment of how other equity-based compensation such as Restricted Stock Units (RSU) and equity awards with performance-based vesting conditions were affected by FAS 123R. [↑](#footnote-ref-11)
12. Ideally we would select a control group with zero total outstanding stock options in 10 years prior to FAS 123R. However, no firm satisfies this requirement in our sample. Given these data limitations, for our control group we select a subsample of firms that issue zero stock options in 2004 and 2005. We view these firms as a control group that is "relatively" unaffected by FAS 123R. This is a fair assumption given that a significant portion of total vega is due to option grants awarded in the current year. Of course we acknowledge the fact that these firms have some outstanding stock options and are thus not the perfect control group.  [↑](#footnote-ref-12)
13. Carter et al. (2007) show that firms choosing to voluntarily expense stock option grants prior to FAS 123Rdecreased their use of options and increased their use of restricted stock following their expensing decisions. Therefore, to ensure that the control firms are not in transition of adjusting their corporate policies in response to changes in CEO compensation vega, we use firms that "started" to voluntarily expense stock option grants in 2002. [↑](#footnote-ref-13)
14. Nonetheless, as we discuss later, we screen our entire sample of firms for the presence of performance-based vesting provisions in their CEO and CFO compensation. [↑](#footnote-ref-14)
15. For both hedge ratios, for robustness we use 1-year hedge ratios where the hedge horizons are only one year. Our results remain unchanged. [↑](#footnote-ref-15)
16. Because of our small sample size we winsorize at 5th and 95th percentiles instead of 1st and 95th percentiles. [↑](#footnote-ref-16)
17. Compensation data for 120 of these firm-year observations is from ExecuComp. We hand-collect compensation data for the remaining 34 firm-year observations from proxy statements. [↑](#footnote-ref-17)
18. Aboody, Barth, and Kasznik (2004) investigate firms’ decisions to voluntarily adopt fair-value method for accounting of compensation expense. Their results show that firms that adopt FAS 123R prior to 2005 vary along several dimensions such as the extent of participation in the capital markets, the private incentives of executives and the board of directors and the level of information asymmetry. If these differences are correlated with hedging outcomes it could bias our results. However, we feel that this is unlikely to be an issue in our study. This is because our analysis centers on one industry and our firms are therefore more homogenous along these dimensions compared to the firms in Aboody et al. (2004). [↑](#footnote-ref-18)
19. We also compare firm-characteristics in just the pre-treatment period for both control groups and treated groups to make sure that prior to the regulation change the two groups are similar. The results are largely unchanged. [↑](#footnote-ref-19)
20. Our results are robust to changing the horizons of the pre-and post-treatment periods. However, by making the pre-treatment period longer (e.g., 3 years) the number of firms which did not grant any options to their CEOs in that period drops significantly which leads to the first control group being small and more different than the treated group. [↑](#footnote-ref-20)
21. In unreported results we repeat this regression substituting the ratio of option pay to total pay for vega. We find that FAS 123R significantly reduced option pay for treated firms. [↑](#footnote-ref-21)
22. These results are consistent with Carter et al. (2007) and Lemmon et al. (2012) who show that financial reporting costs play an important role on the design of executive compensation contracts. [↑](#footnote-ref-22)
23. This type of falsification test is recommended in the survey paper by Roberts and Whited (2012). [↑](#footnote-ref-23)
24. Arguably CFOs rather than CEOs could be in charge of corporate risk management. Therefore, it is important to note that FAS 123R had similar effect on other executives’ compensation packages. While in Table 2 we focus on CEO vega, in untabulated results we find that CFO vegas also drop post-FAS 123R. Nevertheless, the results in Table 3 captures the effect of changes in not only CEO vega but also in other executives vega on firm hedging activities. [↑](#footnote-ref-24)
25. In untabulated results we examine different specifications for the control variables and find that our results are largely unchanged. [↑](#footnote-ref-25)
26. The figures are based on average monthly standard deviations of natural gas prices (dollars per thousand cubic feet) and oil prices (dollars per barrel). [↑](#footnote-ref-26)
27. Using control group 1 we find that the coefficient in the leverage regression is positive and significant at the 10% level; however, the sign of the coefficient is opposite to what would be expected under our hypothesis. [↑](#footnote-ref-27)
28. In untabulated results we also run the exact first difference specification in Hayes et al. (2012) and find similar results. [↑](#footnote-ref-28)
29. Following the convention in previous studies, while all the delta and vega measures we use in our analysis are aggregates over the executive’s entire holdings in the firm, we omit using the qualifier “aggregate” when referring to compensation deltas and vegas elsewhere in the paper. [↑](#footnote-ref-29)