The Characteristics of Firms that Hire Chief Risk Officers

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Abstract

Enterprise risk management (ERM) is a holistic method of managing both operational and strategic risks across an organization. In recent years adoption of ERM has been increasing. We use a hazard model to examine the factors that influence the adoption of this practice. We find that larger firms that are more levered, have more volatile operating cash flows, and have greater institutional ownership are more likely to initiate an ERM program. However, firms with more growth options and firms that have experienced greater changes in market value are less likely to adopt ERM. When the value of the CEO's option and stock portfolio is increasing in stock volatility, the firm is also more likely to adopt ERM. Finally we find that banks with lower levels of Tier 1 capital are more likely to adopt ERM. Our results indicate that firms adopt ERM for reasons consistent with risk management as well as to offset CEO risk taking incentives and to bolster performance.

JEL Classification Codes: G32.

Key Words: Enterprise Risk Management, Chief Risk Officer, Hazard Model

1 Introduction

In recent years, researchers have paid increasing attention to the growing prominence of Enterprise Risk Management (ERM). In most cases this research has focused on the process of ERM and the potential gains from adoption. For example, Nocco and Stulz (2006) argue that the frictionless market view that a firm should not expend resources on managing idiosyncratic risk is unreasonable in the presence of market imperfections. Instead they argue that an integrated, holistic, approach to risk management can be used to create shareholder value. Other papers discuss ERM in broad terms, and mostly assume that ERM has or will be adopted. For example, Aabo, Fraser, and Simkins (2005) provide a road map for implementation and Beasley, Clune, and Hermanson (2005) examine the factors associated with the degree of adoption. There has, however, been little work examining the types of firms that actually implement ERM.

In this paper we examine factors that are hypothesized to be drivers of ERM implementation. Our goal is to shed light on whether firms are engaging in ERM with the goal of value maximization or whether other incentives are driving the implementation decision. Our work is related to Liebenberg and Hoyt (2003) who use a logistic model to examine the particular characteristics of firms adopting ERM.[1] Liebenberg and Hoyt find that size and leverage are both related to the decision to implement ERM, however, many of the other factors in their regression model are insignificant. Their insignificant results is likely due to a small sample (n=26), and the

[1] In a related study, Beasley, Pagach, and Warr (2007) examine the impact of ERM implementation on short-term stock returns and find that firm specific characteristics are important determinants of the stock market reaction to ERM adoption.

use of the logistic model. In this application, a logistic model is not necessarily the appropriate method for testing the significance of a one-time event that can occur through time. We improve upon the method of Liebenberg and Hoyt (2003) in three ways. First we use a larger sample of ERM adopters. Second, we measure a wider range of variables, including the stock and option holdings of managers. And third, we use a Cox proportional hazard model to measure the importance of the variables in the regression analysis. The hazard model allows us to examine a large sample of companies, of which only a proportion choose to adopt ERM, and generates more reliable standard errors than a logit model.

Our research builds on the existing risk management literature that suggests a range of factors that may influence the decision to employ traditional risk management. As ERM is a broader process than traditional risk management, it is unclear whether the factors that drive traditional risk management also influence ERM adoption. For example, ERM may be adopted by poorly performing firms in order to signal to investors that they are attempting to prevent future instances of poor performance. Likewise, if ERM is being adopted due to regulatory or industry pressures it is doubtful that firms implementing ERM will differ from non-implementing firms with respect to financial characteristics, after controlling for industry membership.

The factors that we examine cover a broad range of variables that measure financial, asset, market and managerial characteristics. Financial characteristics represent indirect measures of the likelihood of financial distress. Firms that face greater risk of financial distress and the implicit and explicit costs contained therein may benefit from ERM when ERM reduces the chance of costly lower tail cash flow outcomes. Asset characteristics measure the potential costs of financial distress, such as the inability to pursue growth options. Market characteristics measure the potential costs associated with volatile security performance, such as a higher cost of capital. Finally managerial characteristics measure the degree to which the CEO's stock and option based compensation encourages risk taking or risk avoiding behavior. In addition to examining industrial and financial firms in general, we also look at the subset of banks in our sample and examine industry specific variables such as Tier 1 capital ratios.

As a preview of our results, we find that larger firms that have greater risk of financial distress, i.e. those with more leverage, and more volatile operating cash flows are more likely to adopt ERM, as proxied by hiring a Chief Risk Officer (CRO). We find that firms with more growth options, as proxied by a firm's market-to-book ratio, are less likely to hire a CRO. This finding may reflect a preoccupation with ERM in firms that have lower quality growth options and are trying to create value by focusing more attention on business opportunities currently in place, and believing that ERM will boost the bottom line (a commonly touted claim by ERM proponents).

We find that firms with CEOs that have incentives to take risk, based on option compensation, are also more likely to hire a CRO. This result appears counterintuitive, but is consistent with boards making the CRO appointment to provide a control against the CEO's risk taking incentives.

Look at our banking sub sample, we find that banks with lower capital ratios are more likely to pursue ERM, consistent with them focusing on managing operational risk in the presence of greater leverage risk.

Our paper proceeds as follows; Section 2 presents a literature review and develops our hypothesis. Section 3 presents the data. Section 4 presents the univariate results and Section 5 presents the multivariate hazard model results. Section 6 concludes.

2 Literature Review and Hypothesis Development

Risk management has evolved from a narrow view that focused on corporate insurance and hedging to a holistic, all risk encompassing view, commonly termed Enterprise Risk Management (ERM).[2] ERM is a management process that requires a firm's management to identify and assess the collective risks that affect firm value and apply an enterprise wide strategy to manage those risks (Meulbrock, 2002). The Committee of Sponsoring Organizations of the Treadway Commission (COSO) in its ERM framework defines ERM as

> (A) process, effected by an entity's board of directors, management and other personnel, applied in a strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives (COSO, 2004).

Although there is little empirical research on ERM there have been a number of case studies and surveys that have examined the implementation process and explored the benefits of ERM. For example, Aabo, Fraser, and Simkins, (2005) discuss ERM implementation at Hydro One (a Canadian utility). The conclusions of their study provide a useful framework for understanding the ERM process. In Hydro One's case, the primary goal of ERM is not risk reduction. Instead the firm focuses on using ERM to

[2] See Tufano, (1996); Liebenberg and Hoyt, (2003); Beasley et. al. (2005); and Slywotzky and Dzik (2005) for discussions of the development and adoption of ERM.

achieve a balance between operational risks and returns and to control the risk from lower left tail cash flow events (essentially big losses). The ERM process starts with first identifying all of the risks facing its business, and then assessing the consequences of these risks along with the controls in place to respond to the risks. Management then decides whether to tolerate a risk or mitigate a risk. While this process is consistent with traditional management of risks such as interest rate risk, ERM differs in that it attempts to manage all risks, including operational and reputational risks that normally can not be hedged. It is this examination of all risks facing the firm and the attempt to manage the risks in a holistic manner that separates ERM from traditional silo based risk management.

Despite increased adoption, the realized benefits of ERM are subject to debate, as in a frictionless capital market, risk management is a negative NPV project.[3] The key to value creation by ERM thus depends on the presence of capital market frictions. Several researchers have examined this issue. For example, Guay and Kothari, (2003) find that hedging can be beneficial to the firm in the presence of such frictions and Nocco and Stulz (2006) and Stulz (1996, 2003) argue that risk management activities could be value increasing for shareholders in the presence of agency costs and market imperfections.

ERM could be value creating if it reduces the probability of large negative cash flows (or "costly lower tail outcomes") through the coordination of risks across the enterprise and ensures that no single project risk has an adverse effect on the firm overall (Stulz, 1996, 2003). But it is only firms that face these lower tail outcomes that will

[3] Beasley, Pagach and Warr (2007) find no significant stock price reaction (positive or negative) to ERM adoption.

benefit from ERM, as other firms will see no benefit and could destroy value by spending corporate resources on ERM.

Lower tail outcomes have direct and indirect costs. Events such as bankruptcy and financial distress involve direct outlays to creditors, lawyers and courts. Indirect costs include the inability to pursue profitable growth options, the loss of customer confidence, and the inability to realize the full value of intangible assets upon liquidation. A decline in debt ratings and the resulting increase in borrowing costs can also be costly for shareholders.

Managers who own stock in their company will have an undiversified equity portfolio and will bear a greater proportion of the cost of a lower tail event than a fully diversified shareholder. In an efficient labor market, these managers will demand higher compensation for bearing this idiosyncratic risk. Other stakeholders, such as suppliers, may be reluctant to enter into long term contracts with the firm if the potential for future payment is uncertain. All of these problems can result from the possibility of costly lower tail outcomes and represent value creating opportunities for a risk management program. The market imperfections that we examine are the result of lower-tail outcomes that produce costs associated with financial distress, external financing and managerial risk aversion. Our study complements Nance, Smith and Smithson (1993) who examine firms' use of hedging instruments and Guay and Kothari (2003) who examine the hedging activities of non-financial firms.

In our study, we proxy for ERM adoption with the hiring of a Chief Risk Officer because corporations tend only to disclose minimal details of their risk management programs (Tufano, 1996). There are, however, good reasons to believe that CRO hiring coincides with the decision to follow an ERM program. For example, The Economist Intelligence Unit, (2005) reports that many organizations appoint a member of the senior executive team, often referred to as the chief risk officer or CRO, to oversee the enterprise's risk management process. Walker, et. al. (2002) note that because of its scope and impact, ERM requires strong support from senior management. Beasley et al. (2005) show that the presence of a CRO is associated with a greater stage of ERM adoption.

We examine firm-specific variables that reflect the likelihood and cost of a firm experiencing a lower-tailed event either through increasing the chance of financial distress or increasing the costs associated with such distress. We also attempt to shed light on the impact of managerial incentives on ERM implementation. These variables are grouped into four broad categories. The first; financial characteristics, represent indirect measures of the likelihood of financial distress. Firms that face greater risk of financial distress and the implicit and explicit costs contained therein may benefit from ERM. These variables include leverage, financial slack and operating cash flow volatility. We hypothesize that firms with more leverage and less financial slack will be more likely to implement ERM. Firms with greater operating cash flow volatility are more likely to experience lower tail earnings outcomes.

The second category measures asset characteristics and proxies for the potential costs of financial distress – such as the inability to pursue risky but profitable future projects. These variables include, asset opacity, Research and Development intensity and growth options. We hypothesize that firms with more opaque assets, greater R&D expense and more growth options are more likely to benefit from ERM.

The third category measures market performance and the volatility of the firm's stock returns. We hypothesize that firms with more volatile stock prices are more likely to benefit from ERM. Furthermore, firms that have seen a reduction in value, either as a result of poor stock performance or capital structure changes may implement ERM as a means to convince investors that they are addressing operational issues in order to avoid future poor performance.

The final category measures managerial incentives to protect their own undiversified investment portfolios, or the degree to which their incentives are aligned with those of investors. We compute the partial derivatives of the CEO's stock and option holdings with respect to the stock volatility and the stock price (as in Rogers, 2002). The ratio of these measures captures the risk taking incentives of the CEO. We hypothesize that those CEOs who have compensation portfolios that are more sensitive to volatility (such as close to the money options) will avoid ERM and programs that might try to reduce risk.

Our remaining variables control for industry membership, operating segments and institutional ownership. Later in the paper we include additional bank specific variables when we examine the bank sub sample.

3 Data and Method

Our study starts with 138 announcements of senior risk officer appointments made from 1992-2005 for which we are able to obtain all the necessary data for our tests. Announcements are obtained by searching the business library of LEXIS-NEXIS for announcements containing the words "announced", "named", or "appointed", in conjunction with position descriptions such as "chief risk officer" or "Vice-President -

Enterprise Risk Management".[4] Only announcements for publicly traded companies were retained and in the case of multiple announcements for the same company we selected only the first announcement on the assumption that this represented the initiation of the risk management program.

By using the LEXIS-NEXIS database we hope to capture each firm's first appointment of an executive overseeing an enterprise level risk management program however, it is possible that some appointments, although being the first announcements, are not actually the first appointments. These announcements will add noise to our sample and reduce the power of our tests. It is also possible that we have excluded executives from our sample that oversee an enterprise risk management program but have titles that are excluded from our search. Lam (1999) points out that some risk management executives have titles such as Chief Market and Credit Officer, but these positions may not be primarily focused on ERM. This will result in a misclassification of firms in our model and again reduce the power of our tests.

We collect data for all firms listed in Compustat from 1990 to 2005. We supplement the data with stock price data from CRSP and 13-F ownership data. In a subset of tests we include a variable to measure the sensitivity of the CEO's compensation to the volatility of the stock price. The data for this variable comes from ExecuComp, but is only available for the S&P 1500 firms, and thus reduces the number of CRO hire firms in our sub sample to 77. The full data set is an unbalanced panel in which CRO hirings are indicated by a dummy variable that takes the value 1 in the year that they are made, and zero otherwise.

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[4] We searched for the following titles: Director, Vice-President, Chief, Senior, Executive, Head, Manager, and Managing Director.

Table 1 presents the distribution of the announcements through time as well as the distribution across industries. Most CRO hires tend to be in the later part of the sample period, clustered around 1999 through 2002. A substantial portion of the appointments are located in the financial and utility industries. These are defined in our sample as having SIC codes in the 6000s for financial firms and in the 4900s for utilities.

In our multivariate analysis we examine variables that are either hypothesized determinants of the CRO hire decision or are control variables. These variables are grouped together and defined as follows:[5]

3.1 Financial Characteristics

3.1.1 Leverage

Firms with greater leverage are more likely to suffer from financial distress than firms with low leverage.

Leverage= Total Liabilities/Total Assets = (d6 – d60)/d6 (1)

3.1.2 Cash ratio

Cash Ratio measures the amount of highly liquid assets that the firm has on hand that could be used to make up a short fall in operating cash flows.

Cash Ratio = Cash and Marketable Securities/Total Assets = d1/d6 (2)

3.1.3 Operating cash flow volatility

Firms with more volatile operating cash flows are more likely to benefit from ERM if the goal of ERM is to smooth cash flows. Smoothing cash flows reduces the

[5] Where applicable, the Compustat data items (d#) used to compute the variables are shown.

probability of experiencing a lower tail cash flow outcome   SDCF is the standard deviation of the error term from a regression of the firm's quarterly operating cash flow on the prior quarter's operating cash flow. This regression is run for eight quarters.[6]

3.1.4 Size

We control for size using the log of the market value of equity of the firm at the fiscal year end prior to the CRO hire announcement.

3.2 Asset Characteristics

Asset characteristics measure the potential costs of financial distress, and proxy for the potential unrecoverable losses that may be incurred in financial distress.

3.2.1 Opacity

Firms that have opaque assets may have difficulty selling these assets at purchase cost to avert financial distress, as opaque assets are associated with more information asymmetry thus and thus are more likely to be undervalued. Opacity is computed as:

$$Opacity = Intangibles/\ Total\ Assets = d33/d6 \qquad (3)$$

3.2.2 Growth options

Firms with growth options have much of the firm's value tied to future, and as yet, unrealized cash flows. Because of the uncertain nature of the payoff from such expenditures, the value of these investments are unlikely to be fully realized in bankruptcy, thus ERM may be favored by firms with higher growth options. We proxy

[6] Our results are quantitatively unchanged if we use the standard deviation of EPS as the volatility measure.

for growth options using market-to-book (MB) and Research and Development expense (RD). These variables are computed as:

*MB = Market Value of Equity/ Book Value of Equity = (d199*d25)/d60* (4)

RD = Research and Development Expense / Total Assets = d46/d6 (5)

3.3 Market Characteristics

Market characteristics measure the volatility of the firm and the stock price performance. SDRET is the standard deviation of the firm's daily returns over the year prior to the hiring of the CRO.

Firms that have experienced significant growth in size, either due to stock price performance or acquisitions, may see a need for greater enterprise risk management oversight. Therefore we compute the value change (Value Change) as the percentage change in market value of the firm over the year prior to the hiring of the CRO.

3.4 Managerial incentives

Executive stock and option based compensation can affect the incentives of executives by altering their risk preferences. CEOs that have a large proportion of option based compensation are more likely to prefer strategies that increase the volatility of the firm's stock – thus increasing the value of their option holdings. Conversely, CEOs with larger stock holdings hold undiversified portfolios which are overweighted in their company's stock. These CEOs may prefer strategies that reduce overall stock idiosyncratic risk. The distinction between option and stock compensation is further complicated by the degree to which the option is in the money. Very in the money options provide stock-like incentives compared to at the money or underwater options.

Therefore, measuring option and stock based compensation requires more than just summing the value of the CEO's holdings.

We use the approach of Rogers (2002) who builds upon Core and Guay (2002). Rogers computes a proxy that incorporates CEO incentives to increase risk relative to incentives to increase stock price. This proxy combines the partial derivative of the dividend adjusted Black-Scholes equation with respect to the standard deviation of stock returns and the partial derivative of the Black Scholes equation with respect to the level of the stock price. The first measure, Vega, measures the incentive to take risk and the second measure, Delta, measures the incentive to increase stock price. We compute Vega and Delta for each CEO's stock and option portfolio and use the ratio (as in Rogers, 2002) of the two variables – Vega to Delta as our proxy for the CEO's risk taking incentives.[7] The full details of the comp of Vega and Delta are contained in the appendix.

3.5 Controls

Firms with more operating segments (Numseg) are likely to be able to diversify operating and financial risks within the firm and may have less need of ERM. However, as the number of operating segments increase the range of businesses and risks that the firm is involved in could increase the need for an overall holistic view of risk management. Firms with greater institutional ownership may have greater pressure to install controls associated with ERM. We measure institutional ownership as the percentage of the firm's stock held by institutional investors as recorded in 13-F filings. This variable is designated as PINST. The number of institutional investors is designated

[7] For the stock holdings, vega = 0 and delta = 1.

as NINST. Finally, we control for industry membership – specifically whether the firm is a financial firm or a utility and firm size.

4 Univariate Results

Table 2 presents summary statistics for the main variables. In addition to providing means and medians of the CRO sample and the sample as a whole, the table presents results of tests of the means (t-tests) and medians (sign-rank tests). Note that CRO firms are in the main sample until the year in which they hire a CRO.

The CRO hiring firms tend to have more volatile cash flows and tend to be larger, more levered and have lower cash ratios than the non-hiring firms. These results are to be expected in that CRO hires tend to be more prevalent among financial firms. CRO hiring firms tend to be less opaque than non-hiring firms in that they have lower Opacity, Market-to-Book and Research and Development expenses. These findings are counter to our hypothesis that firms with more opaque assets and more growth options will tend to try and protect those future revenue sources through risk management. These results are most likely being heavily influenced by large number of financial firms in the hiring sample. The multivariate results will allow us to separate out these affects after controlling for industry. CRO hiring firms tend to have less volatile stock prices. The hiring firms have also seen poorer stock performance in the period before the hiring announcement (as evidenced by the value change variable).

In examining compensation, Vega to Delta for the hiring firms is higher than for the non-hiring firms, a result that runs counter to our expectation that firms with volatility preferring CEOs will not choose ERM. Finally we find that the hiring firms have more segments and more institutional ownership than the non-hiring firms, but again these results may be picking up other effects, such as size.

In Table 3 we examine correlations between our key variables. Somewhat unsurprisingly, size is correlated with many of the other variables in manners which might be expected. For example, larger firms tend to have less earnings and stock volatility (SDEBIT and SDRET). Vega to Delta shows little correlation with most of the other variables of interest.

5 Multivariate Determinants of CRO Hiring Announcements

In this section we focus on the multivariate determinants of the CRO hire decision. An important contribution of this paper is the econometric approach that we use to model the relation between the CRO appointment decision and firm characteristics. Typically, binary decisions of this type are modeled using a "static model", so called by Shumway (2001), in which a logit regression is run on a data set that is comprised of the dates on which CROs are hired. On each of these dates, a "hire" dummy variable is created and coded 1 for the firms that have hires, while the other non-hire firms are coded zero. This approach ignores information contained in the time periods on which there are no CRO hires.

An alternative approach is to use the full time series of data, including those periods during which no hiring event occurs. For the periods with no hirings, the dependent binary variable is zero for every firm in the data set. The data set is not a traditional panel data set but more correctly termed an event history data set, which reduces in observations each time a firm hires a CRO and thus exits from the data set. This approach has been used by other authors including Pagano, Panetta and Zingales

(1998) to model the IPO decision and Denis, Denis and Sarin (1997) to model executive turnover.

Using a logit model to estimate the parameters of an event history data set will produce incorrect test statistics because of the assumption that all the observations for a firm are independent. To see this lack of independence, consider that an event on day t=1 can only be preceded by a non event on day t=-1. A hazard model overcomes this problem, and can incorporate the impact of time on the hiring decision. Hazard models, commonly used in medical research, model an event (in this case a CRO hire) as a function of the determinants of the event.[8] The hazard model approach takes account of the evolution of a firm's characteristics and computes a hazard ratio of the firm hiring a CRO, whether or not the firm actually hires. The parameter estimates of the hazard model should be similar to those of the logit model (using a full event history data set), but the hazard model produces superior test statistics. We estimate the following hazard model:

$$CROHIRE_{it} = f(Financial\ Characteristics_{it}, Asset\ Characteristics_{it}, Market\ Characteristics_{it}, Managerial\ Characteristics_{it}, Controls) + e_{it} \quad (6)$$

We use a Cox proportional hazard function to estimate equation 6. The Cox model is a semi parametric model in which the likelihood of the event is not related to elapsed time. The subscript i represents each firm in the data set that could have a CRO hiring announcement, but has not yet had one. The subscript t represents every year from 1990 to 2005. The dependent variable, CROHIRE is a binary variable that takes the

[8] In addition to those cited, several other authors use hazard models in finance research, for example Johnson (2004), Ongena and Smith (2001) , McQueen and Thorley (1994), Deshmukh (2003) and Danielsen, Van Ness and Warr (2007).

value of 1 if the firm announces the appointment of a CRO, and zero otherwise. For the years prior to a CRO hiring, CROHIRE=0. Once a CRO is hired, the observation drops out of the data set. Therefore, a firm can have a maximum of one observation with CROHIRE=1. The independent variables are estimated as of the beginning of the fiscal year in which the CRO is hired.

5.1 Hazard Model Results

Table 4 presents the results of our basic hazard model estimation. Interpreting the economic significance of the coefficients requires estimating the increase in the likelihood of the event, in this case a CRO hire, given a change in the independent variable of interest. Commonly, standardized hazard ratios are computed by calculating the effect of a one standard deviation shift for each independent variable. However, several of the variables in our study are right-tail skewed, and consequently have large standard deviations, which may make cross-sectional comparisons misleading. We therefore closely follow the approach of Danielsen, Van Ness and Warr (2007) and consider a change in each right-hand-side variable equal to 10% of the variable's mean value. This measure is referred to as a 10%-of-mean-standardized hazard ratio to avoid confusion with a ratio based on standard deviations. Because hazard ratios are easier to interpret when the coefficient estimates are positive, we use the absolute value of each coefficient to estimate our 10%-of-mean-standardized hazard ratio. The 10%-of-mean-standardized hazard ratio (Std HR) is computed as:

$$Std\ HR = e^{\left|coef\right| \times 0.1 \times mean} \qquad (7)$$

Table 4 presents our base model for the full sample. The first column "HR" is the hazard ratio, the second "Coef" is the coefficient and the third column "Std HR" is the

"10%-of-mean-standardized hazard ratio". The last column of the table labeled "mean" is the mean of the variable and is used in the computation of the "Std HR" column.

We find that leverage and size are positively related to the likelihood of hiring a CRO. A 10% increase in leverage will result in a 7.1% increase in the likelihood of a hire.[9] This result is consistent with firms that are more levered are at a greater risk of financial distress. The economic significance of the size variable is particularly large, indicating a 10% increase in size will increase the likelihood of a hire by 22.6%. Furthermore, for the standard deviation of cash flows, SDCF, a 10% increase will result in a 1.0% increase in the likelihood of a hire. We find no relation for the Cash Ratio variable.

Of the variables that proxy for the asset characteristics, RD and MB are both significant and negative (the HR is less than 1, resulting in a negative coefficient which is the log of HR).[10] This result is counter to our hypothesis that firms with more growth options and RD investments will seek to protect these through ERM. It is possible that higher growth firms are less concerned with overall enterprise risk management because they are focusing on growth opportunities. Conversely, stable and mature growth firms are looking to improvements (through ERM) in their day-to-day management of operations.

Examining the market variables, we find that only Value Change is significant. The Value Change variable is negative and significant, indicating that the probability of a hire is negatively related to recent change in market value of the firm. In unreported regressions, we replace the value change variable with the year on year price change and

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[9] This magnitude is obtained from the Std HR value of 1.071 which implies that an increase of the mean of the independent variable by 10% will increase the hazard likelihood l.071 times or 7.1%.
[10] For example, a 10% decline in R&D will result in a 3.7% increase in the probability of hiring a CRO.

find that the price change variable is insignificant. The value change variable therefore appears to be picking up changes in the size of the firm, rather than just stock market performance. That the value change variable is negative suggests that firms that have experienced recent rapid growth either due to acquisitions or capital structure changes are less likely to appoint a CRO. This result runs counter to the size variable which indicates that larger firms are more likely to appoint CROs.

Looking at our control variables we find that the number of segments is negative, yet insignificant. This result may reflect the dual effects of diversification on risk management. On one hand we would expect more diversified firms to have less need for ERM as these firms have more opportunity to engage in operational hedges.[11] That firms appear to use diversification instead of risk management is supported by other authors. For example, Hankins (2008) reports evidence that firms use operational hedges as substitutes for financial hedging, and Thomas (2002) finds that diversified firms have more predictable earnings. Alternatively, we might expect a larger more diverse organization to be a good candidate for ERM given the wide range of uncoordinated risks that it faces.

PINST (the percentage of shares held by institutions) is positive and significant, consistent with an institutional desire for greater risk management. Finally, both the financial firm and utility firm dummy variables are positive and highly significant consistent with a preference among these firms for implementing ERM. The significance of these two industries is consistent with previous research (see for example Beasley, et al, 2007). These industries may be implementing ERM earlier for a number of reasons.

[11] As we stated earlier, we might expect firms that have more segments will have a greater need for risk management in order for them to coordinate a broader range of risk exposures.

Both industries are highly regulated with compliance with government regulators being an important issue. In both industries traditional risk management practices are more entrenched and the move to examine risks in a holistic manner may be more easily implemented.

As a robustness check to determine if the results are being driven by regulated firms, we re-ran the table 4 regression model on the non-financial, non-utility firms in the sample. In unreported results we find that size and operating cash flow volatility remain significant predictors of CRO appointments. Furthermore, we find that the negative relation between appointments and the value change variable and the RD variable persist in this sub sample.

5.2 CEO incentives

In Table 5 we explore the effect of CEO compensation on the CRO hire decision. As we stated earlier, data on CEO compensation is only available for a sub set of our firms, and hence we have a reduced sample size. We measure CEO incentives using the ratio of Vega to Delta, as in Rogers (2002). A higher value of this ratio indicates that the value of the manager's compensation is more sensitive to stock volatility.[12] In Table 5, the coefficient on Vega to Delta is positive and significant indicating that as CEOs compensation packages become more sensitive to stock volatility, the likelihood of hiring a CRO increases. This result appears to be at odds with the incentives of a CEO to maximize his/her own personal wealth, as one would expect a rational CEO who has much of his/her compensation in the form of at the money options to prefer that the firm

[12] This variable does not include cash based bonus compensation. In unreported results we included the bonus as a percentage of total compensation, but found it to be insignificant. One problem with using bonus as part of this variable is that it is very difficult to estimate the delta for bonus, i.e. the sensitivity of the bonus to stock price performance.

be more risky. If, however, ERM reduces downside risk without impacting upside risk, the CEO should rationally embrace ERM even if the CEO has an incentive to take risks and gets rewarded in the upside.[13]

It is generally not the CEO that makes the decision to implement ERM; indeed it is the board of directors that usually leads this initiative (Lam, 2001), although during this time period, quite a few CEOs also held the board chairman position. Thus a possible explanation for this result is that the board recognizes that the CEO has an incentive to increase risk and therefore by implementing a risk management program controls the risk that is expected to be taken on by the CEO. From the board's point of view this is a rational strategy – to effectively encourage risk taking by the CEO and at the same time implement a program to actively manage, coordinate and understand these risks.

We also note that the value change variable in this regression specification becomes insignificant. In unreported tests, we re-run this regression on the smaller sample, caused by the data limitations of the vega to delta variable, but without vega to delta and find that the value change variable remains insignificant. We are forced to conclude therefore that the value change variable is quite sensitive to the sample size employed in the regressions.

5.3 Financial Firms

The financial firm dummy in table 4 is highly significant indicating the importance of ERM to this industry group. To explore this result in more detail, we restrict our analysis to financial firms (SICC: 6000-6999) alone. Table 6 repeats the

[13] We thank the referee for suggesting this explanation.

analysis from Table 4 for our sub sample of financial firms.[14] In this regression specification we add dummy variables for the major financial sub-industries in which the firm's segments operate.[15] The results show that the coefficients on operating cash flow volatility, size, market-to-book, number of institutions, and value change and number of segments are significant. These results are largely consistent with the main results from Table 4. We also find that segments with SICC 6000 (depository institutions), 6200 (brokers) and 6400 (insurance agents) are significantly positive. Thus, the adoption of ERM is not uniform throughout the financial industry.

Table 7 investigates banking institutions (SICC 6000 and 6099) in more detail. We add three new variables to the analysis; Tier 1 Capital ratio (Compustat item 337), provision for loan losses (item 342) as a percentage of assets, and a proxy for duration gap. Duration gap requires computation of the duration of the bank's assets and liabilities. Given data restrictions we adopt a more simple approach and compare the annual change in the bank's assets to the change in the bank's liabilities as in Choi (2007).

$$DUR\ RATIO = \frac{\Delta Assets}{Assets} \Big/ \frac{\Delta Liabilities}{Liabilities} \qquad (8)$$

Table 7 presents the results of this regression. Notably, operating cash flow volatility remains a significant determinant of the CRO hire. We also find that Tier 1 Capital is negatively related to the CRO hire decision. Thus firms with lower Tier 1 Capital are more likely to employ a CRO and manage risk. This result is consistent with

[14] In unreported tests we repeat the analysis for utility stocks and find that size and cash flow volatility remain important determinants of CRO hiring for these firms.
[15] In this regression we exclude R&D.

our hypothesis that the firms with high costs of financial distress, or operate in a highly leveraged state are the greatest beneficiaries of ERM. The loan loss or duration variables are insignificant.

6 Conclusion

We use a hazard model to examine the determinants of the firm's decision to adopt enterprise risk management (ERM) which we proxy for with the hiring of a Chief Risk Officer (CRO). The hazard model generates reliable test statistics when a time-series panel data set is used. This approach, coupled with a larger sample, and more explanatory variables, represents an important contribution over previous work in this area.

We find that firms adopting ERM are doing so for some reasons that are consistent with the hypothesized benefits of ERM. For example we find that firms appear to implement ERM when they are larger, have more volatile cash flows, and greater leverage. We also find evidence consistent with firms implementing ERM for what might be considered to be non-risk management reasons. We find a negative relation between CRO hiring and the change in the size of the firm. This result does not appear when we examine the change in the stock price. Thus we conclude that firms that have grown rapidly are less likely to adopt ERM – this result could be a result of the firms naturally diversifying through growth. We also find that firms that hire CROs tend to have fewer growth options. We suspect that this result may be due to ERM being favored by more stable firms, who, in the absence of high growth projects, implement ERM in the belief that it will boost their bottom line.

Other authors find a direct relation between CEO risk taking incentives (option versus stock compensation) and hedging activity. This relation is normally negative in that the more risk taking incentives that the CEO has, the less likely the firm is to hedge. In our tests, the correlation is positive as we find that the likelihood of ERM adoption is increasing in the risk taking incentives of the CEO. A possible explanation for this result is that boards are implementing ERM to offset the risk taking incentives that they have granted to the CEO. This explanation is consistent with ERM being implemented at the direction of the board, whereas day to day hedging may be driven more by management.

When we consider financial firms alone we find that ERM adoption is more prevalent among depository institutions and brokers. Furthermore we find that banks with lower Tier 1 Capital are more likely to hire a CRO, consistent with these highly levered banks needing to have greater awareness of the portfolio of risks facing them.

While our study provides detail into the decision of firms to implement ERM there are limitations. Due to the lack of disclosure by firms about their risk management programs we proxy the decision to adopt ERM by the hiring of a Chief Risk Officer. Further study of the implementation process is needed to understand the evolution of firms' ERM programs. Additionally, further research is needed to understand the Chief Risk Officer's role within the firm; ideally this research should focus on the hiring process and the reporting relationship. The evolution and inner details of firms' ERM programs are an important topic for further study.

Appendix: Computing Vega and Delta for the CEO's Stock and Option Holdings

We follow Rogers (2002), who in turn follows Core and Guay (2002) in computing the option sensitivities to volatility and price. Delta measures the option value's sensitivity with respect to a 1% change in stock price and Vega measures the option value's sensitivity to a 0.01 change in standard deviation. These values are computed as:

Delta: $$\frac{\partial Value}{\partial S}\frac{S}{100} = \exp\{-dT\}N(Z)\frac{S}{100} \quad \text{(A.1)}$$

Vega: $$\frac{\partial Value}{\partial \sigma}\times 0.01 = 0.01\left[\exp\{-dT\}N'(Z)S\sqrt{T}\right] \quad \text{(A.2)}$$

where:

$$Z = \frac{\ln(S/X) + T(r - d + \sigma^2/2)}{\sigma\sqrt{T}}$$

$N(\cdot)$ is the cumulative probability function for the normal distribution, $N'(\cdot)$ is the normal probability density function, S is the share price of the stock at the fiscal year-end, d is the dividend yield as of fiscal year-end, X is the exercise price of the option, r is the risk free rate. We use the risk free rate provided in ExecuComp. σ is the annualized standard derivation of daily stock returns measured over 120 days prior to fiscal year-end and T is remaining years to maturity of option.

The data for estimation is from ExecuComp (and originally from the proxy statements), however, the exercise price and maturity are only available for current years option grants. Therefore to estimate prior years exercise prices and maturities we follow the Core and Guay (2002) algorithm, which is detailed on page 617 of their paper. The proxy statement provides realizable values of options grants (i.e. the excess of the stock price over the exercise price). Because X and T are computed separately for new options, the number and fiscal year-end realizable value of new options must be deducted from the number and realizable value of unexercisable options. Dividing unexercisable (excluding new grants) and exercisable realized values by the number of unexercisable and exercisable options held by the executive, respectively, yields estimates of, on average, how far each of the groups of options are in the money. Subtracting this number from the stock price yields the average exercise price. The exercise price is computed for exercisable and unexercisable options. The time to maturity for the exercisable options is the maturity of the new grants less one year (or nine years if no new grant is made). For the unexercisable options, the time to maturity is the maturity of the new grants less three years (or six years if no grant is made).

We treat the stock holdings of the CEO as having a vega of zero and a delta of one and include them in the computation of vega to delta.

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Table 1. CRO appointments by year

This table presents CRO appointments by year. The totals are broken out by financial firms (6000<= SICC<=6999) and utilities (4900 <= SICC<=4999).

Year	All Firms	Financial Firms	Utilities
1992	7	4	0
1993	9	2	0
1994	8	3	1
1995	9	3	1
1996	11	6	3
1997	5	4	1
1998	6	4	0
1999	9	5	1
2000	13	8	1
2001	23	14	5
2002	14	6	4
2003	12	8	1
2004	9	7	0
2005	3	3	0
	138	77	18

Table 2. Summary Statistics and Sample Comparisons

Leverage = Total liabilities/Total Assets = (d6 – d60)/d6, Cash Ratio = Cash and marketable securities/Total Assets = d1/d6, SDCF is the standard deviation of the error term from a regression of the firm's quarterly operating cash flow on the prior quarter's operating cash flow. This regression is run for eight quarters. Size is ln(market value of equity). Opacity = Intangibles/ Total Assets = d33/d6, MB = Market Value of Equity/ Book Value of Equity = (d199*d25)/d60, RD = Research and Development Expense / Total Assets = d46/d6, SDRET is the standard deviation of the firm's daily returns over the year prior to the hiring of the CRO, Value Change is the percentage change in market value of the firm over the prior year. Vega/Delta is the ratio of Vega, the partial derivative of the CEOs option and stock portfolio to stock volatility and delta is the partial derivative with respect to the stock price as in Rogers (2002). Numseg is the number of operating segments of the firm. PINST is institutional ownership as the percentage of the firm's stock. The number of institutional investors is designated as NINST. The means test is a two sided t-test. The medians test is a Wilcoxon Sign Rank test.

	CRO Hire firms			Non CRO Hire firms			Means		Medians	
	Mean	Median	SD	Mean	Median	SD	Difference	T- Test	Difference	Rank Sum
Financial Characteristics										
Leverage	0.744	0.812	0.217	0.530	0.538	0.260	-0.214	-11.548***	-0.274	-9.772***
Cash Ratio	0.088	0.052	0.110	0.170	0.072	0.218	0.082	8.798***	0.020	3.437***
SDCF	136.224	23.564	357.770	21.862	1.714	165.767	-114.362	-3.741***	-21.85	-10.159***
Asset Characteristics										
Opacity	0.054	0.013	0.105	0.074	0.003	0.138	0.019	2.148**	-0.010	-0.435
MB	2.447	1.820	3.064	4.844	1.849	79.482	2.396	6.349***	0.029	0.556
RD	0.005	0.000	0.017	0.045	0.000	0.135	0.040	26.870***	0.000	5.828***
Market Characteristics										
SDRET	0.026	0.021	0.017	0.040	0.033	0.028	0.015	10.133***	0.012	8.239***
Value Change	0.657	0.083	2.219	1.644	0.190	3.482	0.987	5.213***	0.107	2.086**
Managerial Characteristics										
Vega/Delta	0.503	0.405	0.529	0.358	0.244	0.519	-0.145	-2.583**	-0.160	-2.752***
Controls										
Numseg	4.957	3.000	5.083	3.086	2.000	3.464	-1.871	-4.321***	-1.000	-3.478***
NINST	196.507	148.000	175.678	61.240	23.000	104.929	-135.267	-9.043***	-125.000	-11.037***
PINST	0.454	0.476	0.250	0.308	0.242	0.264	-0.145	-6.828***	-0.234	-6.531***
Size	7.521	7.742	2.117	5.068	4.916	2.111	-2.453	-13.604***	-2.826	-11.973***

***, **, *: Significant at the 1%, 5%, 10% level respectively

Table 3. Correlations

Leverage = Total liabilities/Total Assets = (d6 – d60)/data6, Cash Ratio = Cash and marketable securities/Total Assets = d1/d6, SDCF is the standard deviation of the error term from a regression of the firm's quarterly operating cash flow on the prior quarter's operating cash flow. This regression is run for eight quarters. Size is ln(market value of equity). Opacity = Intangibles/ Total Assets = d33/d6, MB = Market Value of Equity/ Book Value of Equity = (d199*d25)/d60, RD = Research and Development Expense / Total Assets = d46/d6, SDRET is the standard deviation of the firm's daily returns over the year prior to the hiring of the CRO, Value Change is the percentage change in market value of the firm over the prior year. Vega/Delta is the ratio of Vega, the partial derivative of the CEOs option and stock portfolio to stock volatility and delta is the partial derivative with respect to the stock price as in Rogers (2002). Numseg is the number of operating segments of the firm. PINST is institutional ownership as the percentage of the firm's stock. The number of institutional investors is designated as NINST. P values for significance level of each pair-wise correlation are in parenthesis.

	Leverage	Cash Ratio	SDCF	Size	Opacity	MB	RD	SDRET	Value Change	Vega/Delta	Numsegs	NINST
Cash Ratio	-0.0694											
	(0.419)											
SDCF	0.1323	0.0440										
	(0.123)	*(0.609)*										
Size	0.2471	-0.1246	0.3608									
	(0.004)	*(0.145)*	*(0.000)*									
Opacity	-0.2886	-0.0515	-0.0821	-0.0737								
	(0.001)	*(0.549)*	*(0.340)*	*(0.390)*								
MB	0.1521	0.0875	0.0086	0.1354	0.0698							
	(0.075)	*(0.308)*	*(0.920)*	*(0.113)*	*(0.416)*							
RD	-0.3783	0.3436	-0.0743	-0.2501	0.1357	0.0769						
	(0.000)	*(0.000)*	*(0.388)*	*(0.003)*	*(0.113)*	*(0.370)*						
SDRET	0.0345	0.1147	-0.1295	-0.4478	0.0640	0.1331	0.1927					
	(0.688)	*(0.180)*	*(0.132)*	*(0.000)*	*(0.456)*	*(0.120)*	*(0.024)*					
Value Change	-0.1224	0.2925	-0.0624	-0.0463	-0.0913	0.1320	0.2289	0.0202				
	(0.153)	*(0.001)*	*(0.469)*	*(0.590)*	*(0.287)*	*(0.123)*	*(0.007)*	*(0.814)*				
Vega/Delta	0.0093	-0.1740	0.2396	0.1343	-0.0742	-0.0966	-0.1326	-0.1178	-0.1606			
	(0.931)	*(0.103)*	*(0.024)*	*(0.209)*	*(0.490)*	*(0.368)*	*(0.216)*	*(0.272)*	*(0.133)*			
Numseg	-0.0605	-0.0904	0.0378	0.3032	0.1639	0.1717	0.0394	0.0358	0.1565	0.1772		
	(0.481)	*(0.292)*	*(0.661)*	*(0.000)*	*(0.055)*	*(0.044)*	*(0.647)*	*(0.677)*	*(0.067)*	*(0.097)*		
NINST	0.3012	-0.1373	-0.3250	0.8046	-0.0939	0.1281	-0.1998	-0.2284	-0.1999	0.0765	0.1450	
	(0.000)	*(0.108)*	*(0.000)*	*(0.000)*	*(0.273)*	*(0.134)*	*(0.019)*	*(0.007)*	*(0.019)*	*(0.476)*	*(0.090)*	
PINST	0.0657	-0.1758	-0.0553	0.4702	0.0638	0.0276	-0.2517	-0.1396	-0.1812	0.0239	0.1144	0.5446
	(0.444)	*(0.039)*	*(0.521)*	*(0.000)*	*(0.458)*	*(0.748)*	*(0.003)*	*(0.102)*	*(0.033)*	*(0.824)*	*(0.181)*	*(0.000)*

Table 4

Cox proportional hazard model on the determinants of CRO hires for the full sample

Leverage = Total liabilities/Total Assets = (d6 – d60)/d6, Cash Ratio = Cash and marketable securities/Total Assets = d1/d6, SDCF is the standard deviation of the error term from a regression of the firm's quarterly operating cash flow on the prior quarter's operating cash flow. This regression is run for eight quarters. Size is ln(market value of equity). Opacity = Intangibles/Total Assets = d33/d6, MB = Market Value of Equity/Book Value of Equity = (d199*d25)/d60, RD = Research and Development Expense/Total Assets = d46/d6, SDRET is the standard deviation of the firm's daily returns over the year prior to the hiring of the CRO, Value Change is the percentage change in market value of the firm over the prior year. Numseg is the number of operating segments of the firm. PINST is institutional ownership as the percentage of the firm's stock. Financial is a dummy for (6000<=SICC<=6999) and Utility is a dummy for (4900<=SICC<=4999). Std HR is the 10%-of-mean-standardized hazard ratio is computed as: $e^{|coef| \times 0.1 \times mean}$.Absolute value of z statistics in parentheses

	HR	Coef	Std HR	Mean
FINANCIAL CHARACTERISTICS				
Leverage	3.650	1.295	1.071	0.531
	*(2.26)***			
Cash Ratio	1.040	0.039	1.001	0.170
	(0.05)			
ln(SDCF)	1.154	0.143	1.010	0.665
	*(2.83)****			
Size	1.494	0.401	1.226	5.072
	*(4.84)****			
ASSET CHARACTERISTICS				
Opacity	0.606	-0.501	1.004	0.075
	(0.61)			
ln(MB)	0.737	-0.305	1.022	0.702
	*(1.99)***			
RD	0.992	-0.008	1.037	45.103
	*(1.77)**			
MARKET CHARACTERISTICS				
ln(SDRET)	1.454	0.374	1.136	-3.402
	(1.59)			
Value Change	0.825	-0.192	1.032	1.643
	*(4.62)****			
CONTROLS				
Numseg	0.991	-0.009	1.003	2.948
	(0.45)			
PINST	2.179	0.779	1.024	0.309
	*(2.15)***			
NINST	1.001	0.001	1.006	61.460
	(1.07)			
Financial	4.602	1.526	1.032	0.203
	*(5.71)****			
Utility	4.336	1.467	1.005	0.036
	*(4.63)****			
Observations = 84362		CRO hires = 137		

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5

Cox proportional hazard model on the determinants of CRO hires, including CEO incentives

Leverage = Total liabilities/Total Assets = (d6 – d60)/d6, Cash Ratio = Cash and marketable securities/Total Assets = d1/d6, SDCF is the standard deviation of the error term from a regression of the firm's quarterly operating cash flow on the prior quarter's operating cash flow. This regression is run for eight quarters. Size is ln(market value of equity). Opacity = Intangibles/Total Assets = d33/d6, MB = Market Value of Equity/ Book Value of Equity = (d199*d25)/d60, RD = Research and Development Expense/Total Assets = d46/d6, SDRET is the standard deviation of the firm's daily returns over the year prior to the hiring of the CRO, Value Change is the percentage change in market value of the firm over the prior year. Vega/Delta is the ratio of Vega, the partial derivative of the CEOs option and stock portfolio to stock volatility and delta is the partial derivative with respect to the stock price as in Rogers (2002). Numseg is the number of operating segments of the firm. PINST is institutional ownership as the percentage of the firm's stock. The number of institutional investors is designated as NINST. Financial is a dummy for (6000<=SICC<=6999) and Utility is a dummy for (4900<=SICC<=4999). Std HR is the 10%-of-mean-standardized hazard ratio is computed as: $e^{|coef| \times 0.1 \times mean}$. Absolute value of z statistics in parentheses

	HR	Coef	Std HR	Mean
FINANCIAL CHARACTERISTICS				
Leverage	3.209	1.166	1.068	0.561
	(1.18)			
Cash Ratio	0.297	-1.214	1.016	0.128
	(0.90)			
ln(SDCF)	1.057	0.055	1.013	2.339
	(0.93)			
Size	1.723	0.544	1.483	7.245
	*(2.86)****			
ASSET CHARACTERISTICS				
Opacity	0.205	-1.585	1.016	0.098
	(1.24)			
ln(MB)	0.729	-0.316	1.030	0.922
	(1.36)			
RD	0.969	-0.031	1.103	31.154
	*(2.05)***			
MARKET CHARACTERISTICS				
ln(SDRET)	2.024	0.705	1.299	-3.712
	*(1.72)**			
Value Change	0.856	-0.155	1.008	0.493
	(1.37)			
MANAGERIAL INCENTIVES				
Vega/Delta	1.256	0.228	1.033	-1.445
	*(1.96)***			
CONTROLS				
Numseg	0.957	-0.044	1.019	4.201
	(1.54)			
PINST	3.255	1.180	1.071	0.585
	*(1.87)**			
NINST	1.000	0.000	1.000	176.863
	(0.07)			
Financial	4.875	1.584	1.022	0.139
	*(3.84)****			
Utility	4.136	1.420	1.008	0.057
	*(3.20)****			
Observations = 16571		CRO hires = 77		

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6

Cox proportional hazard model on the determinants of CRO hires for financial firms

Financials are (6000<=SICC<=6999). Leverage = Total liabilities/Total Assets = (d6 – d60)/d60, Cash Ratio = Cash and marketable securities/Total Assets = d1/d6, SDCF is the standard deviation of the error term from a regression of the firm's quarterly operating cash flow on the prior quarter's operating cash flow. This regression is run for eight quarters. Size is ln(market value of equity). Opacity = Intangibles/Total Assets = d33/d6. MB = Market Value of Equity/Book Value of Equity = (d199*d25)/d60, SDRET is the standard deviation of the firm's daily returns over the year prior to the hiring of the CRO, Value Change is the percentage change in market value of the firm over the prior year. Numseg is the number of operating segments of the firm. PINST is institutional ownership as the percentage of the firm's stock. The number of institutional investors is designated as NINST. The SICC of the firm's segments enter as dummy variables. Note that SIC 6500 is excluded due to colinearity. Std HR is the 10%-of-mean-standardized hazard ratio is computed as: $e^{|coef| \times 0.1 \times mean}$. Absolute value of z statistics in parentheses.

	HR	Coef	STD HR	Mean
FINANCIAL CHARACTERISTICS				
Leverage	2.252	0.812	1.063	0.747
	(0.99)			
Cash Ratio	0.732	-0.312	1.003	0.100
	(0.28)			
ln(SDCF)	1.137	0.128	1.002	0.136
	*(2.25)***			
Size	1.448	0.370	1.209	5.124
	*(3.45)****			
Opacity	0.189	-1.666	1.004	0.025
	(0.99)			
ln(MB)	0.562	-0.576	1.024	0.418
	*(2.45)***			
Value Change	0.832	-0.184	1.031	1.655
	*(3.25)****			
ln(SDRET)	1.095	0.091	1.035	-3.754
	(0.26)			
Numseg	0.925	-0.078	1.018	2.344
	*(2.12)***			
PINST	1.516	0.416	1.011	0.261
	(0.76)			
NINST	1.002	0.002	1.011	54.131
	*(2.59)****			
seg6000 – Depository Inst.	12.862	2.554	1.001	0.004
	*(3.08)****			
seg6100 – Non Depository Credit Inst.	1.533	0.427	1.002	0.037
	(0.76)			
seg6200 – Security Brokers	4.474	1.498	1.006	0.042
	*(3.33)****			
seg6300 – Insurance Carriers	1.658	0.506	1.006	0.116
	(1.24)			
seg6400 – Insurance Agents	9.162	2.215	1.004	0.020
	*(3.52)****			
seg6700 – Investment Managers	0.727	-0.319	1.005	0.152
	(0.47)			
Observations = 16963		CRO hires = 76		

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7

Cox proportional hazard model on the determinants of CRO hires for banks only

Banks are (6000<=SICC<=6199). SDCF is the standard deviation of the error term from a regression of the firm's quarterly operating cash flow on the prior quarter's operating cash flow. This regression is run for eight quarters. Size is ln(market value of equity). Opacity = Intangibles/Total Assets = d33/d6. MB = Market Value of Equity/Book Value of Equity = (d199*d25)/d60, SDRET is the standard deviation of the firm's daily returns over the year prior to the hiring of the CRO, Value Change is the percentage change in market value of the firm over the prior year. Numseg is the number of operating segments of the firm. PINST is institutional ownership as the percentage of the firm's stock. The number of institutional investors is designated as NINST. Tier 1 Capital is d337, Loan loss provision is d342/d6, duration ratio is $\frac{\Delta Assets}{Assets} \Big/ \frac{\Delta Liabilities}{Liabilities}$ Std HR is the 10%-of-mean-standardized hazard ratio is computed as: $e^{|coef| \times 0.1 \times mean}$. Absolute value of z statistics in parentheses.

	HR	Coef	STD HR	Mean
ln(SDCF)	1.681	0.519	1.006	0.121
	*(2.73)****			
Size	0.825	-0.192	1.099	4.898
	(0.75)			
Opacity	0.004	-5.521	1.003	0.006
	(0.45)			
Ln(MB)	0.794	-0.231	1.009	0.378
	(0.42)			
Value Change	0.859	-0.152	1.023	1.507
	(1.27)			
ln(SDRET)	0.571	-0.560	1.239	-3.829
	(0.80)			
PINST	3.577	1.275	1.024	0.188
	(1.29)			
NINST	1.004	0.004	1.017	43.060
	*(2.74)****			
Tier 1 Capital	0.852	-0.160	1.200	11.409
	*(2.04)***			
Loan Loss Provision	0.541	-0.614	1.000	0.003
	(0.02)			
Duration Ratio	0.844	-0.170	1.016	0.952
	(0.87)			
Observations = 7176			CRO hires = 32	

* significant at 10%; ** significant at 5%; *** significant at 1%