

Minor, Dylan

Working Paper

Shadow risks and disasters

CSIO Working Paper, No. 0127

Provided in Cooperation with:

Department of Economics - Center for the Study of Industrial Organization (CSIO), Northwestern University

Suggested Citation: Minor, Dylan (2014) : Shadow risks and disasters, CSIO Working Paper, No. 0127, Northwestern University, Center for the Study of Industrial Organization (CSIO), Evanston, IL

This Version is available at:

<https://hdl.handle.net/10419/142002>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

THE CENTER FOR THE STUDY
OF INDUSTRIAL ORGANIZATION
AT NORTHWESTERN UNIVERSITY

Working Paper #0127

Shadow Risks and Disasters

By

Dylan Minor

Kellogg School of Management, Northwestern University

February 2014

SHADOW RISKS AND DISASTERS*

Dylan Minor

Kellogg School of Management, Northwestern University

February 2014

Abstract

We explore the relationship between incentives and Shadow Risks—those risks that are not easily captured by common financial measures and yet can lead to major adverse events. Theoretically, increased risk-taking is non-monotonic in higher powered executive compensation. However, for those settings where risky failures are high-stakes—e.g., potential environmental disasters and accounting scandals—the relationship is positive. We test these predictions for environmental and financial accounting failures of large US firms and find that changing CEO equity compensation from 100% stocks to 100% options can increase the odds of an event by 40-60% and the magnitude of such events by over 100%. The effectiveness of policies such as Sarbanes-Oxley and FAS123R in reducing Shadow Risk-taking are discussed.

Keywords: executive compensation, corporate governance, managerial risk-taking, environmental law, accounting law, misconduct, financial crisis

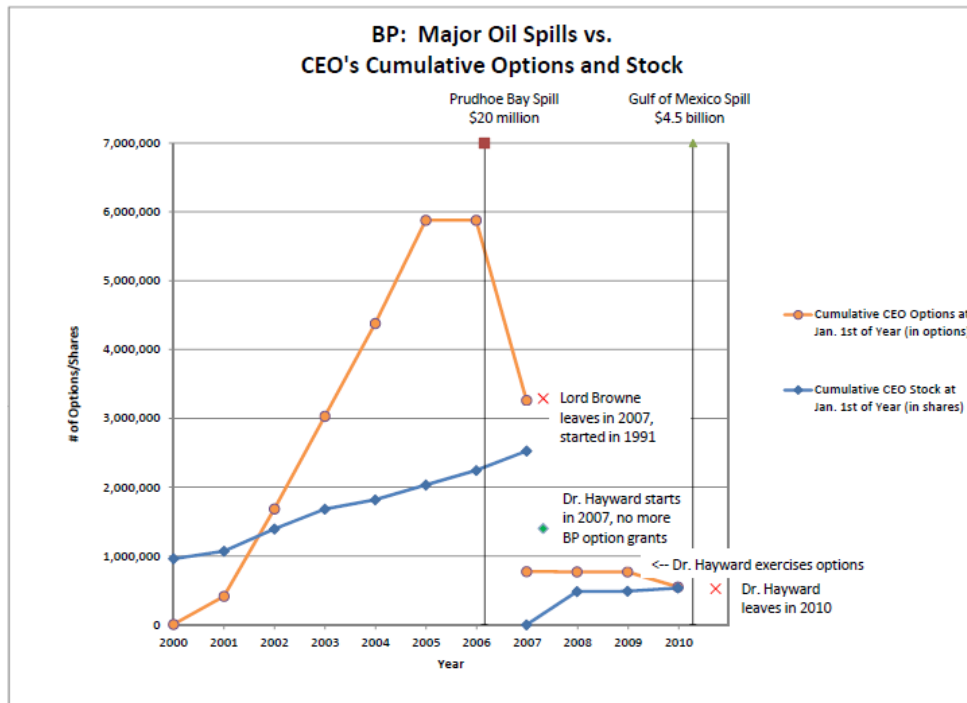
*I thank Jennifer Brown, Georgy Egorov, Mitchell Hoffman, Michelle Lowry, David Matsa, Nicola Persico, Max Schanzbach, and Jun Yang for their helpful comments. Also thanked are the participants at American Law and Economics Association Meetings, Conference on Empirical Legal Studies, the CRES workshop (Washington University, St. Louis), Institutions and Innovation conference (Harvard Business School), Natural Experiments Workshop (Munich), and seminar participants at the Kellogg School of Management and Northwestern Law School. I thank Jared Petravicius for his excellent research assistance and the Ford Center for Global Citizenship for financial support of the project.

"An accident waiting to happen..." Nancy Leveson, member BP investigation panel and MIT (commenting on the BP Gulf of Mexico spill)

"An accident waiting to happen..." Alan Greenspan, former Federal Reserve Chariman (commenting on the financial crisis of 2007-2008)

Executive compensation has come under intense criticism in recent years. Some argue that typical levels of executive pay relative to their firm's other workers is excessive. However, more recently, criticism has suggested that compensation has not only been gratuitous, but that it has also contributed to disasters such as the recent financial crisis and major oil spills.

The Financial Crisis Inquiry Commission (2011) claims that the compensation systems for the "corporate boardroom" regularly incentivized the "big bet" by providing enormous rewards for obtaining financial gains while providing few penalties for avoiding losses, thus contributing to the 2007-2008 financial crisis. Another dramatic example is provide by British Petroleum (BP). Figure 1 reports the cumulative award of options and stocks for BP CEOs Lord Browne and Tony Hayward, both of whose careers ended with a spectacular oil spill. In the case of the former, shares of stocks, and especially shares of options, reached a pinnacle just before the Prudhoe Bay oil spill. Following this disaster, Tony Hayward took over as CEO and began with a large number of options and stock. He would very soon oversee the massive Gulf of Mexico spill, though he did sell a sizable portion of his options just before the spill. An important question is if these kinds of examples are merely suggestive or if there is indeed something deeper at work.



In this paper, we explore the creation of Shadow Risks. That is, those risks that are difficult to capture via traditional financial measures and yet can result in a disaster or a scandal. Despite popular sentiment, it is not obvious *a priori* how equity compensation might affect such Shadow Risk-taking. There has been much work exploring the relationship of equity compensation—both option and stock awards—and managerial risk-taking, where risk-taking is often captured by some financial measure. Both the empirical and theoretical literature provide contradictory evidence on the relationships. Early theoretical work suggests that increased equity compensation in the form of options will increase managerial risk-taking. These arguments appear as early as Jensen and Meckling (1976) and Myers (1977). However, more recently some have argued that increased options can *reduce* risk-taking. For example, Lambert et al. (1991) argue that the leveraged feature of options can reduce managers' appetite for risk. Kadan and Swinkels (2008) show that when including

managerial effort, risk-taking might be reduced as options are increased. In terms of empirical findings, most recently, Gormley et al. (2012) use a natural experiment to find that reduced exposure to options yields reduced risk-taking on several financial dimensions. Guay (1999) show that firms' stock return volatility is linked to increased options. Frydman and Jenter (2010) provide a survey of many more such papers that generally find increased options result in increased financial risk-taking. However, for risk-taking on the dimension of non-financial risk-taking—e.g., earnings manipulation—the empirical literature is divided on whether it is stocks or options (or neither) that increases such risk-taking (see Frydman and Jenter (2010) and cites therein).

The extant work on incentives and risk-taking often considers risk-taking on dimensions such as cash holdings, firm leverage, R&D investment or diversifying acquisitions (see Coles et al. (2006)). However, compared with inducing a manager to take on these standard types of risks, inducing a manager to increase Shadow Risk has two at least two important differences. First, it is likely more difficult to contract with a manager on her level of environmental risk-taking, for example, compared with other financial-based measures of risk. Second, when a Shadow Risk results in a large failure—i.e., some disaster or scandal occurs—it can be very costly to the CEO. In the extreme, such a CEO may have her labor market opportunity severely damaged, as well as face incarceration and large regulatory penalties. Thus, the manager potentially faces a large punishment, and it is often administered outside the scope of the firm.

We formally consider how a CEO engages in Shadow Risks as a function of executive compensation. In particular, A CEO can choose a risky project that provides a greater upside compared with a safer project; however, the risky project also carries a worse downside, should the project fail. The executive's willingness to take on the riskier project is motivated by the *composition* of equity compensation: options and stocks differentially affect executive risk-taking. We argue that the underlying level of risk-taking decided by the firm determines the structure of executive compensation, which in turn affects the nature of projects chosen and thus induces a given level of Shadow Risk-taking.

The more extreme levels of Shadow Risk-taking that result in failure become known as disasters or scandals. For example, in the case of BP, the immediate government fine for its Prudhoe Bay spill was \$20 million, and additional costs far exceeded this amount. The primary cause of the spill was deemed to be poorly maintained pipes. This allegedly arose from BP’s dogmatic adherence to cost cutting, which was incentivized by the CEO’s implementation of cost cutting incentives for top managers. Prosecutors estimated that such subpar maintenance saved the firm some \$9.6 million.¹ Hence, the firm was enjoying a higher payoff until the CEO’s choice of high risk-taking (i.e., inducing low maintenance levels) resulted in a failed risky project. However, this risk-taking was not readily quantified by non-insiders until after failure.

We identify a simple ratio that we refer to as P that captures the nature of executive pay incentives. We find that the relationship between P and risk-taking—both in terms of magnitude and incident rate—is non-monotonic. In particular, for low-stakes settings, where project failures carry lesser consequences, there is a negative relationship between P and magnitude of failures. In contrast, for larger-stakes failures that carry large consequences for the firm and the CEO, the relationship becomes positive. In particular, CEOs presiding over larger and more-frequent disasters and scandals should also be the ones receiving a higher P compensation structure.

We test these predictions empirically for the setting of environmental failures for the largest US public firms. We find that changing equity pay consisting of 0% in options (i.e., which means 100% of equity pay in stock) to 100% in options results in a CEO’s firm facing 42 – 65% increased odds of an environmental incident. In addition, such change in compensation is linked to close to a 100% increase in the magnitude of environmental failures, as measured by total government fines. To our knowledge, this is the first paper to link equity compensation and environmental risk-taking. To test the ratio P in another setting, we explore the relationship between compensation structure and the likelihood of suspected accounting misconduct and

¹Associated Press via MSNBC News on 11/29/2007. Available at: http://www.msnbc.msn.com/id/22014134/ns/business-oil_and_energy/t/bp-pleads-guilty-alaska-oil-spill/

negative earnings restatements; the findings for this setting are similar to those in the environmental risk-taking setting. We also find evidence that these effects come at least partially from incentive rather than selection effects. Finally, we explore the effects of two policies on Shadow Risk-taking.

The balance of the paper is organized as follows. The next section provides our model and primary empirical predictions. Our following section provides our empirical analysis of executive compensation and environmental and accounting failures. Our final section concludes and provides some policy implications.

1 Shadow Risk-Taking

Our model is most similar in spirit to that of Edmans and Liu (2011) who assume that a firm must incentivize its manager via debt and stock. Instead, we consider the two instruments of stocks and options. In addition, whereas they explore contract type as a function of the nature of the firm, we have a different task of linking compensation structure to the outcomes of failures, both in terms of frequency and magnitude.

In our setting, the CEO must choose between a risky project R and a safer project S . Let p be the probability project R (S) succeeds with the firm being worth V_{RS} (V_{SS}) and $1 - p$ chance it fails, providing firm value of V_{RF} (V_{SF}). We could have different p 's for each project type. However, instead, we can simply redefine the firm value outcomes to make it equivalent to having the same p for both R and S . Thus, to simplify exposition, we assume that we have the same p for both project types. We also assume V_{RF} is a random variable whose realization is only observable by the CEO and is drawn from some commonly known uniform distribution G distributed with support $[0, V_{SF}]$. This information structure is meant to capture the notion that risky projects have downsides that are not easily known to outsiders (i.e., Shadow Risks). Thus, although both R and S projects may fail, the risky projects R are considered to generate the Shadow Risk. If the most extreme risky project R is chosen (i.e., $V_{RF} = 0$), failure means that the firm is completely destroyed and becomes worth

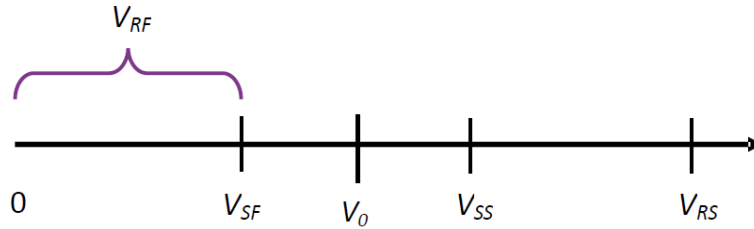
zero.

For some opportunities, it may be in the best interest of the firm for the CEO to choose a Shadow Risk project R over a safer project S . In particular, the principal of the firm wants the CEO to choose R iff $pV_{SS} + (1 - p)V_{SF} \leq pV_{RS} + (1 - p)V_{RF}$, which is equivalent to

$$0 \leq p(V_{RS} - V_{SS}) + (1 - p)(V_{RF} - V_{SF}). \quad (1)$$

We denote the initial value of the firm as V_0 and assume the ordering $0 \leq V_{RF} \leq V_{SF} < V_0 < V_{SS} < V_{RS}$. Thus, the value of the firm after a risky success is greatest, but a risky failure leaves the firm worth the least.

The following diagram summarizes the ending firm value V_{ij} , with the project type $i \in \{Risky, Safe\}$ and outcome $j \in \{Success, Failure\}$



The CEO is paid in equity compensation consisting of some portion of options and some portion of stock. We normalize her salary to zero, since salary does not affect project choices. Payoffs for the CEO for each possible state of the world are as follows:

Payoff	V_{RS}	V_{SS}	V_{SF}	V_{RF}
Options	$\alpha(V_{RS} - V_0)$	$\alpha(V_{SS} - V_0)$	0	$-\frac{k}{V_{RF}}$
Stocks	βV_{RS}	βV_{SS}	βV_{SF}	$-\frac{k}{V_{RF}}$

For the case of compensating a CEO in stock, she then simply receives fraction β of the firm, as long as there is not a risky failure. The fraction α measures the level of option compensation to the CEO. Typically executive option awards are issued at

the money, which means for our setting that options only have value after a successful project outcome. Thus, the CEO receives share α of the firm's *increase* in value, which happens only when a project— R or S —succeeds.

Regardless of compensation structure, in the event of a risky failure, V_{RF} is realized and the executive faces a penalty of $\frac{-V_{RF}}{k}$. This can be thought of as lost future income or reputation for the CEO, as well as regulator fines and possible incarceration. This penalty is also increasing in the magnitude of failure.

A CEO compensated solely by options chooses R when it has positive expected payoff to himself: $p\alpha(V_{RS} - V_{SS}) - (1-p)\frac{k}{V_{RF}} > 0$. However, this will not be satisfied for some risky projects since we may have a realization as low as $V_{RF} = 0$. A CEO that is compensated only via stocks chooses R iff $p\beta(V_{RS} - V_{SS}) - (1-p)\left(\beta V_{SF} + \frac{k}{V_{RF}}\right) > 0$. Again, since we can have $V_{RF} = 0$, the CEO will at least sometimes choose the safer project when paid all in stock.

For the CEO to choose the riskier project, it must be that the expected payoff from choosing R is greater than the safer one, which can be written as

$$(1-p)\left(\beta V_{SF} + \frac{k}{V_{RF}}\right) \leq p(\alpha + \beta)(V_{RS} - V_{SS}) . \quad (2)$$

The firm, meanwhile, will choose some cutoff value V_{RF}^* such that the CEO chooses all risky projects R when $\tilde{V}_{RF} \geq V_{RF}^*$ and chooses S otherwise, where \tilde{V}_{RF} is the realization of the random variable V_{RF} . This means that with a realization of V_{RF}^* , the firm is indifferent between the CEO choosing R and S , which happens when $p(V_{RS} - V_{SS}) + (1-p)(V_{RF}^* - V_{SF}) = 0$: the expected benefit of choosing the risky project equals the expected benefit of choosing the safer one. This implies that

$$V_{RF}^* = \frac{-p(V_{RS} - V_{SS})}{(1-p)} + V_{SF} . \quad (3)$$

We refer to V_{RF}^* as the *risk-taking standard* of the firm. We assume that the primitives of the model take on values such that $V_{RF}^* = \frac{-p(V_{RS} - V_{SS})}{(1-p)} + V_{SF} > 0$ so that we can rule out the case where the risky project is preferred by the firm for any possible realization of V_{RF} ; if this was true, risky projects should always be chosen and there is no project selection tension.

Finally, although risky projects are not always preferred, they are still sometimes attractive. Formally, we assume that $(V_0 - V_{SF}) \leq (V_{RS} - V_{SS})$. This inequality means that the gain from a risky over safer project success is at least as great in magnitude as the loss from the *best* possible risky failure (i.e., recall $V_{RF} \sim U[0, V_{SF}]$).

With these preliminaries, we can present the timeline of our stylized model:

1. The firm offers the CEO an equity pay contract (i.e., stocks and options)
2. The CEO observes the return characteristics of each project and chooses one
3. A project succeeds (fails) at probability p ($1 - p$)
4. Payoffs are realized

In the appendix, we analyze the firm's decision problem and the ultimate contract offered, which we characterize in the following Lemma:

Lemma 1 *CEOs receive options share $\alpha^* = \frac{V_{RF}^* \beta + \frac{k}{V_{RF}^*}}{-V_{RF}^* + V_{SF}}$*

Proof. See appendix ■

This α^* from Lemma 1 induces the CEO to implement the risky project R if and only if it has a higher expected net present value compared to choosing the safer project S .

We next consider comparative statics to identify some testable empirical predictions. As shown in the appendix, the relationship of the share of options α^* offered and a firm's risk standard V_{RF}^* is non-monotonic. However, for **high-stakes** environments—those settings for which the firm faces significant losses in the event of a risky failure or the CEO faces a large penalty for a risky failure (as defined formally in the appendix)—we have the following findings:

Proposition 2 *Assuming **high-stakes**, an **increase** in option share α^* **increases** the chance $q(1 - p)$ of risky failure and **decreases** the expected value of the firm upon a risky failure $E[V_{RF} | V_{RF} > V_{RF}^*]$.*

Proof. See appendix ■

Thus, as a greater level of options are offered to the CEO, we expect a greater chance of risky failure and such failure to even further reduce the value of the firm. To take our predictions to the data, we link the outcome variable α^* in our theory to a simple, observable variable. We call this new outcome variable the ratio P and define it thus

$$P \equiv \frac{E[V_{option}]}{E[V_{stock}] + E[V_{option}]}, \quad (4)$$

which is the expected value of option awards divided by the expected value of option awards and stock awards. In other words, P is the fraction of the value of equity compensation that the CEO receives in the form of options, which is readily identified in our data. Our final proposition provides our empirical predictions linked to P :

Proposition 3 *Assuming **high-stakes**, an **increase in the ratio** P results in*

1. an **increase** in the odds of a risky failure.
2. an **increase** in the expected cost of risky failure $V_0 - E[V_{RF}|V_{RF} > V_{RF}^*]$

Proof. See appendix ■

After a discussion of risk-taking within organizations, we explore these predictions for the setting of environmental risk-taking and disasters.

2 Empirical Analysis

2.1 Risk-Taking within Organizations

Firms are not simply silos of CEOs; CEOs work within and through organizations. Thus, we now consider an example that illustrates the process of a CEO translating their choosing of higher risk projects into organizational level risk-taking. Returning

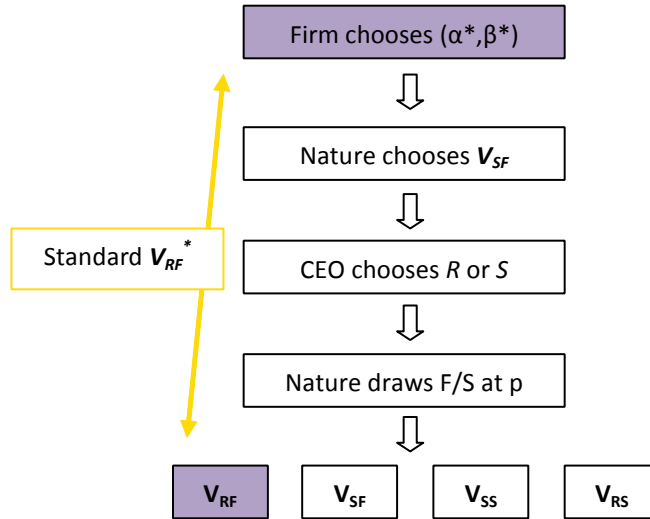
to our BP case, the former CEO Lord Browne chose to mandate aggressive short term earnings targets. In particular, he created an annual "contract" with some 250 of BPs top managers that was based on their respective division's short-run annual profits.² As the Prudhoe Bay incident reveals, the primary means by which BP created short term increases in profits was to reduce maintenance and safety expenditures. Safety investments can both reduce the chance of an event, as well as its magnitude. Thus, the consequences of these firm-wide, incentivized choices were increased chance of environmental failures and increased expected magnitude of failure. The next BP CEO, Tony Hayward, was also committed to a policy of shaving costs: almost immediately upon becoming CEO, Howard emailed associates about the importance of continued cost cutting. Once a CEO decides to increase risk-taking—e.g., increased cost cutting—it may be only a matter of months until such risk-taking increases the chance of an incident and its likely magnitude. For example, if pipelines are inspected and maintained monthly, it could immediately be decided that the next inspection will not occur for six months. Of course, most any type firm can choose to be more lax about its environmental safety management process. Alternatively, a CEO could incept direct incentives with frontline managers to encourage aggressive financial accounting practices, leading to an increased chance of accounting misconduct and its magnitude.

Whatever the case, we assume that we cannot consistently observe the micro, organizational level of risk-taking. Hence, we can rely on our theory to link organizational risk-taking to CEO compensation and observed failures and their magnitudes. In fact, it could be the case that traditional measures of financial risk-taking, such as volatility of earnings, suggest *lower levels* of organization risk-taking for some firms that are actually taking greater risks. For an extreme example, consider Bernard L. Madoff Investment Securities LLC. This firm was involved in major risk-taking by running an elaborate Ponzi scheme. However, if we measured organizational risk-taking via volatility of cash flow, we would find this firm was below average in terms of risk-taking; in fact, the firm's cash flows were remarkably stable. It was not

²These institutional details can be found in the Fortune magazine article available here: <http://features.blogs.fortune.cnn.com/2011/01/24/bp-an-accident-waiting-to-happen/>

until the Bernie Madoff scandal emerged that one could identify the extent of the organization’s risk-taking.

In summary, the following chart shows the link of a firm’s risk-taking standard V_{RF}^* that is induced by its choice of α^* , which translates into a certain compensation structure for the CEO. It is assumed that V_{RF}^* is generally *unobservable* to the econometrician, whereas the structure of executive compensation and failures are readily observable. For high-stakes risk-taking, the standard of risk is negatively correlated with both the relative level of options pay and relative magnitude and incidence rate of failure. Hence, the underlying cause of risk-taking standard induces relative options pay, as measured by P , to be *positively* correlated with incidence and magnitude of disasters, and this is something we can test empirically.



2.2 Data

We use the setting of environmental law-breaking as a test of executive compensation and Shadow Risk-taking. This environment has several desirable features for our problem. First, at least for larger US firms, environmental failures are relatively easy to capture—both in terms of incidence and magnitude. Second, for most large, US

companies, we can identify compensation data on the firm’s CEO. Third, similar to our model, while the financial benefits of greater risk-taking (e.g., cost savings) often appear in a firm’s financial statements, the extent of the downside of the risk-taking is difficult to identify by an outsider, especially through traditional financial measures. Fourth, environmental incidences, in aggregate, are economically important. Fifth, environmental incidences occur more frequently than other forms of risk-taking such as financial crises, providing greater promise of identification.

Our particular environmental dataset, CEPD, was compiled by the IRRC. For the period 1996 through 2006, the IRRC aggregated breaches of environmental law for each physical location of a firm’s operation up to the company level. In total, this included the (approximately) top 1,500 US public firms in the United States. MSCI acquired the CEPD dataset and has not increased the observations beyond 2006. Violations include the breaking of a myriad of environmental laws: Atomic Energy Act, Clean Air Act, Clean Water Act, Endangered Species Act, Federal Insecticide, Fungicide and Rodenticide Act, Mining Safety and Health Act, Resource Conservation and Recovery Act, Safe Drinking Water Act, and the Toxic Substances Control Act. The CEPD dataset includes both the incidences of violation for each of these environmental acts, as well as the total government imposed fines. A particular incident may induce several violations of environmental law—both multiple violations of a particular act, as well as violations across acts.

We consider the magnitude of the total government fine (i.e., the total fines across all counts of environmental law breaking for an incident) as a proxy for the severity of the event. Government fines are typically only a fraction of the overall cost of an event. For a dramatic example, BP’s Prudhoe Bay spill induced a \$20 million government fine. However, BP also had to pay \$25 million in civil costs, \$60 million for instituting a new government mandated safety program and some \$500 million of construction costs, bringing the final bill to at least \$605 million.³ Hence, for this particular case, the \$20 million reported in our CEPD dataset represents roughly 3.3% of the total cost.

³Figures are reported by the Associated Press in The Guardian 5/4/2011, available here: <http://www.guardian.co.uk/environment/2011/may/04/bp-25m-north-slope-oil-spill>

In total, the CEPD includes both large and small violations. The mean government fine for our data is approximately \$223,000. Based on the Prudhoe example above, this would amount to \$6.8 million in total average expenses.⁴ Only the largest of these failures would be considered an environmental disaster. However, smaller violations can be thought of as increased chance of a larger failure—a "tip of the iceberg" signal of increased risk-taking and possibly a looming Shadow Risk. If we only considered the most extreme events, there would be too few for identification. Instead, in our analysis, in addition to considering any law-breaking events, we also separately analyze small and large incidences.

We merge the CEPD dataset with COMPUSTAT and Execucomp data to identify firm financials and CEO compensation. Firm financial controls include firm leverage, as defined as total debt to total assets, firm market value, and Tobin's Q. For CEO compensation, we obtain the annual value of options and stock awards. These two values are then used to calculate the ratio P as identified from our theory section in equation (4). Finally, we include total annual compensation as a control.

Although we control for firm invariant environmental factors through firm fixed effects, this does not control for any time-varying environmental effects. To address this, we merge data from KLD analytics on the environmental performance ratings of firms. Chatterji et al. (2009) find that environmental performance ratings, as measured by KLD analytics, are important in explaining next year's firm's environmental failures, as measured by the CEPD database. Thus, we will be testing whether conditional on observable environmental performance, does compensation structure further explain environmental risk-taking and disasters. As suggested by our theory, we expect much of the managerial environmental risk-taking is latent and not observable until an incident occurs; hence, compensation patterns should provide further information on risk-taking in equilibrium.

Summary statistics for our primary variables are reported in Table 1. On average, firms experience an event (i.e., a breach of at least one environmental law in a given year) about 15% of the time, or about every 6 years. Firms are also large—averaging

⁴Unfortunately, very few incidences have sufficient data on the total expenses incurred for an incident, which is why we focus on the government fines.

over \$11 billion in market capitalization. The average CEO is receiving about \$6 million per annum in total compensation and about 75% of equity compensation is in the form of options (i.e., ratio P), on average.

2.3 Results: Environmental Events

Our primary regression model for analyzing incidence rates is a panel logit model with firm fixed effects. Specifically, we use

$$\Pr(Event_{it} = 1) = \frac{1}{1 + e^{-Q_{it}}}, \quad (5)$$

where $Event_i$ equals 1 when firm i has broken the law in year t .

$$Q_{it} = \alpha_i + \beta \frac{O_{i,t-1}}{O_{i,t-1} + S_{i,t-1}} + \mathbf{X}_{it}\boldsymbol{\delta},$$

where α_i is a fixed effect for firm i and \mathbf{X}_{it} is a matrix of control variables that include year fixed effects and financial and environmental performance controls outlined in the previous section. The regressor $\frac{O_{i,t-1}}{O_{i,t-1} + S_{i,t-1}}$ is the ratio P from our theory model and is calculated as the ratio of the total value of CEO option awards to the total value of CEO option and stock awards at time $t-1$ for firm i .⁵ Hence, the coefficient estimate $\hat{\beta}$ of β is our primary estimate of interest. Our model predicts that for larger stakes events, $\beta > 0$. Although fixed effects estimation is possible in the panel logit setting, to do so, we must drop observations of firms that never have an event or firms that have an event ever year. Of the 1,459 firms in our sample, 3.2% have an event every year and 74.5% never experience an event during our time series. By firm, the mean number of events across the entire 11 year time series is 1.3 events. Conditional on a firm having at least one event, the mean number of events is 3.5 across the 11 years.

⁵Based on personal conversations with officials at the Environmental Protection Agency and a human resource consultancy, it appears that with this $t-1$ specification, a CEO typically knows her compensation structure 6 – 24 months before an event occurs in our *CEPD* data.

In addition to this primary specification, we estimate a linear panel model with firm fixed effects. Although this model must assume the probability of an event is linear in its terms, it allows us to consider those firms that never or always have an event in our sample. We specify this model thus:

$$Event_{it} = \alpha_i + \beta \frac{O_{i,t-1}}{O_{i,t-1} + S_{i,t-1}} + \mathbf{X}_{it} \boldsymbol{\delta} + e_{it}. \quad (6)$$

In the next section, we consider the relationship between P and incident rates, our first prediction. In the following section, we then turn to our second prediction—the relationship of P and the magnitude of events.

2.3.1 Prediction 1: Increased P results in increased odds of an event

We report our baseline specification in Table 2. Column (1) reports results controlling for unobserved firm heterogeneity and total CEO compensation. The logit estimate of roughly .5 can be converted to an odds ratio format,⁶ yielding $e^{.5} = 1.6487$. This means that if a CEO goes from receiving all equity compensation in stock (i.e., $P = 0$) to receiving all equity compensation in options (i.e., $P = 1$), her firm will have 64.87% increased odds of facing an environmental incident the next year. Adding all of the other controls does little to change the relative magnitude and significance of the coefficient of interest, as shown in columns (2) – (4).

We next consider our linear panel model with firm fixed effects. Table 3 reports coefficient estimates for this specification. Note that the observations for column (1) are 5,108 compared to 1,750 for column (1) in Table 2; this is due to the inclusion now of all firms (i.e., adding those that never and always face an event in a given year). As seen in column (1), coefficient estimates suggest that the probability of an environmental incident increases by approximately 5%. Recall from Table 1 that the baseline chance of an event is 15%, which means that a CEO going from equity compensation structure $P = 0$ to $P = 1$, results in a 33% increased chance of an event. We can convert our linear model coefficient estimate to odds in order to

⁶Recall that the odds of an event is calculated as $\frac{\Pr[Event=1]}{\Pr[Event=0]}$. The odds ratio is the ratio of two odds.

compare these estimates to our results found in Table 2. In particular, a baseline probability of 15%, means that the odds of an event are $\frac{15\%}{85\%} = 0.17647$. Adding another 5% chance results in an event odds of $\frac{20\%}{80\%} = 0.25$. This means the impact of a CEO going to $P = 1$ from $P = 0$ results in an odds ratio of $\frac{0.25}{0.17647} = 1.4167$. In other words, our linear specification estimates a CEO going from equity compensation consisting of all stock to all options increases the odds of an event by 41.67%, versus our panel logit model which predicts increased odds of 64.87%. Both of these estimates are substantial in magnitude and both models report coefficient estimates that are significant at the 5% level for all specifications, with the exception of the specification reported in column (4) in Table 3, where the estimate is significant at the 5.6% level. The similarity in estimates persists despite the fact that the logit model uses approximately 34% of the observations that the linear model utilizes.

Thus far, we have been using firm fixed effects to control for unobserved firm heterogeneity. Recent financial economic research suggests not doing so, can produce spurious results and incorrect inferences (see Gormley and Matsa (2012)). Nonetheless, if fixed effects are not called for, we are, of course, using a less efficient estimator, possibly failing to identify other important effects. We run a Hausman test to determine if a linear random effects panel model would be appropriate given that a linear fixed effect panel model is correct. Since we are using clustered standard errors it is important to not use the conventional Hausman test, which assumes α_i and e_{it} are *i.i.d*—but this is violated if clustered standard errors are appropriate for within firm serial correlation. Instead we turn to the method of Wooldridge (2002) to accommodate our setting. Results from this test report a Sargan-Hansen statistic of 113.50, which yields a p-value = 0.0000. Hence, we can strongly reject the efficacy of using a random effects model for our empirical setting.

One feature of theory that we have not taken advantage of is that high-stakes event settings should yield a positive relationship with P , whereas as small-stakes events should yield a negative relationship. Of course, our setting of environmental events could consist mostly of higher stakes events, which means all event rates would have a positive relationship to compensation structure P . To consider this prediction, we return to our logit fixed effects panel model and re-code events as either bottom-

quartile or top-quartile magnitude events. Magnitude is again the total government fines imposed for an incident. Table 4 reports these results. Column (1) contains the same specification reported in column (4) of Table 2, which contains all controls. Column (2) shows us that if we define an event as only those in the smallest quartile magnitude-wise, the effect is no different statistically from zero. However, the top quartile, in contrast, has a coefficient estimate on P that is 80% greater than if we include all events: .93 vs. .53. This estimate from column (3) suggests a CEO going from compensation $P = 0$ to $P = 1$ will oversee a firm with increased odds of 253% that the next year his firm will face a substantial environmental event.

We also conduct the same exercise with our linear fixed effect model so that we can include all observations. Table 5 reports these results, which are similar to Table 4: the top-quartile events are significantly related to P and the bottom ones are not. In sum, these findings suggest that in terms of incidence rate, CEO compensation structure, as measured by P , is positively related to high-stakes events.

2.3.2 Robustness Tests

We are not claiming that CEO compensation causes environmental risk-taking and disasters *per se*; instead, as argued in Section 2, we are proposing that CEO compensation is an important channel through which a firm ultimately influences firm-level environmental risk-taking. In particular, if higher levels of relative options pay, as measured by P , increase next year's odds of an event, it should not be the case that this year's odds of an event influences next year's compensation structure P . A simple test of this is to reverse the order of events: We re-run the specifications in Table 2 with the modification that we measure P the year *after* rather than the year *before* an event. As reported in Table 6, none of the specifications are significant. In fact, with all of our controls (i.e., column (4)), the estimated relationship becomes slightly negative.

Another natural question is to what extent is compensation structure P simply a proxy for other important compensation variables. First, it could be that the total option awards currently held by a CEO is what really matters in determining incident

rates; last year’s option award is simply a proxy for this larger value. Similarly, it could also be that the current total value of stock held by the CEO is what really determines incident rates and P somehow proxies for this. We explore these possibilities by rerunning the specification from Table 4 in column (3) (i.e., the specification with all of our controls), and then add controls for a CEO’s value of total stock and option awards currently held through the previous year, each logged.⁷ We report these results in Table 7. Column (1) replicates the results from column (3) in Table 4 for comparison purposes: our baseline regression with all controls. Column (2) then replaces our lagged ratio P with the lagged values for the log of total stocks and options owned by the CEO. Surprisingly, neither regressor can help predict the odds of an environmental event. Meanwhile, the coefficient P changes little in estimate or significance when adding these additional controls.

Another important measure of executive compensation is the CEO’s Delta of their options portfolio. Some argue that Delta should increase risk-taking, whereas others argue that it should decrease risk-taking. This ambiguity arises both in the theory and empirical literature (see Coles et al. (2006) and cites therein). For this paper, Delta is the dollar change in CEO wealth as function of a 1% change in stock price. We calculate the CEO’s Delta for each executive in our sample using the same method as in Guay (1999) and Core and Guay (2002). The results of adding this measure of Delta as a regressor are reported in column (3). The coefficient on Delta is not statistically different from 0. The coefficient on the ratio P is now slightly greater and even more significant at the 1% level.

A final common measure of the nature of equity compensation, and seemingly most related to our study, is Vega. This measures how much of an increase in wealth a CEO receives with a 1% increase in her company’s stock volatility. We calculate this measure as in Guay (1999) and Core and Guay (2002). All things equal, this measure should be positively correlated with managerial risk-taking (see Coles et al. (2006)). However, it should be positively correlated only with managerial risk-taking

⁷Specifically, we calculate the log of the current total options and stock holdings as each $\ln(1 + Value)$, where Value is the value given by Execucomp for each of total holding values. Execucomp reports zero values.

that increases her company’s stock volatility. Column (4) reports that our coefficient on Vega is positive but no different statistically from zero. This suggests that while Vega tends to do well in capturing traditional measures of risk taking, it does not seem to capture Shadow Risk-taking, at least when operationalized as environmental risk-taking. Meanwhile, the coefficient on our compensation ratio P becomes slightly greater and is still significant at the 5% level.

In total, it does not seem to be the case that our compensation ratio P is simply a noisy proxy for measuring other important executive compensation measures. In fact, for our setting of environmental risk-taking it seems to do a better job than conventional measures in predicting such risk-taking. However, it is important to stress environmental risk-taking—especially the kind that results in spectacular disasters—could be considered more of an "off balance sheet" risk. The conventional measures of managerial risk-taking—firm leverage, reduced cash surplus, R&D investment, reduced capital purchases, and more focused lines of business and acquisitions—are all forms of risk-taking easily observable by the financial market and thus embedded in a company’s stock return and volatility. In contrast, managerial choices such as shirking on oil pipe inspections or choosing not to install automatic shutoff valves on oil platforms are much more difficult for the market to identify and price into a company’s stock. Perhaps the ratio P can help on that dimension in predicting such risks. Now we turn to quantifying these risky failures.

2.3.3 Prediction 2: Increased P results in increased event cost

For testing our second prediction, we use a similar specification to our linear panel model in the previous section. However, we now change our dependant variable from an event indicator to the log of total government fines. In particular, we utilize the following model:

$$\ln(1 + fine)_{it} = \alpha_i + \beta \frac{O_{i,t-1}}{O_{i,t-1} + S_{i,t-1}} + \mathbf{X}_{it}\boldsymbol{\delta} + e_{it},$$

where $fine$ is the total government fine assessed for the incident and all of the

other regressors are as they were in equation (6) . Of course, since Prediction 2 is a conditional prediction, we now only have observations for those firm-years that record an environmental incident. Our main coefficient of interest is again β .

Table 8 reports the results for similar specifications to Table 2. The first three specifications yield a significant coefficient on P at the 5% level. The final specification with all controls yields significance at the 10% level. Since these are semi-elasticities, the coefficient estimates suggest that, roughly speaking, a CEO going from $P = 0$ to $P = 1$, conditional on experiencing an event, will witness greater total event costs of 78% to 96%.

Since we are using a linear panel FE model we again need to ask if it is the appropriate model vis-a-vis a random effects model. Conducting a Hausman test, as we did in section in our previous section, we find a Sargan-Hansen statistic of 39.948 p-value =0.0008, which causes us to strongly reject the null that the random effects model is appropriate given that the fixed effects model is appropriate.

Informed by our theory, we again consider the comparison of the large and small events. Unfortunately, we now have a significantly reduced sample size compared to the previous section; thus, we now simply partition fines into below and above median fines. We use all of the controls used for the results in column (4) of Table 8 for Table 9. For comparison purposes, column (1) in Table 9 replicates the results in Column (4) of Table 8. We find that using the sample of large fines (i.e., above median) creates an estimate of the coefficient on P significant at the 5% level compared with a 10% significance level when using the sample of all fines. Further, the estimate using only larger fines is over 50% greater in magnitude compared with the full sample that includes small fines. Meanwhile, a sample of only small fines does not yield a significant estimate of the coefficient on P . If we instead partition fines, as in the previous section—by top and bottom quartiles—small events have a negative correlation with lagged P (i.e., coefficient of $-.64$) and large events have a positive coefficient on lagged P (i.e., coefficient of $.25$), which are both consistent with our theory. Nonetheless, these do not reach statistical significance at conventional levels.

We also re-run the specification from column (4) in Table 8 with the addition of the natural log of total company stock, options, Delta, and Vega. Again, none

of these control variables are significant and they do not materially change the results. Similarly, the current magnitude of an event does not predict next year's compensation structure P .

2.3.4 Selection vs. Incentives

Although it seems higher P results in greater failure rates and magnitudes of failures, it is not clear if this is because of selection or incentives. It could be that firms that want to take on greater levels of Shadow Risk, attract those CEOs more willing to do so by offering a higher P as opposed to the greater P incentivizing greater Shadow Risk-taking. To attempt to disentangle these two possibilities, we conduct the same exercise as in the last two subsections, but now at the CEO-firm level. That is, we use a fixed effect for each CEO-firm pair, whereas before that fixed effect was at the firm level. Thus, we will only be able to identify any effect of P on Shadow Risk-taking by the variation of P while a particular CEO is at one particular. Although this approach will potentially remove significant variation from the analysis, it allows us to better identify the incentive effect. If there is no effect of P at the CEO-firm level, then we cannot rule out that the effects of P come through selection as opposed to incentives.

In Table 10, we report the results of both a logit and linear fixed effects model for the CEO-firm level. Now, when considering only top quartile or bottom quartile magnitude events, we find coefficient estimates that are positive and negative, respectively. If the condition of high-stakes occurs at some level in between the top and bottom quartile, these opposite sign estimates are consistent with the theory. However, only the high magnitude (i.e., top quartile) events are significant (at the 5% level), which means we cannot rule out small-stakes have no relationship with P . Thus, identification is coming from the larger-stakes events, which parallels our earlier findings when analyzing the data at the firm rather than CEO-firm level. In terms of magnitude of effect, when including events of all magnitudes, the coefficient estimates at the CEO-firm level are about half of the magnitude of those at the firm level. However, the top quartile estimates are quite similar for both levels of analysis.

In terms of P 's effect on the cost of an event, as reported in Table 11, the magnitudes are similar. In terms of significance, the CEO-firm level has lower significance for its estimates, which is not a surprise since we are now only identifying these differences from pay variation of a particular CEO while at a single firm. The final column with all controls has a p-value of 11%, whereas all of the other specifications carry p-values less than 10%.

In sum, it seems a substantial portion of the effect identified earlier at the firm level is also occurring at the CEO-firm level, at least for the high magnitude events. This suggests that an important channel through which CEO compensation effects incident rate and magnitudes occurs through incentive provision and not only selection.

Despite all of the above findings, it is possible the ratio P only predicts the incident rate and magnitude of events for environmental risk-taking and not other settings. To further explore this possibility, we now analyze the ratio P in a different setting—financial accounting risk-taking—which also occurred over a different time period.

2.4 Results: Financial Accounting Risk-Taking and Policy Effects

Financial accounting represent another setting where, similar to environmental failures, getting caught for breaking accounting law can be viewed as a failed risky-project. Firms can choose to be more aggressive in their accounting practices, amplifying their firm's risk-taking standard. However, this increased risk-taking may not be readily observable day-to-day. In this setting, an event is an earnings restatement that results in an SEC investigation. This means that for this setting we are really measuring the *likelihood* of breaking the law; to the extent being investigated by the SEC for suspicious financial accounting is correlated with greater risk-taking, we can conceptualize an SEC investigation as a signal of higher risk-taking.

The reason that we proceed with this section of analysis is several fold. First, some studies have shown that options pay is related to accounting misconduct (e.g.,

see Burns and Kedia (2006) and cites therein). Since we are using an uncommon measure of equity pay (i.e., P) compared to the extant literature, we want to examine if its use replicates past results using other measures. Second, restatements with SEC investigations are rare events—these carry less than a 0.5% annual incident rate in our dataset, which allows for testing our predictions in an entirely different setting from our environmental risk-taking one. That is, this provides a test for rarer events than the previous environmental setting. Finally, at the end of 2005, it became more costly to provide options due to FAS 123R.⁸ Our accounting data cover the period 2000 through 2011; hence, we can consider any differential effects of options before and after this policy change, whereas this is not possible with our environmental data since the database was discontinued after 2006. We can also consider any time trend differences between another major policy change potentially affecting financial accounting conduct: Sarbanes Oxley. Instead of directly shifting the cost of providing options, as did FAS 123R, this policy essentially increased the penalty an executive faced if presiding over a financial accounting incident.

Our analysis proceeds just as before. However, our dependent variables are now different. Specifically, we obtain them from Audit Analytics, which reports accounting restatements and whether or not these result in an investigation by the SEC. Restatements can be due to simple, benign clerical errors or can be due to consequential issues such as earnings manipulation. The most suspicious of restatements are the ones, presumably, investigated by the SEC. Audit Analytics also reports the net change in earnings of a restatement.

For this section, we employ a random effects model instead of a fixed effects model. For our linear model, we again conduct a Hausman test. We find in this setting of financial accounting risk-taking, that if a fixed effects estimate model is appropriate, we cannot reject a random effects model as also appropriate (p value of 0.53). However, since this then means the Random Effects model is the more efficient estimator, we utilize it. For consistency, we also use a random effects model for the logit panel. In addition, if we used a fixed effect logit panel model, due to the rare event nature of this sample, we would only be following 50 firms—since the

⁸See Hayes et al. (2012) for a summary of this rule as it pertains to options accounting.

fixed effect model must drop all firms that never have an event.

Table 12 reports our logit panel specifications. Including all controls, as reported in column (3), the coefficient of 1.49 implies a CEO going from receiving all equity compensation in stock to all in options (i.e., $P = 0$ to $P = 1$), will the next year oversee a firm with some 343% increased odds of a financial accounting investigation. This coefficient estimate on P is significant at the 5% level in column (3) and at the 1% level for the other columns.

Table 13 reports the same specifications as in Table 12, but for a linear panel model. All specifications show the coefficient estimates on P to be significant at the 1% level, and close to an average value of .4%, which amounts to an 80% increase in the likelihood of a financial accounting event. Since incident rates are less than 1%, the increase in odds, as indicated by the odds ratio, is similar to an increase in probability. Converting the 80% increase in chance to an odds ratio yields 1.81, which implies an 81% increased odds of an event. Thus, in contrast to our environmental risk-taking setting, the linear estimator and logit estimator imply sharply different increases in odds. When estimating low probability events, the shape of the tail of the statistical distribution clearly matters.

As mentioned, a nice feature of studying this accounting data, in addition to having a larger sample, is that our time series passes through two significant accounting policy changes. We had the passage of both the Sarbanes-Oxley Act (2002) and FAS 123R (2005). The former act essentially created a bigger stick for CEOs involved in accounting misconduct. In terms of our model, this means the penalty k becomes greater. In this case, the equilibrium risk-taking will still be the same, as it is not determined by k . Instead, the firm will need to increase the CEO's carrot by means of increased options to induce the CEO take on the same desired level of risk as before. Hence, our model predicts Sarbanes-Oxley will have no effect on risk-taking in equilibrium and thus will not be associated with the incidence of restatements investigated by the SEC.

The FAS 123R policy change, in contrast, essentially made it more expensive for a firm to award options. Although not explicitly considered in our model, if this somehow limited the level of options that could be provided compared with before

such a rule change, we would witness relatively fewer options, and, consequently, a lower level of risk-taking. This would result in fewer and lesser in magnitude Shadow Risks, on average.

We consider these two policy changes with a simple, non-parametric time specification. We add an indicator variable that takes on the value 1 for all years that the new policy is effective, which begins in 2002 and 2006 for the Sarbanes-Oxley Act and FAS 123R, respectively. To limit collinearity with our year fixed-effects, we create year fixed-effects from 2004 onward. We report these results in Table 14. Columns (1) and (3) do not include year fixed effects and columns (2) and (4) do. Coefficient estimates on P are similar to before adding such policy controls and are significant at the 5% (1%) level for the logit (linear) panel. It appears Sarbanes-Oxley had no effect on alleged financial accounting misconduct—at least in terms of SEC investigations. Meanwhile, FAS 123R caused a significant drop in accounting incident rates across all specifications at the 1% level, except for the logit panel specification without year fixed-effects.

We now consider the magnitude of accounting restatements that are investigated by the SEC. Accounting restatements can result in a positive or negative change in earnings. We analyze negative restatements by taking the natural log of their absolute value. In addition, if we restrict ourselves to those restatements that also have an SEC investigation, we have a mere 47 observations with our specifications and not enough power to identify a relationship between CEO compensation and magnitude. Further, of these 47 observations, 22 have a net zero value in earnings restatement, leaving only 25 observations to identify the magnitude of any possible effect.

However, we can more loosely define our event as a negative earnings restatement (i.e., rather than one that also results in an SEC investigation). Doing so increases our observations to 283. In contrast to our environmental incident data, accounting restatements are quite rare even for firms that experience one. In fact, for our 12 year sample, for firms that face a restatement, 72.4% never experience an additional restatement. If we only consider negative earnings restatements, then 82.1% of firms only experience one such an event. Thus, when considering the condi-

tional magnitude of an event, our sample is similar to a cross section. Consequently, we implement an OLS model to measure the relationship of firm compensation and earnings restatement magnitude. We also add industry controls at the NAICS code 2-digit level.

We do find a relationship between compensation structure P and the magnitude of negative earnings restatements. Table 15 reports these results. Since these are semi-elasticities, the magnitudes suggest that a CEO going from $P = 0$ to $P = 1$ will oversee a roughly 57% to 71% increase in the magnitude of a negative earnings restatement, conditional on facing such a restatement. If we restrict our sample to only those firms that experience a single event, and use all of the controls from column (4) in Table 15, our reduced sample of 182 observations yields a coefficient on P of .84 and is significant at the 10% level.

3 Conclusion

We explored the possible link between equity compensation and failed risky projects, where the largest of these failures (i.e., Shadow Risks) represent environmental disasters and accounting scandals. Our theoretical model showed that the relationship is non-monotonic. In particular, for those environments where the opportunities and failures are relatively low-stakes, there is a *negative* relationship between the share of equity compensation in options and risky-project incident rate and magnitude. Here, options encourage the CEO to take on "too much" risk since the failure of such projects carries little penalty for the CEO. Hence, as project attractiveness increases, the firm must decrease relative options compensation. However, for those large-stakes settings, where failure can be very costly to the CEO—i.e., disasters and scandals—the firm must aggressively incentivize the CEO to take on the firm's desired level of risk-taking. This is accomplished through relatively more options, as measured by the ratio P . More risk-taking then means more observed failures and increased magnitude of these failures, on average.

We tested these predictions in the setting of breaking environmental law and accounting law. We found that changing a CEO's compensation from 100% stock to

100% options (i.e., $P = 0$ to $P = 1$) resulted in 42 – 65% increased odds of an environmental incident and close to a doubling of the magnitude of fines. Similarly, for the same change in equity compensation, we found over an 80% increased odds that the firm has an accounting restatement that is investigated by the SEC. Similarly, we found the magnitude of negative earnings restatements increase by 56% to 71%. As suggested by our theory, we found that it is primarily the largest events that are positively related to CEO compensation structure P . We also found that the effect of P seems to be coming from not only a selection effect of particular CEOs, but also an incentive effect.

As far as policy, our theoretical model suggests increasing the regulatory stick against a CEO for failed risky project outcomes does not change the incident rate nor the magnitude of loss. Intuitively, making the stick larger does not change the optimal risk-taking level for the firm and thus the firm simply restructures compensation to induce the CEO to still incur the same level of risk-taking as when the stick was smaller. In contrast, making it more costly to provide a carrot (i.e., increasing the cost of providing options) can reduce a firm’s choice of risk-taking. We found evidence that a rule change of the former—Sarbanes-Oxley—did not reduce risk-taking (and thus risky project failures), whereas a rule change of the latter—FAS 123R—was effective in reducing risk-taking.

In sum, our findings suggest that the largest failures in firms may come from higher risk-taking by the CEO. However, this higher risk-taking is being incentivized by the firm’s choice of equity compensation. Thus, it is not clear that liability over such events should rest primarily on the CEO. To the extent that the board of directors freely sets the CEO’s compensation structure, they too can be complicit in the firm’s disasters and scandals.

References

- [1] Burns, N., & Kedia, S. (2006). The impact of performance-based compensation on misreporting. *Journal of Financial Economics*, 79(1), 35-67.
- [2] Chatterji, A. K., Levine, D. I., & Toffel, M. W. (2009). How well do social ratings actually measure corporate social responsibility?. *Journal of Economics & Management Strategy*, 18(1), 125-169.
- [3] Coles, J. L., Daniel, N. D., & Naveen, L. (2006). Managerial incentives and risk-taking. *Journal of Financial Economics*, 79(2), 431-468.
- [4] Core, J., & Guay, W. (1999). The use of equity grants to manage optimal equity incentive levels. *Journal of accounting and economics*, 28(2), 151-184.
- [5] Edmans, A., & Liu, Q. (2011). Inside debt. *Review of Finance*, 15(1), 75-102.
- [6] Frydman, C and D Jenter, (2010). CEO Compensation. *Review of Financial Economics*, 75-102.
- [7] Gormley, TA, Matsa, DA, Milbourn, TT, (2012). CEO Compensation and Corporate Risk- Taking: Evidence from a Natural Experiment. AFA 2012 Chicago Meetings Paper.
- [8] Gormley, T. A., & Matsa, D. A. (2012). Common errors: How to (and not to) control for unobserved heterogeneity. forthcoming, *Review of Financial Studies*.
- [9] Guay, W. R. (1999). The sensitivity of CEO wealth to equity risk: an analysis of the magnitude and determinants. *Journal of Financial Economics*, 53(1), 43-71.
- [10] Hayes, R. M., Lemmon, M., & Qiu, M. (2012). Stock options and managerial incentives for risk-taking: Evidence from FAS 123R. *Journal of Financial Economics*.
- [11] Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics*, 3(4), 305-360.

- [12] Kadan, O., & Swinkels, J. M. (2008). Stocks or options? Moral hazard, firm viability, and the design of compensation contracts. *Review of Financial Studies*, 21(1), 451-482.
- [13] Lambert, R. A., Larcker, D. F., & Verrecchia, R. E. (1991). Portfolio considerations in valuing executive compensation. *Journal of Accounting Research*, 129-149.
- [14] Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of financial economics*, 5(2), 147-175.
- [15] Shrieves, R., & Gao, P. (2002). Earnings management and executive compensation: a case of overdose of option and underdose of salary? In *EFA 2002 Berlin Meetings Presented Paper*.
- [16] United States. Financial Crisis Inquiry Commission. (2011). *Financial crisis inquiry report: final report of the national commission on the causes of the financial and economic crisis in the United States*. Government Printing Office.
- [17] Wooldridge, J.M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.

4 Appendix: Proofs

Lemma 1 *CEOs receive options share* $\alpha^* = \frac{V_{RF}^* \beta + \frac{k}{V_{RF}^*}}{-V_{RF}^* + V_{SF}}$

Proof: The firm's problem is written as

$$\max_{\alpha, \beta} \pi \equiv \left[\begin{array}{l} q(p(1-\alpha-\beta)V_{RS} + p\alpha V_o + (1-p)E[V_{RF}|V_{RF} > V_{RF}^*]) \\ + (1-q)(p(1-\alpha-\beta)V_{SS} + p\alpha V_o + (1-p)((1-\beta)V_{SF})) \end{array} \right],$$

$$\text{subject to } \frac{\beta + \frac{k}{V_{RF}^* V_{SF}}}{\alpha + \beta} \leq \frac{p}{(1-p)} \frac{V_{RS} - V_{SS}}{V_{SF}}, \alpha^* + \beta^* \leq 1 \text{ and } \alpha^*, \beta^* \geq 0,$$

where we define $q \equiv \Pr(V_{RF} \geq V_{RF}^*)$. We proceed by assuming, as in Edmans and Liu (2011), that the firm induces the CEO to choose the first-best policy (i.e., choose R if and only if its expected value is greater than S). This adds the constraint

$$\frac{\beta + \frac{k}{V_{RF}^* V_{SF}}}{\alpha + \beta} \leq \frac{p}{(1-p)} \frac{V_{RS} - V_{SS}}{V_{SF}}. \quad (7)$$

The conditions $\alpha^* + \beta^* \leq 1$ and $\alpha^*, \beta^* \geq 0$ ensure no more than the entire firm is given away and that only positive shares are given away.

The proof proceeds by first assuming that the principal could directly choose V_{RF}^* . Thus, conditional on V_{RF}^* , q is fixed and it can readily be shown that

$$\frac{\partial \pi}{\partial \alpha} < \frac{\partial \pi}{\partial \beta} < 0, \quad (8)$$

which means that options are lower cost than stock as a form of executive compensation. However, the principal cannot directly choose V_{RF}^* but instead must induce the CEO to take on some risk-standard V_{RF}^* . This is achieved through choosing α and β such that we meet inequality (7). Since it is costly for the firm to provide α and β , this constraint will bind. At $\alpha = \beta = 0$, clearly (7) is not met. At the extreme, If $\frac{k}{V_{RF}^* V_{SF}} > \frac{p}{(1-p)} \frac{V_{RS} - V_{SS}}{V_{SF}}$, then $\alpha = 1$ will be chosen, as α is less costly to the firm

than β . This is the case where k is so great that the firm cannot induce as much risk-taking as it would like and thus must settle for a higher V_{RF}^* than desired. In this setting, it means that there is no relationship between changes in the primitives and α^* (i.e., because $\alpha^* = 1$ regardless of parameter perturbations). Thus, to explore interior solutions we now focus on those cases where

$$\begin{aligned} k &< \left(\frac{p}{(1-p)} (V_{RS} - V_{SS}) \right) V_{RF}^* \\ &= \left(\frac{p}{(1-p)} (V_{RS} - V_{SS}) \right) \left(\frac{-p(V_{RS} - V_{SS})}{(1-p)} + V_{SF} \right). \end{aligned} \quad (9)$$

Note that less α than β is required to meet the inequality (7). Hence, since inequality (8) also shows that α is less costly than β , the firm will choose some $\alpha > 0$ and $\beta = 0$. However, if we assume some $\underline{\beta} \geq 0$,⁹ this means that the payment α^* is then

$$\alpha^* = \frac{\underline{\beta} + \frac{k}{V_{RF}^* V_{SF}}}{\frac{p}{(1-p)} \frac{V_{RS} - V_{SS}}{V_{SF}}} - \underline{\beta}.$$

Recalling that $V_{RF}^* = \frac{-p(V_{RS} - V_{SS})}{(1-p)} + V_{SF}$, with further rearranging, our expression for the α^* becomes:

$$\alpha^* = \frac{V_{RF}^* \underline{\beta} + \frac{k}{V_{RF}^*}}{-V_{RF}^* + V_{SF}}. \quad (10)$$

QED

Proposition 2 *Assuming high-stakes (i.e., $V_{SF} (V_{RF}^*)^2 \underline{\beta} < k (V_{SF} - 2V_{RF}^*)$),*

⁹Kadan and Swinkles (2008) similarly find that firms should provide 100% options and no stocks—unless the firm has a substantial threat of bankruptcy, which does not generally include our empirical setting. Nonetheless, in practice we often observe that equity compensation consists of stock, in addition to options, even for large, stable firms. This could be driven by industry norms or a budget constraint for offering options. It could also be driven by convexity of cost in providing stocks and options, rather than the linear cost assumed above. Abstracting away from the source, we assume that there is some minimum $\underline{\beta}$ such that firms need to provide some amount of stock to managers. However, with $\underline{\beta} = 0$, our following comparative statics still hold.

an increase in option share α^* increases the chance $q(1-p)$ of risky failure and decreases the expected value of the firm upon a risky failure $E[V_{RF}|V_{RF} > V_{RF}^*]$.

Proof: We first show how α^* changes as V_{RF}^* changes. We will then link this result to show how changes in V_{RF}^* affect $E[V_{RF}|V_{RF} > V_{RF}^*]$ and $q(1-p)$. We first consider a change in V_{RF}^* originating from primitives other than V_{SF} ; we will consider the case of V_{SF} separately since both α^* and V_{RF}^* are a function of V_{SF} . Taking the derivative of α^* with respect to the risk-standard yields

$$\frac{\partial \alpha^*}{\partial V_{RF}^*} = \frac{2kV_{RF}^* + V_{SF}(V_{RF}^*)^2 \underline{\beta} - kV_{SF}}{(V_{RF}^*)^2 (-V_{RF}^* + V_{SF})^2} <> 0.$$

The sign of $\frac{\partial \alpha^*}{\partial V_{RF}^*}$ is determined by the sign of $2kV_{RF}^* + V_{SF}(V_{RF}^*)^2 \underline{\beta} - kV_{SF}$. In other words, α^* is non-monotonic in risk-taking. We will have $\frac{\partial \alpha^*}{\partial V_{RF}^*} < 0$ iff

$$V_{SF}(V_{RF}^*)^2 \underline{\beta} < k(V_{SF} - 2V_{RF}^*). \quad (11)$$

If $\underline{\beta} = 0$, then this condition simplifies to

$$\frac{2p(V_{RS} - V_{SS})}{(1-p)} > V_{SF}.$$

We refer to those settings where inequality (11) is met as the condition of **high-stakes**. This inequality is met when the risk-standard V_{RF}^* is sufficiently low, which means that the expected value of a risky failure is sufficiently adverse. In addition, it also occurs with sufficiently high penalty k to the CEO upon a risky failure. If condition (11) is not met, then for this region of parameters, the comparative statics are simply reversed.

It is also the case that $\frac{d\alpha^*}{dV_{RF}^*} < 0$. This can be seen by noting that

$$\frac{d\alpha^*}{dV_{SF}} = \frac{\underline{\beta} + \frac{-k}{(V_{RF}^*)^2}}{\frac{p}{(1-p)}(V_{RS} - V_{SS})}.$$

This expression is negative when $\underline{\beta} + \frac{-k}{(V_{RF}^*)^2} < 0$, which occurs under **high-stakes**.

That is, if $V_{SF} (V_{RF}^*)^2 \underline{\beta} < k (V_{SF} - 2V_{RF}^*)$ then $k > (V_{RF}^*)^2 \underline{\beta}$, since $\frac{V_{SF}}{(V_{SF} - 2V_{RF}^*)} > 1$.

Now consider how lowering the risk-standard V_{RF}^* affects $E[V_{RF}|V_{RF} > V_{RF}^*]$ and $q(1-p)$. It is trivial that $E[V_{RF}|V_{RF} > V_{RF}^*]$ decreases as V_{RF}^* decreases: decreasing V_{RF}^* lowers the lower bound of support of V_{RF} while maintaining the same upper bound of support. It is not, however, trivial that $q(1-p)$ increases as V_{RF}^* decreases; an increase in p lowers the risk-standard V_{RF}^* , which means that q increases while $(1-p)$ decreases. To determine the net effect note that

$$\frac{d}{dp} (q(1-p)) = \frac{(V_{RS} - V_{SS})}{V_{SF}} > 0.$$

We now combine these three comparative statics to conclude that if a firm lowers its risk standard V_{RF}^* , option share α^* increases, the chance $q(1-p)$ of a risky failure increases, and the expected value of the firm upon a risky failure $E[V_{RF}|V_{RF} > V_{RF}^*]$ decreases.

QED

Proposition 3 *Assuming risky projects are high-stakes, an increase in the ratio P results in*

1. an **increase** in the odds of a risky failure.
2. an **increase** in the expected cost of a risky failure $V_0 - E[V_{RF}|V_{RF} > V_{RF}^*]$

Proof: We must show that any change in P results in the same directional change in α^* . Then, using Proposition 2, along with noting that an increased chance of an event also means increased odds and noting that the cost of a risky failure (i.e., $V_0 - E[V_{RF}|V_{RF} > V_{RF}^*]$) is strictly decreasing in $E[V_{RF}|V_{RF} > V_{RF}^*]$, the proof is complete. The expected value of options compensation can be written as

$$\begin{aligned} E[V_{option}] &= \alpha (qp(V_{RS} - V_0) + (1-q)p(V_{SS} - V_0)) \\ &= \alpha (qpV_{RS} + (1-q)pV_{SS} - pV_0) \end{aligned}$$

The expected value of compensation in stock is written

$$\begin{aligned}
E[V_{stock}] &= \beta (qpV_{RS} + (1 - q) (pV_{SS} + (1 - p) V_{SF})) \\
&= \beta (qpV_{RS} + (1 - q) pV_{SS} - pV_0 + pV_0 + (1 - q) (1 - p) V_{SF}) .
\end{aligned}$$

Now consider the ratio P , which we define as

$$P \equiv \frac{E[V_{option}]}{E[V_{stock}] + E[V_{option}]} \quad (12)$$

First note that holding all other variables fixed, P is increasing in α since $P < 1$. Hence, we need only show that $\frac{d}{dt} E[V_{stock}] \leq \frac{d}{dt} E[V_{option}]$, where t is some parameter of $E[V_{stock}]$ or $E[V_{option}]$ that also increases α^* ¹⁰. Examination of $E[V_{stock}]$ and $E[V_{option}]$ shows that they are identical aside from $E[V_{stock}]$ containing an additional term $pV_0 + (1 - q) (1 - p) V_{SF}$. We want to show that $\frac{d}{dt} [pV_0 + (1 - q) (1 - p) V_{SF}] \leq 0$. We see that excluding p , V_{SF} and all of the parameters that create q , all reduce the value of $pV_0 + (1 - q) (1 - p) V_{SF}$ as they also increase α^* . Thus, we must finally check that this term is (weakly) decreasing in p (since α^* is increasing in p) :

¹⁰If a parameter (e.g., V_{SF}) decreases α^* , then take t to be its inverse (i.e., $\frac{1}{V_{SF}}$).

$$\begin{aligned}
& \frac{d}{dp} [pV_0 + (1-q)(1-p)V_{SF}] \\
= & V_0 - (1-q)V_{SF} - \frac{dq}{dp}(1-p)V_{SF} \\
= & V_0 - \left(1 - \frac{V_{SF} - V_{RF}^*}{V_{SF}}\right)V_{SF} - \frac{dq}{dp}(1-p)V_{SF} \\
= & V_0 - \left(\frac{V_{RF}^*}{V_{SF}}\right)V_{SF} - \left(\frac{\frac{1}{(1-p)^2}(V_{RS} - V_{SS})}{V_{SF}}\right)(1-p)V_{SF} \\
= & V_0 - V_{RF}^* - \frac{1}{(1-p)}(V_{RS} - V_{SS}) \\
= & V_0 - \left(\frac{-p(V_{RS} - V_{SS})}{(1-p)} + V_{SF}\right) - \frac{1}{(1-p)}(V_{RS} - V_{SS}) \\
= & V_0 - V_{SF} - (V_{RS} - V_{SS}) \\
\leq & 0
\end{aligned}$$

where the final inequality follows from $(V_0 - V_{SF}) \leq (V_{RS} - V_{SS})$. QED.

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Event (1/0)	7705	15.04%	35.75%	0	1
Total Fines	1132 \$	223,674 \$	1,346,869 \$	1 \$	25,000,000
Ratio <i>P</i> of Equity Comp	5999	75.08%	35.42%	0%	100%
Total Compensation (mm)	7628 \$	6,257 \$	12,758 \$	- \$	600,347
Environmental Strengths	7705	0.17	0.47	0.00	4.00
Environmental Concerns	7705	0.32	0.80	0.00	6.00
Market Value	7704 \$	11,261 \$	31,666 \$	0 \$	507,217
Market to book Ratio	7696	2.51	1.62	1.00	28.88
Leverage	7465	0.21	0.18	0.00	4.91
Year	7705	n/a	n/a	1996	2006

ratio *P* is the ratio of CEO total options compensation divided by total options and stock compensation for a given year

Table 2: The Relationship of *P* and Environmental Events: Logit Panel Model

Dependent Variable: Environmental Incident (1,0)				
	(1)	(2)	(3)	(4)
Ratio <i>P</i> of Equity Comp at t-1	0.5095** (2.29)	0.4878** (2.07)	0.5830*** (2.61)	0.5278** (2.24)
Total Compensation at t-1	0.0000 (0.26)	0.0000 (0.30)	0.0000 (0.09)	0.0000 (0.36)
KLD Env Strengths at t-1		-0.0304 (-0.17)	-0.0025 (-0.01)	-0.0225 (-0.12)
KLD Env Concerns at t-1		-0.1013 (-0.73)	-0.0935 (-0.66)	-0.0466 (-0.32)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Env Controls	No	Yes	Yes	Yes
Financial Controls	No	No	Yes	Yes
Year Fixed Effects	No	No	No	Yes
N	1750	1750	1715	1715

t statistics reported in parentheses

Standard errors are calculated via bootstrap method (400 repetitions)

* p<0.10 **p<.05 ***p<.01

Table 3: The Relationship of *P* and Environmental Events: Linear Panel Model

Dependent Variable: Environmental Incident (1,0)				
	(1)	(2)	(3)	(4)
Ratio <i>P</i> of Equity Comp at t-1	0.0509** (2.07)	0.0488** (1.97)	0.0577** (2.31)	0.0496* (1.91)
Total Compensation at t-1	0.0000 (0.33)	0.0000 (0.38)	0.0000 (0.15)	0.0000 (0.82)
KLD Env Strengths at t-1		-0.0042 (-0.13)	-0.0028 (-0.09)	-0.0058 (-0.19)
KLD Env Concerns at t-1		-0.0215 (-0.78)	-0.0207 (-0.75)	-0.0130 (-0.48)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Env Controls	No	Yes	Yes	Yes
Financial Controls	No	No	Yes	Yes
Year Fixed Effects	No	No	No	Yes
N	5108	5108	4938	4938

t statistics reported in parentheses
standard errors are clustered at the firm-level

* p<0.10 **p<.05 ***p<.01

Table 4: Relationship of *P* and High vs. Low Magnitude Events: Logit Panel Model

Dependent Variable: Environmental Incident (1,0)			
	(1)	(2)	(3)
Ratio <i>P</i> of Equity Comp at t-1	0.5278** (2.40)	0.0103 (0.03)	0.9257** (2.18)
Total Compensation at t-1	0.0000 (0.35)	0.0000 (0.27)	-0.0000 (-0.56)
KLD Env Strengths at t-1	-0.0225 (-0.11)	-0.2237 (-0.94)	-0.3571 (-1.35)
KLD Env Concerns at t-1	-0.0466 (-0.31)	-0.0173 (-0.08)	-0.2651 (-1.55)
Incident Magnitude	All	4th Q	1st Q
Firm Fixed Effects	Yes	Yes	Yes
Env Controls	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Financial Controls	Yes	Yes	Yes
N	1715	895	749

t statistics reported in parentheses

Standard errors are calculated via bootstrap method (400 repetitions)

* p<0.10 **p<.05 ***p<.01

Table 5: Relationship of *P* and Large vs. Small Magnitude Events: Linear Panel Model

Dependent Variable: Environmental Incident (1,0)			
	(1)	(2)	(3)
Ratio <i>P</i> of Equity Comp at t-1	0.0496* (1.91)	0.0028 (0.16)	0.0374** (2.19)
Total Compensation at t-1	0.0000 (0.82)	0.0000 (0.51)	-0.0000 (-0.59)
KLD Env Strengths at t-1	-0.0058 (-0.19)	-0.0129 (-0.77)	-0.0230 (-1.19)
KLD Env Concerns at t-1	-0.0130 (-0.48)	-0.0015 (-0.11)	-0.0248 (-1.34)
Incident Magnitude	All	4th Q	1st Q
Firm Fixed Effects	Yes	Yes	Yes
Env Controls	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Financial Controls	Yes	Yes	Yes
N	4938	4938	4938

t statistics reported in parentheses

standard errors are clustered at the firm-level

* p<0.10 **p<.05 ***p<.01

Table 6: Falsification Test of the Relationship of *P* and Incident Rates

Dependent Variable: Environmental Incident (1,0)				
	(1)	(2)	(3)	(4)
Ratio <i>P</i> of Equity Comp at t+1	0.2556 (1.11)	0.2475 (1.00)	0.2426 (0.97)	-0.2443 (-0.93)
Total Compensation at t-1	0.0000 (0.38)	0.0000 (0.39)	0.0000 (0.28)	0.0000 (0.66)
KLD Env Strengths at t-1		-0.1012 (-0.35)	-0.0283 (-0.10)	-0.2103 (-0.77)
KLD Env Concerns at t-1		-0.0891 (-0.61)	-0.0898 (-0.57)	-0.0358 (-0.21)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Env Controls	No	Yes	Yes	Yes
Financial Controls	No	No	Yes	Yes
Year Fixed Effects	No	No	No	Yes
N	1401	1401	1377	1377

t statistics reported in parentheses

Standard errors are calculated via bootstrap method (400 repetitions)

* p<0.10 **p<.05 ***p<.01

Table 7: Additional Compensation Controls

Dependent Variable: Top Quartile Environmental Incident (1,0)				
	(1)	(2)	(3)	(4)
Ratio <i>P</i> of Equity Comp at t-1	0.9257** (2.23)	0.9139** (2.02)	1.2131*** (2.66)	1.1032** (2.45)
Ln(Total Stock Value) at t-1		0.0767 (0.62)		
Ln(Total Option Value) at t-1		-0.0423 (-0.69)		
Total Delta at t-1			-0.0003 (-0.67)	
Total Vega at t-1				0.0016 (0.85)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Env Controls	Yes	Yes	Yes	Yes
Financial Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
N	749	705	724	724

t statistics reported in parentheses

Standard errors are calculated via bootstrap method (400 repetitions)

* p<0.10 **p<.05 ***p<.01

Table 8: Relationship of *P* and Magnitude of Environmental Events

Dependent Variable: $\ln(1+\text{total government fines})$				
	(1)	(2)	(3)	(4)
Ratio <i>P</i> of Equity Comp at t-1	0.9637** (2.26)	0.9275** (2.12)	0.9527** (2.15)	0.7790* (1.79)
Total Compensation at t-1	-0.0000 (-0.74)	-0.0000 (-0.55)	-0.0000 (-0.22)	-0.0000 (-0.17)
KLD Env Strengths at t-1		-0.1460 (-0.47)	-0.1521 (-0.50)	-0.1156 (-0.38)
KLD Env Concerns at t-1		-0.2247 (-0.92)	-0.2301 (-0.91)	-0.1512 (-0.61)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Env Controls	No	Yes	Yes	Yes
Financial Controls	No	No	Yes	Yes
Year Fixed Effects	No	No	No	Yes
N	820	820	813	813

t statistics reported in parentheses
standard errors are clustered at the firm-level

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Table 9: Relationship of *P* and Magnitude of Events (Large vs. Small)

Dependent Variable: $\ln(1+\text{total government fines})$			
	(1)	(2)	(3)
Ratio <i>P</i> of Equity Comp at t-1	0.7790* (1.79)	0.3243 (0.62)	1.2898** (2.07)
Total Compensation at t-1	-0.0000 (-0.17)	-0.0000 (-0.48)	-0.0000 (-0.79)
KLD Env Strengths at t-1	-0.1156 (-0.38)	-0.2886 (-1.03)	-0.2623 (-0.94)
KLD Env Concerns at t-1	-0.1512 (-0.61)	0.0789 (0.42)	0.0204 (0.06)
Incident Magnitude	All	<Median	>Median
Firm Fixed Effects	Yes	Yes	Yes
Env Controls	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Financial Controls	Yes	Yes	Yes
N	813	410	403

t statistics reported in parentheses

standard errors are clustered at the firm-level

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Table 10: Incentive Effects on Incident Rates

Dependent Variable: Environmental Incident (1,0)						
	(1)	(2)	(3)	(4)	(5)	(6)
Ratio <i>P</i> of Equity Comp at t-1	0.2574 (0.94)	-0.1736 (-0.37)	0.9873** (2.13)	0.0260 (0.91)	-0.0056 (-0.25)	0.0391** (2.38)
Total Compensation at t-1	-0.0000 (-0.00)	0.0000 (0.34)	-0.0000 (-0.53)	0.0000 (0.29)	0.0000 (0.57)	-0.0000 (-0.54)
KLD Env Strengths at t-1	-0.2295 (-0.98)	-0.7830** (-2.17)	-0.3677 (-1.12)	-0.0223 (-0.64)	-0.0378* (-1.91)	-0.0215 (-0.92)
KLD Env Concerns at t-1	-0.3079 (-1.64)	-0.2419 (-0.93)	-0.4652** (-2.09)	-0.0406 (-1.33)	-0.0169 (-0.87)	-0.0377 (-1.62)
Model	Logit FE	Logit FE	Logit FE	Linear FE	Linear FE	Linear FE
Incident Magnitude	All	4th Q	1st Q	All	4th Q	1st Q
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Env Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Financial Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	1297	635	538	4938	4938	4938

t statistics reported in parentheses

Logit panel standard errors are calculated via bootstrap method (400 repetitions)

Linear panel standard errors are clustered at the firm-ceo pair level

* p<0.10 **p<.05 ***p<.01

Table 11: Incentive Effects on Event Magnitudes

Dependent Variable: $\ln(1+\text{total government fines})$				
	(1)	(2)	(3)	(4)
Ratio <i>P</i> of Equity Comp at t-1	1.0827* (1.93)	1.0657* (1.86)	1.0805* (1.91)	0.9278 (1.59)
Total Compensation at t-1	0.0000 (0.31)	0.0000 (0.34)	0.0000 (0.30)	0.0000 (0.35)
KLD Env Strengths at t-1		0.0627 (0.14)	0.0364 (0.08)	0.0895 (0.20)
KLD Env Concerns at t-1		-0.1542 (-0.53)	-0.1742 (-0.60)	-0.1738 (-0.62)
Firm-CEO Fixed Effects	Yes	Yes	Yes	Yes
Env Controls	No	Yes	Yes	Yes
Financial Controls	No	No	Yes	Yes
Year Fixed Effects	No	No	No	Yes
N	726	726	722	722

t statistics reported in parentheses

standard errors are clustered at the firm-ceo pair level

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Table 12: The Relationship of *P* and Financial Accounting Events: Logit Panel Model

Dependent Variable: Accounting Incident (1,0)			
	(1)	(2)	(3)
Ratio <i>P</i> of Equity Comp at t-1	2.1384*** (3.29)	2.4113*** (3.42)	1.4885** (2.07)
Total Compensation at t-1	0.0000 (0.57)	0.0000 (0.50)	0.0000 (0.25)
Firm Random Effects	Yes	Yes	Yes
Financial Controls	No	Yes	Yes
Year Fixed Effects	No	No	Yes
N	13586	13098	13098

t statistics reported in parentheses

standard errors are bootstrap (400 repetitions)

accounting incident is a restatement that is investigated by the SEC

* p<0.10 **p<.05 ***p<.01

Table 13: The Relationship of *P* and Financial Accounting Events: Linear Panel Model

Dependent Variable: Accounting Incident (1,0)			
	(1)	(2)	(3)
Ratio <i>P</i> of Equity Comp at t-1	0.0058*** (4.76)	0.0066*** (4.77)	0.0037*** (2.95)
Total Compensation at t-1	0.0000 (0.86)	0.0000 (0.85)	0.0000 (0.66)
Firm Random Effects	Yes	Yes	Yes
Financial Controls	No	Yes	Yes
Year Fixed Effects	No	No	Yes
N	13586	13098	13098

t statistics reported in parentheses

standard errors are clustered at the firm level

accounting incident is a restatement that is investigated by the SEC

* p<0.10 **p<.05 ***p<.01

Table 14: The Effect of Policy Changes on Potential Accounting Misconduct

Dependent Variable: Accounting Incident (1,0)				
	(1)	(2)	(3)	(4)
Ratio <i>P</i> of Equity Comp at t-1	1.4339** (1.97)	1.4874** (2.24)	0.0036*** (2.80)	0.0037*** (2.96)
Post Sarbanes Oxley (1,0)	-0.2383 (-0.60)	-0.2114 (-0.55)	-0.0026 (-0.86)	-0.0020 (-0.62)
Post FAS 123R (1,0)	-1.7309 (-0.70)	-22.9125*** (-10.28)	-0.0049*** (-3.97)	-0.0063*** (-3.87)
Panel Regression Model	Logit	Logit	Linear	Linear
Firm Random Effects	Yes	Yes	Yes	Yes
Financial Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	No	Yes	No	Yes
N	13098	13098	13098	13098

t statistics reported in parentheses

Standard errors for logit are calculated via bootstrap method (400 repetitions)

Standard errors for linear are clustered at the firm level

accounting incident is a restatement that is investigated by the SEC

* p<0.10 **p<.05 ***p<.01

Table 15: Relationship of *P* and Magnitude of Financial Accounting Events

Dependent Variable: $\ln(1+\text{abs}(\text{negative earnings restatement}))$				
	(1)	(2)	(3)	(4)
Ratio <i>P</i> of Equity Comp at t-1	0.7114** (2.38)	0.7080** (2.48)	0.5645* (1.88)	0.5920* (1.76)
Total Compensation at t-1	0.0001*** (4.17)	0.0000** (2.38)	0.0000** (2.24)	0.0000*** (2.99)
Regression Model	OLS	OLS	OLS	OLS
Financial Controls	No	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
Industry Controls	No	No	no	Yes
N	283	274	274	274

t statistics reported in parentheses

robust standard errors

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$