Enterprise Risk Management Adoption and Managerial Incentives[1]

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Abstract: Enterprise Risk Management (ERM) is the approach of managing all risks faced by a firm in an integrated, holistic fashion. This research analyzes factors that influence a firm's decision to start an ERM program. Our comprehensive survey data of German property-liability insurance companies allows us to construct direct measures of ERM program adoption and ERM quality. We find that negative changes in past firm performance increase a firm's probability to adopt ERM and are accompanied by significant improvements in the quality of a firm's risk management process. Furthermore, these effects are stronger for firms that would be expected to have relatively high forced CEO turnover rates after periods of bad performance, supporting the prediction of the career concerns view and consistent with managerial incentives generally. Skilled managers concerned about keeping their jobs should reduce the volatility of a firm's earnings after a period of poor performance, and ERM adoption can help achieve that goal. [Key words: Enterprise risk management, hedging, career concerns, managerial incentives.] JEL Classifications: C33; G22; G32; M12.

INTRODUCTION

Enterprise Risk Management (ERM) takes a holistic view of risk management. The focus of ERM is on coordinating and controlling offsetting risks across the enterprise to maintain the probability of large negative

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earnings and cash flows within acceptable limits.[5] ERM contradicts the frictionless market view that firms should not expend resources on managing idiosyncratic risk. However, in a world with transaction costs, ERM can create value by avoiding the underinvestment problem in financially constrained firms by reducing the cost of external financing and by creating synergies between different risk management activities (see, e.g., Meulbroek, 2002, Nocco and Stulz, 2006). Hence, previous research has focused on detecting a positive relationship between ERM adoption and firm value (see, e.g., Hoyt and Liebenberg, 2011; Eckles, Hoyt, and Miller, 2014; Farrell and Gallagher, 2015; Altuntas, Liebenberg, Watson, and Yildiz, 2017; Ai, Bajtelsmit, and Wang, 2018), on documenting the main characteristics of ERM programs (see, e.g., Colquitt, Hoyt, and Lee, 1999; Kleffner, Lee, and McGannon, 2003; Beasley, Clune, and Hermanson, 2005; Altuntas, Berry-Stölzle, and Hoyt, 2011), and on understanding a firm's decision to start an ERM program (Liebenberg and Hoyt, 2003; Pagach and Warr, 2011).

In this study, we extend the latter strand of literature by examining factors that influence a firm's decision to start an ERM program from a dynamic perspective. Our main focus is on whether firms are more likely to adopt an ERM program after a period of poor performance, and we find evidence of such a time-series relationship. This result is consistent with the prediction of the managerial career concerns view.[6] Skilled managers concerned with keeping their jobs would be expected to focus on reducing the volatility of firms' earnings after periods of poor performance (Nam, Wang, and Zhang, 2008), and ERM adoption can help achieve that goal (Eckles et al., 2014).[7]

We use data from an industry that is almost tailor-made for an empirical analysis of ERM adoption: the German property-liability insurance industry. Property-liability insurers are in the risk business and, due to the nature of their business, they experience fluctuations in earnings.[8] Furthermore, the German property-liability insurance industry embraced ERM, and during our sample period over 60 percent of firms adopted ERM, which provides the necessary variation for an empirical analysis. In addition, the

[5]The Committee of Sponsoring Organizations of the Treadway Commission defines ERM as "a process, effected by an entity's board of directors, management and other personnel, applied in strategy-setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risks to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives" (COSO, 2004).

[6]It should also be noted that compensation for senior executives is generally linked to firm performance (profits or stock performance) and reflects managerial incentives generally. However, this linkage is entirely consistent with the concepts reflected in the managerial career concerns view and would not alter our expectations regarding the likelihood of ERM adoption after a period of poor performance.

modest size of the German property-liability insurance industry allows survey-based research designs to cover over 90% of the market based on premium volume. The detailed survey responses also allow us to examine the quality of a firm's overall risk management approach.

We estimate a dynamic logistic regression model explaining ERM adoption with one-year lagged firm characteristics. Firm-year observations after a firm adopts ERM are excluded from the analysis. Consistent with the managerial career concerns view, we find a negative relationship between a firm's one-year lagged change in performance and its likelihood of adopting an ERM program, which indicates that firms are more likely to start an ERM program after a period of poor performance. Alternatively, we regress continuous risk management quality measures on one-year lagged firm characteristics to explain quality improvements in a firm's risk management process. We find that negative changes in past firm performance are associated with significant improvements in the quality of a firm's risk management process.

To provide additional evidence supporting the managerial career concerns view, we use a triangulation approach and split the sample into subsamples across which we expect to see a stronger effect of our main independent variable of interest: the one-year lagged change in performance. We then re-estimate the baseline models for each subsample separately. We find that the impact of the one-year lagged change in performance on a firm's likelihood to adopt ERM is stronger for firms that would be expected to have relatively high forced CEO turnover rates after periods of bad performance, which supports the managerial career concerns view.

Admittedly, there are possible alternative explanations for the observed pattern that negative changes in performance are associated with a higher likelihood of ERM adoption in the following year. While we cannot rule out all alternative explanations completely, we perform a number of additional tests and provide evidence ruling out the most salient three: new leadership, regulatory pressure, and pressure by rating agencies.

[7]The ISO 31000 standard is clear that the goal of ERM is to minimize the cost of risk including opportunity costs of forgone business opportunities. In that sense, ERM supports the overall strategic goal of maximizing the firm's profit. It is theoretically possible that ERM adoption leads a company to the conclusions that they should take on more risk. However, ERM adoption gives the firm a powerful tool to manage its risks in a cost-efficient way (e.g., exploiting natural hedges within the firm). If ERM adoption reduces the marginal cost of reducing risk, then the optimal level of risk for firms should be lower after ERM adoption. Eckles et al. (2014) test this argument empirically and document that firms experience a reduction in stock return volatility after ERM adoption.

[8]McShane, Zhang, and Cox (2012) specifically consider risk allocation activities by insurers on an enterprise-wide basis.

This paper makes several contributions to the literature. First, we provide evidence that time-series dynamics of firm performance matter for ERM adoption decisions. Our result that the likelihood of ERM adoption increases after a period of poor performance supports the view that managers who are concerned about losing their job might adopt ERM to avoid getting fired, among other reasons. Second, our study contributes to the literature by providing a detailed analysis of German property-liability insurance companies and their risk management practices. The companies in our sample have a combined market share of over 90% of the German property-liability insurance market. Third, in addition to analyzing the decision to adopt an ERM program, the detailed survey responses also allow us to examine the quality of a firm's overall risk management approach. We construct two indices of a firm's risk management quality and use them in our analysis. Fourth, since we have both an ERM indicator variable and a continuous measure of risk management quality, we can test whether firms' statements that they adopt ERM are accompanied by actual improvements in the quality of their risk management process or are just lip service to the ERM concept. Our results that ERM announcements are actually accompanied by an improved risk management process provide justification for the use in prior studies of an ERM indicator variable based on firm announcements.

Our paper is structured as follows. The next section provides the conceptual background and explains the development of the hypotheses. The sample selection and data are discussed in the third section of the paper. Next, the methodology and empirical findings are presented. The final section concludes.

CONCEPTUAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

ERM improves the traditional risk management approach where different risk categories are managed in separate risk "silos" by integrating all risk management activities in one holistic enterprise-wide framework. Such a unified risk management approach allows firms to better understand their overall risk profile, exploit natural hedges, and avoid the duplication of risk management expenditure (see, e.g., Harrington, Niehaus, and Risko, 2002; Meulbroek, 2002, Aabo, Fraser, and Simkins, 2005; Nocco and Stulz, 2006). Hoyt and Liebenberg (2011) find that ERM adoption leads to a 20% increase in firm value measured with Tobin's *Q* for U.S. insurance companies.[9] There seem to be multiple channels through which ERM adoption can create firm value. Eckles et al. (2014) document a

reduction in firm risk and an increase in risk-adjusted performance after ERM adoption, Berry-Stölzle and Xu (2018) document a reduction in firms' cost of capital after ERM adoption, Ai et al. (2018) point out that performance increases after ERM adoption are primarily realized by diversified firms, and Altuntas, Berry-Stölzle, and Cummins (2019) document that ERM adoption helps firms achieve economies of scale and scope.

Our study contributes to the strand of literature that examines the determinants of ERM adoption (Liebenberg and Hoyt, 2003; Pagach and Warr, 2011) by focusing on the possible impact of managerial career concerns on ERM adoption decisions. Our argument builds on the rich literature on managers' concerns about the effect of current performance on future compensation and the effect of these concerns on their decisions. If poor performance negatively impacts managers' reputation and results in lower wage offers in the future, managers are disciplined through this labor market mechanism to produce high performance (Fama, 1980; Holmström, 1982; Gibbons and Murphy, 1992; Chung, Sensoy, Stern, and Weisbach, 2012). However, the performance of managers is usually measured with increases in firm value, stock price changes, or firms' accounting earnings. But a firm's earnings do not just depend on the manager's ability. A firm's earnings also depend on (random) events outside the control of the manager (e.g., price changes on factor markets). Therefore, poor performance in one year could just be "*bad luck*" and investors update their *a priori* beliefs about the manager's ability by observing the firm's performance over time (see, e.g., DeMarzo and Duffie, 1995). If the manager engages in risk management, the volatility of the firm's earnings decreases and, hence, improves the informativeness of earnings as a signal of the manager's ability.[10,11] While high-ability managers benefit from risk management because it allows them to reveal their superior ability, low-ability managers may *not* hedge to delay getting identified as low-ability managers (Breeden and Viswanathan, 2016).

[9]A number of other studies also document a positive relationship between ERM adoption and firm performance (see, e.g., Eckles et al., 2014; Nair, Rustambekov, McShane, and Fainshmidt, 2014; Grace, Leverty, Phillips, and Shimpi, 2015).

[10]It is theoretically possible that ERM adoption leads a company to the conclusions that they should take on more risk to reach the optimal level. However, ERM adoption gives the firm a powerful tool to manage its risks in a cost-efficient way (e.g., exploiting natural hedges within the firm). If ERM adoption reduces the marginal cost of reducing risk, then the optimal level of risk for firms should be lower after ERM adoption. Eckles et al. (2014) test this argument empirically and document that firms experience a reduction in stock return volatility after ERM adoption.

[11]Ma and Wang (2014) consider the implications of executive compensation structures on risk taking within the property-liability insurance industry.

DeMarzo and Duffie (1995) show that risk management creates value for shareholders by improving the quality of information about a firm's investment project; improved quality of information increases the value of the shareholders' option to continue or stop the firm's investment project. In both the DeMarzo and Duffie (1995) and the Breeden and Viswanathan (2016) model, managers' hedging decisions are motivated by career concerns (Fama, 1980; Holmström, 1982); if a manager loses his reputation of "being good," future compensation will decline.

Nam et al. (2008) examine the optimal adoption of risk management by a utility-maximizing manager with career concerns in a two- period model. Because of the dynamic, two-period nature of their model, Nam et al. (2008) can examine time series patterns of career concerns and risk management activities. They show that it is optimal for managers with high initial reputation, defined as *a priori* beliefs of investors that the manager has high ability, not to engage in risk management in the first period. Because of their high initial reputation, these managers can survive an early bad outcome without losing their jobs and are still considered to be reasonably good managers. Such managers only engage in risk management in the second period if performance in the first period was poor. Hence, Nam et al.'s (2008) model generates the testable prediction that high-ability managers will only engage in risk management activities after some early bad results.[12]

When a CEO is initially hired, she does not yet have a track record of managing the firm and investors have to form expectations about her ability as CEO of the firm. We argue that only managers with high performance in previous positions become CEOs. We further argue that investors will probably assume that the CEO has a high ability, or using the terminology of Nam et al.'s (2008) model, that the CEO has high initial reputation. Based on Nam et al.'s (2008) high initial reputation case, we can then state the following hypothesis:

H1 ***Career Concerns Hypothesis I:*** *Negative changes in past performance increase a firm's probability of adopting ERM.*

In the context of Nam et al.'s (2008) model, risk management is defined as an activity which reduces the volatility of the firm's earnings. Of course, a firm can reduce its earnings volatility by improving its risk management process without implementing the ERM approach. Similarly, a firm that adopted the ERM approach a few years ago can further reduce its earnings

[12]Note that Nam et al.'s (2008) model includes a fixed transaction cost of engaging in risk management. So, even if risk management is costly, it is optimal for a CEO with high initial reputation to engage in risk management after a period of poor performance.

volatility by improving its ERM process. We, therefore, expect to see an improvement in the overall quality of a firm's risk management approach following a drop in firm performance.

On the other hand, ERM adoption can only lead to a reduction in earnings volatility if it is accompanied by a significant improvement in the overall quality of a firm's risk management approach, rather than just representing lip service to a holistic enterprise-wide risk management system. Thus, we can state the following two testable hypotheses:

H2 ***ERM Quality Hypothesis:*** *ERM adoption is accompanied by significant improvements in the quality of a firm's risk management approach.*

H3 ***Career Concerns Hypothesis II:*** *Negative changes in past performance are accompanied by improvements in the quality of a firm's risk management approach.*

SAMPLE SELECTION AND DATA

An empirical research study should use a dataset that allows a sound test of the research question. To answer our research question whether negative changes in past performance increase a firm's probability to adopt ERM, we examine the time period during which the first half of the property-liability insurance companies in Germany adopt an ERM program. We argue that this time period is well suited for our analysis.[13]

The analysis is based on company-level data of property-liability insurance companies supervised by the German insurance authority (*BaFin*). We have two data sources: the Altuntas et al. (2011) survey of how companies implement risk management and the KIVI GmbH financial statement database. The KIVI database includes financial statements of all German property-liability insurance companies with premiums written in excess of 40 million Euros. The same threshold of 40 million Euros is used for the survey, and all property-liability insurers exceeding the threshold in 2008 are included in the survey. There are 113 such insurers in Germany, and 95 of them participated in the survey. Hence, the survey response rate was 84 percent and the participating insurers have a combined market share of over 90% of the German property-liability insurance market.

The survey was based on an extensive questionnaire including 86 questions on 21 aspects of the ERM approach and was conducted as a series

[13]A growing body of the finance literature explicitly uses historical data to test theory (see, e.g., Bittlingmayer, 1998; Knüpfer, Rantapuska, and Sarvimäki, 2017).

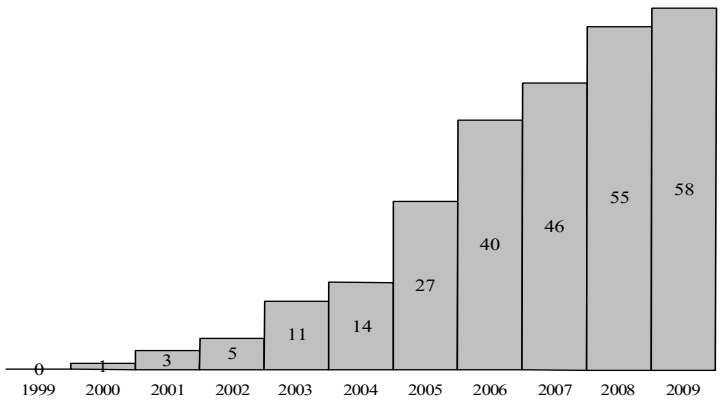


Fig. 1. Cumulative number of survey respondents engaged in ERM by year.
Notes: A total of 95 property-liability insurance companies participated in the survey; 58 of them adopted ERM by 2009.

of standardized telephone interviews in the first half of 2009.[14,15] The questionnaire specifically asks whether a company has an ERM program and when the company adopted it.[16] Figure 1 presents the cumulative number of firms that adopted ERM in (or prior to) a given sample year; the number of firms with ERM programs steadily increased from zero in 1999

[14]The telephone interviews were conducted with the Chief Risk Officer, his assistant, or an individual named by the CFO or his assistant. The survey was sent to the company in advance and they were asked to collect the information prior to the interview. In surprisingly many cases, the Chief Risk Officer himself spent about one hour on the phone discussing their risk management approach. If the interviewer had the impression that a question was misunderstood or if the participant could not answer a question based on the information he had collected prior to the interview, there was either a follow-up phone call or email conversation to clarify the open points. This process ensured that the survey reflects the combined institutional knowledge of the firms rather than the memory of one individual. Participants received a summary report including descriptive statistics of the survey results in exchange. The interviewer had the impression that participants were very interested in the topic and how the industry as a whole is implementing ERM, creating incentives to participate in the survey. Any survey data is basically "self-reported" data. However, there is no reason to believe that this data suffers from any biases other than being survey data.

[15]There is no consensus how the quality of a risk management program should be evaluated. The survey design as well as the calculation of the risk management quality indices therefore follows an intuitive approach, starting with the basic components of the risk management process, and includes additional organizational components that representatives of the German insurance industry in informal discussions during the design stage of the survey viewed as relevant. An undisputed advantage of our approach is its transparency; the survey process, the questionnaire, and the mapping of responses to index values are all well documented.

to 58 in 2009. In addition, the questionnaire includes detailed questions about specific ERM activities and a company's risk management process in general. For each risk management activity, the questionnaire also identifies the point in time when the activity was implemented. For further details about the survey, as well as for a purely descriptive analysis of the data, see Altuntas et al. (2011).[17]

We merge the survey data with financial statement data from the KIVI database for the years 1999 to 2008. Note that due to mergers, acquisitions, and legal restructurings, not all firms included in the survey have a consistent financial statement record for the whole 1999 to 2008 period. To ensure that a firm's performance measures can be compared over time, we start with the set of survey respondents in 2008 and work backwards through the years. We drop firm-year observations prior to any mergers, acquisitions, or legal restructurings. The resulting unbalanced panel data set consists of 849 firm-year observations.

To examine the dynamic determinants of ERM adoption, we need to convert the data into a survival dataset. This survival dataset includes all observations of firms that have not yet adopted the ERM approach. The survival dataset includes observations of firms in the year they adopt ERM, but observations in the years after ERM adoption are removed from the dataset. Thus, the number of observations in the dataset decreases from year to year. When firms have adopted ERM, they are considered censored or no longer observed. The resulting survival dataset has 702 firm-year observations. We then exclude firms with fewer than three consecutive years of data as our analysis is performed using lagged changes in firm performance. The resulting dataset spans the years 2001–2009 and consists of 553 firm-year observations with 53 unique firms adopting ERM during the sample period.

[16]Of course, ERM adoption does not happen overnight, but is rather a process that takes months if not a few years. However, if companies commit to adopting ERM they usually invest significant time and resources in improving their risk management approach in a relatively short time interval (e.g., 12–24 months). That is why we argue that an ERM indicator variable based on the year of adoption is a meaningful variable. Our analysis of changes in risk management quality around the year of ERM adoption also supports that view. We actually find that ERM adoption is accompanied by significant improvements in the quality of a firm's risk management approach in the (t–1) to (t+1) event window, where t stands for the year of ERM adoption.

[17]The original German questionnaire as well as an English translation is available upon request.

DYNAMIC DETERMINANTS OF ERM ADOPTION

To identify the determinants of ERM adoption, we focus on time series variation in the risk management profile of insurance companies. We model an insurer's decision to adopt ERM using a dynamic logistic regression model. Shumway (2001) shows that the dynamic logistic regression model is equivalent to the discrete-time Cox proportional hazard model. The data set used to estimate the dynamic logistic regression model is a survival data set. The dependent binary variable, the ERM indicator, is zero for every firm in the data set that has not adopted the ERM approach. The dependent binary variable is equal to 1 in the year the firm adopts ERM and is cut off in the year after ERM adoption.[18] The dynamic logistic regression approach has been used by previous researchers, for instance, to model the IPO decision (Pagano, Panetta, and Zingales, 1998), executive turnover (Denis, Denis, and Sarin, 1997), or hedge fund failures (Brown, Goetzmann, and Park, 2001; Kim, 2016).

The specification of the model is as follows:

$$ERM_{i,t} = \alpha + \beta_1 \Delta performance_{i,t-1} + \beta'_2 X_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

where $ERM_{i,t}$ is a dummy variable coded as 1 if insurer i has adopted ERM in year t, and zero otherwise, $\Delta performance_{i,t-1}$ is the one-year change in insurer i's performance, $X_{i,t-1}$ is a vector of control variables, and $\varepsilon_{i,t}$ is a random error term. All independent variables are lagged one year. Standard errors are adjusted for firm-level clustering. A negative and significant estimate for β_1 would support the Career Concerns Hypothesis I (H1). The control variables are specified in Table 1, and the remainder of this section discusses these variables.

Variables Included in the Regression Model

The literature examining the effect of firm performance on forced CEO turnover uses a firm's return on assets (ROA) and stock market returns as measures of firm performance (see, e.g., Huson, Parrino, and Starks, 2001; Dahya, McConnell, and Travlos, 2002; Farrell and Whidbee, 2002).[19] Stock

[18]The detailed survey data also allows us to determine which firm has a Chief Risk Officer. Out of the 58 firms that adopt ERM, 6 also have a CRO, but 52 have not. Out of the 10 firms that have a CRO, 6 also adopt ERM, but 4 do not. In the German property-liability insurance industry, ERM adoption and CRO hires seem to be quite distinct events.

Table 1. Variable Definitions

Variable	Expected sign	Definition
ERM indicator		Indicator variable equal to 1 if insurer adopted ERM, 0 otherwise
ΔROA	–	ROA (t) – ROA (t–1)
ROA		Net income / total assets
Capital to Assets	–	Equity capital / total assets
Liquidity	–	Liquid assets / liabilities
Size	+	Natural logarithm of total assets
HHI	–	Herfindahl concentration index of direct premiums written across business lines
Tax	+	Tax-expenses / total assets
Group	+	Dummy variable equal to 1 if insurer is affiliated with a group, 0 otherwise
Mutual	–	Dummy variable equal to 1 if insurer is a mutual, 0 otherwise
Public	+/–	Dummy variable equal to 1 if insurer is organized as an insurer under public law, 0 otherwise

market returns are not available for the insurers in our sample, since not all insurers are stock companies and the stock companies in the sample are not publicly traded. Therefore, we use ROA as our measure of firm performance and the one-year change in the ROA to test the career concerns hypothesis. Our model includes both variables to control for the level effect while testing for the impact of performance changes. ROA is calculated as net income divided by the book value of assets.

To capture the expected costs of financial distress, our model includes the ratio of equity capital as shown on the balance sheet to total assets. The

[19]More precisely, Huson et al. (2001), Dahya et al. (2002), and Farrell and Whidbee (2002) use a firm's industry average adjusted ROA as performance measure. The industry average adjusted ROA is calculated by subtracting the median ROA of all firms in a single industry from an individual firm's ROA. In our study, we control for differences across industries by focusing on just one industry. Hence, we use the ROA to measure firm performance in our study.

capitalization of an insurance company is an important indicator of its financial strength and the capital to assets ratio has been found to be negatively related to the probability of experiencing financial distress (see, e.g., Pottier and Sommer, 2002). Thus, firms with a lower capital to asset ratio are more likely to benefit from ERM adoption.

Nance, Smith, and Smithson (1993) argue that firms can reduce the expected costs of financial distress by holding more liquid assets. Firms with more liquid assets are, hence, less likely to benefit from ERM adoption. To capture any effect of short-term liquidity on ERM adoption, we include the ratio of liquid assets to liabilities in our model.[20]

A variable capturing the size of the firm is also included in the model. Hoyt and Liebenberg (2011) argue that larger firms are more likely to engage in ERM due to their relatively high complexity, the fact that they face a wider array of risks, and their financial ability to bear the administrative cost of ERM adoption. Therefore, we include the natural log of total assets as a size variable in our model. In a similar vein, product diversification increases the complexity of a firm and, hence, more diversified firms should be more likely to benefit from ERM adoption (Standard & Poor's, 2005). To capture insurers' diversification across business lines, we follow the standard approach in the insurance literature and use the Herfindahl concentration index of direct premiums written across business lines as an inverse measure of product diversification (see, e.g., He and Sommer, 2010; Cheng, Elyasiani, and Jia, 2011).

To capture tax incentives for ERM adoption, we follow Cole and McCullough (2006) and include the total amount of taxes paid relative to firm assets in our model. The expectation is that higher amounts of taxes paid lead to greater incentives to reduce earnings volatility and, hence, to start an ERM program.

Miccolis and Shah (2000) argue that pressure from external stakeholders is an important driver of ERM adoption decisions. For an insurance company that is a member of an insurance group, other affiliated companies are arguably important stakeholders. He and Sommer (2011) document an increased likelihood of nonroutine CEO turnover for insurance companies that are members of insurance groups, indicating that groups influence the governance structure of their members. Therefore, we expect that an insurance company that is a member of an insurance group will be

[20]Our liquidity variable is similarly designed to the "liquidity ratio" used by Chen and Wong (2004). One of their major findings is that liquidity ratio is one of the factors that significantly affect the financial health of insurers and, hence, should be explicitly monitored by regulators to avoid insolvency.

more likely to engage in ERM, and we include a group affiliation dummy in the model.[21]

There are different organizational forms in the insurance industry. Since the stock organizational form has a comparative advantage in controlling agency conflicts related to the owner-manager conflict, it can allow more managerial discretion and, hence, write on average more risky business than mutual insurance companies (Mayers and Smith, 1981; Lamm-Tennant and Starks, 1993). We include a mutual indicator dummy in our model. Due to less risk taking, we expect mutual insurers to be less likely to benefit from ERM adoption.[22] In addition to mutual insurance companies and stock insurance companies, there is a third organizational form in the German market: public insurance companies. Public insurance companies are non-profit organizations under public law; they are owned by state or local authorities. Historically, the function of public insurers was to serve a certain region by providing reliable insurance coverage, and until today, most public insurers restrict their business to "their" region.[23] Excessive risk taking is not in line with public insurers' traditional goal of providing reliable coverage. However, the fact that public insurers are owned by local and state authorities, which can bail them out with taxpayers' money, may create incentives for additional risk taking. Hence, we do not have a clear prediction about whether public insurers take on more risk or less risk than the other two organizational forms and whether public insurers will be more likely or less likely to engage in ERM. To capture any effect of the public organizational form, we include a public indicator dummy in our model.

We use the one-year change in the ROA to test the Career Concerns Hypothesis I (H1). The model also includes year dummy variables and line of business controls. The line of business control variables measure the fraction of premiums written in each line of business and, hence, capture differences between business lines, including differences in the loss distributions and volatilities of the business lines.[24]

[21]Scordis (2018) considers the influence of a board-level risk committee on value.

[22]Another argument is that mutual insurance companies are subject to less external monitoring and should therefore be less likely to adopt ERM (Miccolis and Shah, 2000).

[23]See Berry-Stölzle, Lai, and Wende (2010) for a more detailed description of public insurance companies in Germany.

[24]The lines-of-business included in the calculation are: personal accident, personal liability, total auto, legal expenses, fire, homeowners' personal property, residential and commercial building damage, and transportation. The omitted category is the aggregate of credit insurance and other miscellaneous business.

Descriptive Statistics and Univariate Differences of Regression Variables

Table 2 shows summary statistics for all firms in the sample and a univariate comparison between ERM adopting and non-adopting firms.[25] In the full panel dataset, 30.3% of all observations are from firms that are engaged in ERM. Descriptive statistics for firms with *ERM indicator*=1 and firms with *ERM indicator*=0 are based on the survival dataset used in the dynamic logistic regression model; firms with fewer than three years of consecutive data are excluded and observations in the years after ERM adoption are also excluded. Thus, the 53 observations of firms with *ERM indicator=1* are from 53 unique firms in the year in which they adopt ERM.

We can see that the average ERM adopting firm is much larger than the average non–ERM adopting firm. ERM adopting firms have, on average, lower capitalization or, in other words, higher financial leverage than non-adopting firms. Among the group of ERM firms, there are fewer insurance companies under public law than in the group of non-adopters. Furthermore, ERM firms hold, on average, less liquid assets than non-adopting firms, and ERM firms also seem to decrease their fraction of liquid assets in the year of ERM adoption.

Dynamic Logistic Regression Model Results

The dynamic logistic regression results from Equation (1) are presented in Table 3. The estimates are based on a survival data set, in which the dependent ERM indicator variable is equal to 1 in the year the firm adopts ERM, and is cut off in the year after ERM adoption. The two models presented only vary with respect to whether the line of business control variables are included. In both model specifications, the coefficient on the one-year lagged change in performance variable *Delta ROA (t–1)* is negative and significant at the five percent level, which indicates a negative relationship between changes in past performance and ERM adoption as measured by the ERM indicator. The magnitude of this effect is quite large. A one-standard-deviation decrease in the *Delta ROA (t–1)* variable—or, in other words, a drop in a firm's ROA by 0.04001, or about 4%—increases an insurer's probability to adopt ERM by 0.0330, which corresponds to a 34.79% increase relative to the 0.0949 sample mean. Overall, these results provide support for the Career Concerns Hypothesis I (H1), which states

[25]For simplicity we refer to firm-year observations as "firms" from this point forward.

Table 2. Descriptive Statistics and Univariate Comparison

	Full sample (N = 849)			ERM indicator = 1 (N = 53)			ERM indicator = 0 (N = 500)		
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
ERM indicator	0.303			1.000			0.000***		
ΔROA	–0.001	0.000	0.038	–0.008	–0.001	0.032	–0.001	–0.001	0.039
ROA	0.041	0.036	0.049	0.039	0.036	0.041	0.037	0.033	0.046
Capital/Assets	0.219	0.194	0.107	0.189	0.157	0.092	0.224**	0.199***	0.102
Liquidity	0.069	0.031	0.108	0.057	0.030	0.070	0.078**	0.041	0.103
Size	6.066	5.919	1.329	6.380	6.068	1.341	5.965**	5.773**	1.316
HHI	0.492	0.380	0.298	0.533	0.383	0.335	0.472	0.372	0.280
Tax	0.015	0.010	0.019	0.013	0.009	0.015	0.013	0.009	0.016
Group	0.938			0.962			0.918		
Mutual	0.372			0.340			0.364		
Public	0.184			0.075			0.248***		

Note: N denotes firm-year observations. Descriptive statistics for the full panel dataset (N=849) are based on the 2000 through 2009 period for the ERM indicator variable, and on the 1999 through 2008 period for all other variables. Descriptive statistics for firms with *ERM indicator* = 1 and firms with *ERM indicator* = 0 are based on the survival dataset used in the dynamic logistic regression model; firms with fewer than three years' consecutive data are excluded and observations in the years after ERM adoption are excluded. Thus, the 53 observations of firms with *ERM indicator = 1* are from 53 unique firms in the year in which they adopt ERM. Statistical significance of differences between ERM-adopting and non-adopting firms is based on a t-test for means, a Wilcoxon signed-ranks test for medians, and a χ^2-test for dummy variables. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively. *Delta ROA* is the one-year change in ROA. *ROA* is equal to net income divided by total assets. *Capital/Assets* is equal to the ratio of the equity capital to total assets. *Liquidity* is the ratio of liquid assets to liabilities. *Size* is the natural logarithm of total assets. *HHI* is the Herfindahl concentration index of direct premiums written across business lines. *Tax* is the total amount of taxes paid divided by total assets. *Group* is equal to 1 if insurer is affiliated with a group, 0 otherwise. *Mutual* is 1 if insurer is a mutual, 0 otherwise. *Public* is equal to 1 if insurer is organized as an insurer under public law, 0 otherwise.

Table 3. Determinants of ERM Adoption

Dep. var.: ERM indicator	(1)	(2)
Intercept	–4.704***	–3.125
	(1.473)	(1.963)
Delta ROA (t–1)	–8.784**	–9.160**
	(3.968)	(4.086)
ROA (t–1)	–1.115	1.614
	(5.078)	(5.863)
Capital to Assets (t–1)	–0.135	0.070
	(1.911)	(2.127)
Liquidity (t–1)	–2.184	–2.048
	(2.087)	(2.265)
Size (t–1)	0.214*	0.188
	(0.110)	(0.127)
HHI (t–1)	0.651	–1.212
	(0.576)	(1.312)
Tax (t–1)	7.465	3.935
	(12.850)	(13.925)
Group (t–1)	1.604**	1.460*
	(0.780)	(0.849)
Mutual (t–1)	–0.703*	–1.025**
	(0.389)	(0.519)
Public (t–1)	–1.774***	–1.346**
	(0.600)	(0.618)
Line of business controls	No	Yes
Year dummy variables	Yes	Yes
Pseudo *R*-squared	0.163	0.183
χ-squared	67.962	75.286
Number of observations	553	553

Notes: The dependent variable in both logistic regression models is an ERM indicator equal to 1 if the insurer adopted ERM in year *t*, 0 otherwise. Estimates are based on a survival data set; firms are removed from the sample in the year after ERM adoption. Hence, the number of observations in the data set decreases from year to year. All independent variables are measured in year t–1. *Delta ROA* is the one-year change in ROA. *ROA* is equal to net income divided by total assets. *Capital to Assets* is equal to the ratio of the equity capital to total assets. *Liquidity* is the ratio of liquid assets to liabilities. *Size* is the natural logarithm of total assets. *HHI* is the Herfindahl concentration index of direct premiums written across business lines. *Tax* is the total amount of taxes paid divided by total assets. *Group* is equal to 1 if insurer is affiliated with a group, 0 otherwise. *Mutual* is 1 if insurer is a mutual, 0 otherwise. *Public* is equal to 1 if insurer is organized as an insurer under public law, 0 otherwise. Line of business controls are calculated by dividing premiums written in each line of business by total premiums written. Year dummies are included in each regression. Standard errors are adjusted for firm-level clustering and appear in parentheses below each coefficient estimate. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively.

that firms with negative changes in past performance are, all else equal, more likely to adopt ERM.[26]

In addition, the coefficient of the *Size (t–1)* variable is positive and significant in Model (1), indicating that larger firms are more likely to adopt ERM. This result is consistent with the findings of Liebenberg and Hoyt (2003) and Pagach and Warr (2011). Interestingly, the coefficient of the *Size (t–1)* variable becomes insignificant when we include line-of-business controls (see Model (2)). These results indicate that when line-of-business controls are omitted, size proxies for these variables. Thus, the product mix of larger insurers seems to differ systematically from the product mix of smaller insurers. A correlation test reveals that firm size is significantly positively related to the business lines personal liability, total auto and fire, but negatively related to the business lines personal accident and legal expenses.

As expected, group affiliation is significantly positively associated with the likelihood of adopting ERM, confirming that pressure from external stakeholders is an important driver of ERM adoption decisions (Miccolis and Shah, 2000; Hoyt and Liebenberg, 2011). The coefficient of the *Mutual (t–1)* variable is negative and significant in all four models, indicating that mutual insurers are less likely to start an ERM program. Since mutual insurers address agency conflicts between managers and owners by restricting managerial discretion and risk taking (Mayers and Smith, 1981; Lamm-Tennant and Starks, 1993), mutual insurers may benefit less from an ERM program than stock insurers. Similarly, the coefficient of the *Public (t–1)* variable is negative and significant in all four models, indicating that insurance companies under public law are less likely to adopt ERM.

Moderating Effects of Group Affiliation and Organizational Form

Of course, managerial career concerns should be stronger in firms in which the owners of the firm have the incentives and power to fire nonperforming CEOs. It is therefore a natural next step to utilize cross-sectional differences in forced CEO turnover rates across different types of firms to

[26]We perform a number of robustness checks and our main result is robust to the following alternative model specifications: (1) A model specification that controls for changes of other firm characteristics, more precisely the one-year change of the capital to assets ratio, the one-year change of the liquidity ratio, the one-year change of the firm size variable, and the one-year change of the line of business Herfindahl index. (2) A model specification that controls for insurance companies' investments in market share by adding a one-year lagged measure of premium growth. (3) A model specification that controls for the average change in industry performance by replacing the *Delta ROA (t–1)* variable with an industry-adjusted measure that was created by subtracting the sample average of the *Delta ROA (t–1)* variable in a given year from firms' individual changes in ROA.

find further evidence in support of the Career Concerns Hypothesis I (H1). We expect the probability of ERM adoption after periods of bad performance to be higher in firms with relatively higher forced CEO turnover rates compared to firms with relatively low forced CEO turnover rates.

He and Sommer (2011) examine CEO turnover in the property-liability insurance industry and document significant differences between members of an insurer group and single unaffiliated insurers as well as between mutual insurance companies and stock insurance companies. The likelihood of non-routine CEO turnover is significantly higher in companies that are affiliated with an insurance group compared to single unaffiliated insurance companies (He and Sommer, 2011, Table 7), presumably because performance information is more readily available within a group structure, allowing peer-monitoring as an additional internal control mechanism for managers (Fama and Jensen, 1983). We, therefore, expect group affiliation to moderate the relationship between changes in past firm performance and ERM adoption. To test this prediction, we interact the *Delta ROA (t–1)* variable in our baseline model specification with two indicator variables capturing whether an insurer is affiliated with a group or whether an insurer is a single unaffiliated firm. The coefficients of these two interaction terms document separately for affiliated and unaffiliated insurers to what degree the likelihood of those insurers to adopt ERM is influenced by changes in past performance.

Models (1) and (2) in Table 4 present the results. The only difference between Models (1) and (2) is the inclusion of line of business control variables in Model (2). In both models, the coefficient of the *Group * Delta ROA (t–1)* interaction term is negative and significant, but the coefficient of the *Single * Delta ROA (t–1)* interaction term is insignificant. Consistent with our prediction, these estimates indicate a negative relationship between changes in past performance and ERM adoption for affiliated insurers whose CEOs face a higher likelihood of losing their jobs, but no significant relationship for single unaffiliated insurers whose CEOs are less likely to get fired.

There is a broad stream of literature on differences between organizational forms in the insurance industry, pointing out that mutual insurance companies have a relatively weak corporate governance mechanism (see, e.g., Cummins, Weiss, and Zi, 1999). Consistent with this view, He and Sommer (2011) document that negative performance of stock insurance companies increases the probability of a nonroutine CEO turnover. However, they do not find any relationship between negative performance and CEO turnover for mutual insurance companies. He and Sommer's results imply that CEOs of mutual insurers may be less concerned about their careers after a period of poor performance than CEOs of companies in

Table 4. The Moderating Effects of Group Affiliation and Organizational Form

Dep. var.: ERM indicator	(1)	(2)	(3)	(4)
Intercept	–4.458***	–2.420	–4.726***	–3.134
	(1.427)	(1.895)	(1.489)	(1.969)
Group * Delta ROA (t–1)	–9.059**	–9.266**		
	(4.430)	(4.492)		
Single * Delta ROA (t–1)	0.426	1.540		
	(4.234)	(4.036)		
Mutual * Delta ROA (t–1)			–7.907	–8.154
			(5.164)	(5.024)
Non-Mutual * Delta ROA (t–1)			–9.370*	–9.936*
			(5.200)	(5.495)
ROA (t–1)	–1.140	0.471	–1.017	1.795
	(5.043)	(5.931)	(5.097)	(5.883)
Capital to Assets (t–1)	–1.186	–0.817	–0.092	0.120
	(1.890)	(2.195)	(1.907)	(2.120)
Liquidity (t–1)	–2.610	–1.942	–2.184	–2.062
	(2.103)	(2.405)	(2.091)	(2.273)
Size (t–1)	0.224**	0.224*	0.215*	0.187
	(0.110)	(0.135)	(0.110)	(0.127)
HHI (t–1)	0.581	–1.828	0.656	–1.205
	(0.563)	(1.211)	(0.577)	(1.315)
Tax (t–1)	7.662	4.091	7.267	3.598
	(13.317)	(14.720)	(12.706)	(13.743)
Group (t–1)	1.159*	1.025	1.606**	1.458*
	(0.698)	(0.772)	(0.782)	(0.849)
Mutual (t–1)			–0.694*	–1.016*
			(0.400)	(0.522)
Public (t–1)	–1.349**	–0.985	–1.778***	–1.352**
	(0.555)	(0.647)	(0.600)	(0.619)
Line of business controls	No	Yes	No	Yes
Year dummy variables	Yes	Yes	Yes	Yes
Pseudo *R*-squared	0.153	0.169	0.163	0.183
χ-squared	62.603	62.826	68.523	76.707
Number of observations	553	553	553	553

Notes: The dependent variable in all four logistic regression models is an ERM indicator equal to 1 if the insurer adopted ERM in the year t, 0 otherwise. Estimates are based on a survival data set; firms are removed from the sample in the year after ERM adoption. Hence, the number of observations in the data set decreases from year to year. All independent variables are measured in year t–1. *Delta ROA* is the one-year change in ROA. *ROA* is equal to net income divided by total assets. *Capital to Assets* is equal to the ratio of the equity capital to total assets. *Liquidity* is the ratio of liquid assets to liabilities. *Size* is the natural logarithm of total assets. *HHI* is the Herfindahl concentration index of direct premiums written across business lines. *Tax* is the total amount of taxes paid divided by total assets. *Group* is equal to 1 if insurer is affiliated with a group, 0 otherwise. *Mutual* is 1 if insurer is a mutual, 0 otherwise. *Public* is equal to 1 if insurer is organized as an insurer under public law, 0 otherwise. *Delta Capital to Assets* is the one-year change in the capital to assets ratio. *Delta Liquidity* is the one-year change in the liquidity ratio. *Delta Size* is the one-year change in insurer size, and *Delta HHI* is the one-year change in the *HHI* variable. Line of business controls are calculated by dividing premiums written in each line of business by total premiums written. Year dummies are included in each regression. Standard errors are adjusted for firm-level clustering and appear in parentheses below each coefficient estimate. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively.

which the owners of the firm have the incentives and power to fire non-performing CEOs. We therefore expect the organizational form of an insurance company to moderate the relationship between changes in past firm performance and ERM adoption. To test this prediction, we interact the *Delta ROA (t–1)* variable in our baseline model specification with two indicator variables capturing whether an insurer is a mutual company or whether an insurer has another organizational form.[27]

Models (3) and (4) in Table 4 present the results. The only difference between Models (3) and (4) is the inclusion of line of business control variables in Model (4). In both models, the coefficient of the *Non-Mutual * Delta ROA (t–1)* interaction term is negative and significant, but the coefficient of the *Mutual * Delta ROA (t–1)* interaction term is insignificant. Consistent with our prediction, these estimates indicate a negative relationship between changes in past performance and ERM adoption for insurance companies whose CEOs face a higher likelihood of losing their jobs, but no significant relationship for mutual insurers whose CEOs are less likely to get fired. Overall, these results provide additional support for the Career Concerns Hypothesis I (H1).

Possible Alternative Explanations

There are several possible alternative explanations for the observed pattern that negative changes in performance are associated with an increased probability of ERM adoption in the following year. Included among these are new leadership, regulatory pressure, and pressure by rating agencies.

If a CEO gets fired after a period of poor performance and the newly hired CEO adopts ERM, we will observe ERM adoption after a period of poor firm performance, but the ERM adoption decision is rather driven by the change in leadership than by career concerns of an established CEO. To distinguish between the effects of career concerns and new leadership, we manually collect the names of the CEOs from the annual reports of our sample firms for all years from 1999 to 2009. We then code an indicator variable equal to one for years in which a new CEO takes over, and zero otherwise. We include this *New CEO* indicator together with an interaction

[27]The group of insurance companies with organizational forms other than mutual insurance companies include stock companies and public companies. While the non-profit, public insurance companies are owned by state or local authorities, they share a major characteristic with stock companies: The owners of the companies have the incentives and the power to intervene and fire the CEO if the company does not perform well. We therefore distinguish between stock and public insurers on the one hand and mutual insurers on the other hand to capture major differences in average CEO turnover rates.

term between the *New CEO* indicator and the *Delta ROA (t–1)* variable into our model. The results are reported in Table 5. If new CEOs hired after a year of poor performance were driving ERM adoption decisions, we would see a negative and significant coefficient for the *New CEO * Delta ROA (t–1)* interaction term and the significance of the *Delta ROA (t–1)* variable would disappear. We find exactly the opposite. The coefficient of the *Delta ROA (t–1)* variable remains negative and significant and the coefficient of the *New CEO * Delta ROA (t–1)* interaction term is insignificant. Furthermore, the coefficient of the *New CEO* indicator variable is negative and significant, providing some evidence that new CEOs are less likely to start an ERM program compared to established CEOs.

Regulatory pressure cannot convincingly explain ERM adoption of our sample insurers either. Since the deregulation of the German insurance market in 1994, the market can be described as competitive. Regulatory interventions are restricted to violations of market conduct (e.g., discrimination) and to insurers in financial distress. The German regulatory law in conjunction with the Solvency Ordinance (*Kapitalausstattungsverordnung*) explicitly specifies a level of equity capital that insurers are required to hold; this required level of capital is a crude function of the underwriting risk as outlined in the European Union's Solvency I standard. The German insurance authority (*Bundesanstalt für Finanzdienstleistungsaufsicht* or BaFin) monitors whether the amount of equity capital on the balance sheet meets the required level. If a company's equity capital is below the required level the BaFin will ask the company to prepare a business plan that explains how the company will restore its solvency. If no convincing business plan can be provided, the company will be declared bankrupt and will be run off. Arguably, the BaFin can exert pressure on insurance companies with equity capital below the required level to include ERM adoption in their action plan to restore solvency. However, most German insurance companies hold much more capital than required. The average ratio of actual equity capital to required capital in our sample is 313%. Only eleven of the firm-year observations in the sample have less equity capital than required. These eleven observations are from six unique insurers. Four of these six insurers did not adopt ERM before the end of our sample period. Two of the six insurers adopted ERM, but one of these two insurers adopted ERM three years after restoring its capitalization. Overall, only one out of six insurers adopted ERM in the year following a period of financial distress. Therefore, it is hard to argue that the regulatory authority in Germany exerts pressure on insurers to adopt ERM.

There are two rating agencies that cover a significant share of the German insurance industry: Standard & Poor's and Assekurata. We reached out to both rating agencies to verify whether information about

Table 5. New CEOs and ERM Adoption

Dep. var.: ERM indicator	(1)	(2)
Intercept	–4.830***	–3.226
	(1.484)	(1.968)
Delta ROA (t–1)	–6.985*	–7.006*
	(4.015)	(4.094)
New CEO * Delta ROA (t–1)	–25.953	–27.045
	(17.643)	(17.466)
New CEO	–1.290*	–1.291*
	(0.762)	(0.749)
ROA (t–1)	–1.102	1.506
	(5.060)	(5.936)
Capital to Assets (t–1)	0.266	0.477
	(1.869)	(2.083)
Liquidity (t–1)	–2.017	–1.761
	(2.124)	(2.317)
Size (t–1)	0.245**	0.226*
	(0.112)	(0.131)
HHI (t–1)	0.642	–1.334
	(0.585)	(1.318)
Tax (t–1)	6.704	2.875
	(13.107)	(14.486)
Group (t–1)	1.621**	1.483*
	(0.793)	(0.855)
Mutual (t–1)	–0.708*	–1.030*
	(0.410)	(0.530)
Public (t–1)	–1.846***	–1.386**
	(0.593)	(0.599)
Line of business controls	No	Yes
Year dummy variables	Yes	Yes
Pseudo *R*-squared	0.177	0.198
χ-squared	70.232	78.051
Number of observations	552	552

Notes: The dependent variable in all four logistic regression models is an ERM indicator equal to 1 if the insurer adopted ERM in the year t, 0 otherwise. Estimates are based on a survival data set; firms are removed from the sample in the year after ERM adoption. Hence, the number of observations in the data set decreases from year to year. All independent variables are measured in year t–1. *Delta ROA* is the one-year change in ROA. *ROA* is equal to net income divided by total assets. *Capital to Assets* is equal to the ratio of the equity capital to total assets. *Liquidity* is the ratio of liquid assets to liabilities. *Size* is the natural logarithm of total assets. *HHI* is the Herfindahl concentration index of direct premiums written across business lines. *Tax* is the total amount of taxes paid divided by total assets. *Group* is equal to 1 if insurer is affiliated with a group, 0 otherwise. *Mutual* is 1 if insurer is a mutual, 0 otherwise. *Public* is equal to 1 if insurer is organized as an insurer under public law, 0 otherwise. *Delta Capital to Assets* is the one-year change in the capital to assets ratio. *Delta Liquidity* is the one-year change in the liquidity ratio. *Delta Size* is the one-year change in insurer size, and *Delta HHI* is the one-year change in the *HHI* variable. Line of business controls are calculated by dividing premiums written in each line of business by total premiums written. Year dummies are included in each regression. Standard errors are adjusted for firm-level clustering and appear in parentheses below each coefficient estimate. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively.

insurers' ERM program is used in the rating process. For our sample period, neither Assekurata nor Standard & Poor's considered insurers' ERM approach in the rating process. Note that Standard & Poor's has different rating procedures in different countries. While ERM has been a rating factor in the U.S. for a number of years, Standard & Poor's did not consider ERM when rating German insurance companies before May 2013. Therefore, it is hard to argue that pressure from rating agencies can explain ERM adoption decisions of our sample insurers.

CHANGES IN RISK MANAGEMENT QUALITY

To examine the determinants of changes in the quality of a firm's risk management approach, we use two measures of quality. The first measure captures the average quality of the basic components of an ERM system. More precisely, the *Average Risk Management Quality Index* for firm k in year t is defined as:

$$RMquality_{k,t} = \frac{1}{7}\sum_{j=1}^{7} COMP_{k,j,t} \tag{2}$$

where $COMP_{k,j,t}, j = 1,\ldots,7$ denotes the quality of the following seven ERM components: (1) identifying the firm's risk appetite, (2) risk aggregation, (3) risk capital allocation, (4) using risk-adjusted performance measures, (5) linking management incentives to risk, (6) risk management culture, and (7) audit. The quality of each ERM component is measured on a scale from zero to one based on individual survey items (the details are provided in the Appendix). Thus, the *RMquality* index defined in Equation (2) takes on values between zero and one, with higher values indicating a higher average quality. Of course, this index is based on the assumption that its components capture all relevant parts of an ERM system in a meaningful way. While we believe this is the case, an undisputed advantage of our approach is its transparency; the survey process, the questionnaire, and the mapping of responses to index values are all well documented.

The second measure of risk management quality captures the main idea of ERM, namely, the degree to which a firm actually has a holistic approach towards risk management. Since a risk management program is only as strong as its weakest component, having a high *average* quality across fragmented risk management activities may not be the best approach. Thus, we calculate an entropy measure of a firm's degree of diversification across the different ERM components (see, e.g., Palepu,

1985).[28] The measure takes on higher values for firms that have a balanced risk management approach. The measure takes on lower values for firms that just focus on improving some ERM components while ignoring the weaker ones. Specifically, we calculate the *Holistic Risk Management Index* of firm *k* in year *t* as:

$$RMholistic_{k,t} = \sum_{j=1}^{7} \left(\frac{COMP_{k,j,t}}{\sum_{j} COMP_{k,j,t}} \ln \left(\frac{\sum_{j} COMP_{k,j,t}}{COMP_{k,j,t}} \right) \right) \quad (3)$$

where $COMP_{k,j,t}$ denotes ERM component $j = 1, \ldots, 7$. Figure 2 presents a box-and-whisker plot of the sample firm's *Average Risk Management Quality Index* for the 1999 through 2009 period and a box-and-whisker plot of the *Holistic Risk Management Index* for the firms in our sample. The boxes illustrate the 25th and 75th percentiles, the lines in the boxes represent the medians, the whiskers illustrate the range of adjacent values as defined by Tukey (1977), and the black dots represent all individual data points outside the range of adjacent values. The graphs show a clear upward trend in the median as well as in the 25th and 75th percentiles of both measures of risk management quality across the sample period.

Industry-Adjusted Changes in Risk Management Quality Following Firms' Adoption of ERM

To test the ERM Quality Hypothesis (H2), which states that ERM adoption is accompanied by significant improvements in the quality of firms' risk management approach, we employ an event study methodology similar to the approach of Lee, Mayers, and Smith (1997). We adjust for the average time trend in the industry by subtracting the industry average from the firm-specific risk management quality measures. We then test for significant changes of this adjusted quality measure around the adoption

[28]We use the entropy measure of diversification for conceptual reasons. At the heart of ERM is the idea that a risk management program is only as strong as its weakest part. Therefore ERM focuses on a balanced, enterprise-wide approach to risk management. The entropy measure captures this basic concept well as the following example highlights: Firm A and B both have three ERM components. The quality of the three components for Firm A is 0.1, 0.5, and 0.5, respectively. The quality of Firm B's ERM components is 0.2, 0.2, and 0.2, respectively. Firm B's weakest component has a higher quality than Firm A's weakest component (0.2 > 0.1). The entropy measure we use in this study assigns Firm B a higher value than Firm A (1.099 > 0.935). However, the average ERM quality index leads to the opposite result, assigning Firm A a higher value than Firm B (0.367 > 0.2).

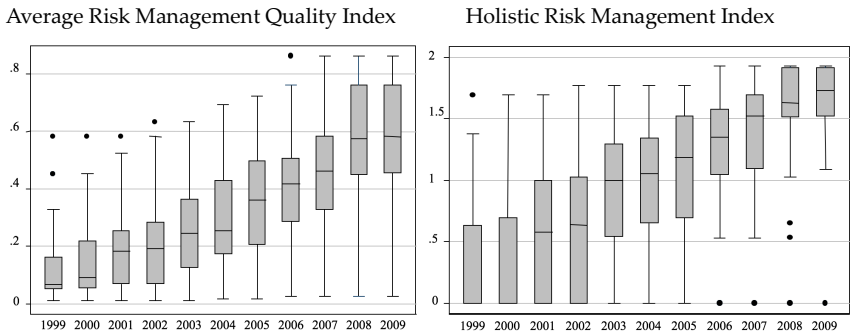


Fig. 2. Distribution of the Average Risk Management Quality and the Holistic Risk Management Index by year.
Notes: This figure presents box-and-whisker plots of the *Average Risk Management Quality Index* and the *Holistic Risk Management Index* for the sample firms. The boxes visualize the 25th and 75th percentiles, the lines in the boxes represent the medians, the whiskers visualize the range of adjacent values as defined by Tukey (1977), and the black dots represent all individual data points outside the range of adjacent values. The *Average Risk Management Quality Index* is based on individual survey items and takes on values between zero and one, with higher values indicating a higher average quality.

of ERM programs; the test is based on the $(t-1)$ to $(t+1)$ event window, where t represents the year in which a firm adopts ERM.

More precisely, we calculate the industry-adjusted change in firm i's risk management quality between year $(t+1)$ and year $(t-1)$ as

$$\Delta AdjRMquality_i = AdjRMquality_{i,t+1} - AdjRMquality_{i,t-1}, \qquad (4)$$

where $AdjRMquality_{i,t} = RMquality_{i,t} - IndustryAverage_t$ represents the industry-adjusted risk management quality of firm i, $RMquality_{i,t}$ is firm i's own risk management quality as defined in Equation (2) (or Equation (3) respectively), and $IndustryAverage_t$ is the average risk management quality across all sample firms. Note that we work with an alternative specification of the $IndustryAverage_t$ as well. The alternative is based on separate averages for stock, mutual, and public insurance companies in the sample. Depending on the firm's organizational form, the corresponding average is subtracted from that firm's risk management quality measure. We then use a t-test and the Wilcoxon signed-ranks test to examine whether the industry-adjusted change in risk management quality defined in Equation (4) differs significantly from zero.

Table 6 presents the results of a t-test (Wilcoxon signed-ranks test) of the null hypotheses that the mean (median) of the industry-adjusted

Table 6. Changes in Risk Management Quality Relative to Firms' Adoption of ERM, Pooled Across Nine Adoption Years

	Change (%)	
	Mean	Median
Average Risk Management Quality		
Industry adjustment based on pooled sample of insurers	9.78*** (0.000)	10.99*** (0.000)
Separate industry adjustments for stocks, mutuals, and publics	8.58*** (0.000)	8.85*** (0.001)
Holistic Risk Management Index		
Industry adjustment based on pooled sample of insurers	23.35*** (0.000)	14.58*** (0.000)
Separate industry adjustments for stocks, mutuals, and publics	21.14*** (0.000)	9.25*** (0.001)

Notes: The null hypotheses are that the mean and/or median of the changes in the industry-adjusted Average Risk Management Quality Index and the industry-adjusted Holistic Risk Management Index as defined in Equation (4) equal zero. The changes are based on the (t–1) to (t+1) event window, where t represents the year in which a firm adopts ERM. Statistical significance of the mean is based on the t-test, and statistical significance of the median is based on the Wilcoxon signed-ranks test; p-values are reported in parentheses. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively.

change in risk management quality defined in Equation (4) differs significantly from zero. The table presents two versions of the test. In the pooled version, the industry adjustment is the same for all insurers in the sample and is based on the pooled sample of all insurers; whereas the alternative version uses separate industry adjustments for stock insurers, mutual insurers and insurers, under public law.

For both versions of the test, changes of the Average Risk Management Quality Index defined in Equation (2) are positive and significantly different from zero at the one percent level, indicating that firms actually improve the quality of their risk management system when they implement an ERM program. In addition, changes of the Holistic Risk Management Index defined in Equation (3) are positive and significantly different from zero at the one percent level, indicating that firms really focus on a holistic approach towards risk management when they adopt ERM. The Holistic Risk Management Index captures whether firms have a balanced

risk management approach and improve the quality of all ERM components equally. Overall, the results presented in Table 6 strongly support the ERM Quality Hypothesis (H2)[29]. In addition, our results that ERM announcements are actually accompanied by an improved risk management process provide justification for the use of an ERM indicator variable based on firm announcements in prior studies.

Dynamic Determinants of Changes in Risk Management Quality

The theoretical argument that career concerns influence top management's decision to engage in risk management is not limited to ERM adoption. In Nam et al.'s (2008) dynamic model of risk management adoption, the term risk management refers to all activities that reduce earnings volatility and, hence, improve the informativeness of earnings as a signal of the manager's ability. Therefore, Nam et al.'s (2008) model generates an additional testable prediction with respect to the quality of a firm's risk management program: Top managers will only improve their firms' risk management program after a period of poor performance. To test this prediction and to provide empirical evidence supporting the Career Concerns Hypothesis II (H3), we perform ordinary least squares (OLS) regressions of changes in firms' average risk management quality on the determinants of ERM adoption discussed earlier. The specification of the model is as follows:

$$\Delta RMquality_{i,t} = \alpha + \beta_1 \Delta performance_{i,t-1} + \beta'_2 X_{i,t-1} + \varepsilon_{i,t} \qquad (5)$$

where $\Delta RMquality_{i,t} = RMquality_{i,t+1} - RMquality_{i,t-1}$ is the change of the average risk management quality index (see Equation (2)) of insurer i from year $(t-1)$ to year $(t+1)$. All independent variables are as defined in Equation (1) and standard errors are adjusted for firm-level clustering.

In the same vein, we regress $\Delta RMholistic_{i,t} = RMholistic_{i,t+1} - RMholistic_{i,t-1}$, the change of the holistic risk management index defined in Equation (3), on the determinants of ERM adoption:

$$\Delta RMholistic_{i,t} = \alpha + \beta_1 \Delta performance_{i,t-1} + \beta'_2 X_{i,t-1} + \varepsilon_{i,t}. \qquad (6)$$

Note that the OLS regressions are based on the full panel data set and not on the survival data set used for the dynamic logistic regression model.

[29]The results of this event study test can also be viewed as validation that the ERM indicator variable actually captures an improved corporate risk management process.

Table 7 presents the OLS estimation results from Equations (5) and (6). Models (1) and (2) and Models (3) and (4) only vary with respect to the control variables included. In all four model specifications the coefficient of the *Delta ROA (t–1)* variable is negative and significant, indicating that firms with negative changes in past performance are, all else equal, more likely to increase their risk management quality. These findings provide support for Hypothesis (H3) and the career concerns view, which predicts that top managers are more likely to engage in risk management activities after a period of low profitability (Nam et al., 2008).[30]

Moderating Effects of Group Affiliation and Organizational Form

Again, we use cross-sectional differences in forced CEO turnover rates across different types of firms as documented in He and Sommer (2011) to find further evidence in support of the Career Concerns Hypothesis II (H3). Career concerns should be more pronounced in firms affiliated with a group relative to single unaffiliated firms and less pronounced in mutual firms relative to other organizational forms, which tend to have higher forced CEO turnover rates on average. To test these predictions, we interact the *Delta ROA (t–1)* variable in the baseline model with two indicator variables capturing whether (1) an insurer is affiliated with a group or is a single unaffiliated firm and with two indicator variables capturing whether (2) an insurer is a mutual company or has another organizational form.

Models (1), (2), (5), and (6) in Table 8 present the results contrasting affiliated and unaffiliated insurers. Consistent with our prediction, the coefficient of the *Group * Delta ROA (t–1)* interaction term is negative and significant and the coefficient of the *Single * Delta ROA (t–1)* interaction term is insignificant in all four models. These estimates indicate a negative relationship between changes in past performance and improvements in the quality of firms' risk management process for affiliated insurers whose CEOs face a higher likelihood of losing their jobs, but no significant

[30]We perform a number of robustness checks and our main result is robust to the following alternative model specifications: (1) A model specification that controls for changes of other firm characteristics, more precisely the one-year change of the capital to assets ratio, the one-year change of the liquidity ratio, the one-year change of the firm size variable, and the one-year change of the line of business Herfindahl index. (2) A model specification that controls for insurance companies' investments in market share by adding a one-year lagged measure of premium growth. (3) A model specification that controls for the average change in industry performance by replacing the *Delta ROA (t–1)* variable with an industry-adjusted measure that was created by subtracting the sample average of the *Delta ROA (t–1)* variable in a given year from firms' individual changes in ROA.

Table 7. Determinants of Changes in Firms' Risk Management Quality

Dep. var.:	ΔRMquality		ΔRMholistic	
	(1)	(2)	(3)	(4)
Intercept	0.042	0.077	0.261**	0.329**
	(0.040)	(0.058)	(0.122)	(0.163)
Delta ROA (t–1)	–0.261**	–0.267**	–0.747**	–0.716*
	(0.106)	(0.103)	(0.376)	(0.371)
ROA (t–1)	0.096	0.088	0.113	–0.024
	(0.169)	(0.176)	(0.474)	(0.515)
Capital to Assets (t–1)	–0.097	–0.114	–0.300	–0.328
	(0.069)	(0.072)	(0.191)	(0.199)
Liquidity (t–1)	0.023	0.009	0.125	0.065
	(0.057)	(0.060)	(0.170)	(0.184)
Size (t–1)	0.004	0.003	0.003	0.002
	(0.004)	(0.005)	(0.013)	(0.014)
HHI (t–1)	0.005	–0.003	0.018	0.030
	(0.019)	(0.041)	(0.053)	(0.118)
Tax (t–1)	–0.676*	–0.590	–1.038	–0.764
	(0.403)	(0.417)	(1.141)	(1.247)
Group (t–1)	0.055**	0.046	0.126*	0.122*
	(0.024)	(0.029)	(0.070)	(0.068)
Mutual (t–1)	–0.041***	–0.040***	–0.117***	–0.105***
	(0.014)	(0.014)	(0.038)	(0.040)
Public (t–1)	–0.044***	–0.049**	–0.101**	–0.089
	(0.015)	(0.019)	(0.041)	(0.056)
Line of business controls	No	Yes	No	Yes
Year dummy variables	Yes	Yes	Yes	Yes
R-squared	0.125	0.129	0.064	0.069
Adjusted *R*-squared	0.102	0.095	0.039	0.032
Number of observations	657	657	657	657

Notes: The dependent variable in Models (1) and (2) is the change in the Average Risk Management Quality Index from year (t–1) to year (t+1), and the dependent variable in Models (3) and (4) is the change in the Holistic Risk Management Index from year (t–1) to year (t+1). OLS estimates are based on the full panel data set. All independent variables are measured in year t–1. *Delta ROA* is the one-year change in ROA. *ROA* is equal to net income divided by total assets. *Capital to Assets* is equal to the ratio of the equity capital to total assets. *Liquidity* is the ratio of liquid assets to liabilities. *Size* is the natural logarithm of total assets. *HHI* is the Herfindahl concentration index of direct premiums written across business lines. *Tax* is the total amount of taxes paid divided by total assets. *Group* is equal to 1 if insurer is affiliated with a group, 0 otherwise. *Mutual* is 1 if insurer is a mutual, 0 otherwise. *Public* is equal to 1 if insurer is organized as an insurer under public law, 0 otherwise. Line of business controls are calculated by dividing premiums written in each line of business by total premiums written. Year dummies are included in each regression. Standard errors are adjusted for firm-level clustering and appear in parentheses below each coefficient estimate. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively.

relationship for single unaffiliated insurers whose CEOs are less likely to get fired.

Models (3), (4), (7), and (8) in Table 8 present the results contrasting mutual insurers and insurers with other organizational forms. Consistent with our prediction, the coefficient of the *Non-Mutual * Delta ROA (t–1)* interaction term is negative and significant, but the coefficient of the *Mutual * Delta ROA (t–1)* interaction term is insignificant. These estimates indicate a negative relationship between changes in past performance and improvements in the quality of firms' risk management process for insurance companies whose CEOs face a higher likelihood of losing their jobs, but no significant relationship for mutual insurers whose CEOs are less likely to get fired. Overall, these results provide additional support for the Career Concerns Hypothesis II (H3).

New CEOs and Changes in Firms' Risk Management Quality

If a CEO gets fired after a period of poor performance and the newly hired CEO improves the risk management process, we will observe an increase in risk management quality after a period of poor firm performance. However, the increase in risk management quality is driven by the change in leadership rather than by the career concerns of an established CEO. To distinguish between the effects of career concerns and new leadership, we include the *New CEO* indicator together with an interaction term between the *New CEO* indicator and the *Delta ROA (t–1)* variable in our model. The results are reported in Table 9. If new CEOs hired after a year of poor performance were driving improvements in risk management quality, we would see a negative and significant coefficient for the *New CEO * Delta ROA (t–1)* interaction term, and the significance of the *Delta ROA (t–1)* variable would disappear. We find exactly the opposite. The coefficient of the *Delta ROA (t–1)* variable remains negative and significant and the coefficient of the *New CEO * Delta ROA (t–1)* interaction term is insignificant. These results indicate that career concerns of established CEOs rather than decisions by new, incoming CEOs are a major factor in firms' investments in an improved risk management process. These results provide further support for the Career Concerns Hypothesis II (H3).

Overall, our results highlight a time-series dimension or path-dependence of CEOs' decisions to improve their firms' risk management process and to move toward an enterprise-wide approach. Of course, there are other possible actions CEOs can take after a period of low performance, but those are beyond the scope of our paper and are left for future research.

Table 8. The Moderating Effects of Group Affiliation and Organizational Form

	ΔRMquality				ΔRMholistic			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.020	0.057	0.021	0.057	0.158	0.231	0.160	0.232
	(0.041)	(0.058)	(0.040)	(0.058)	(0.123)	(0.159)	(0.123)	(0.158)
Group * Delta ROA (t–1)	–0.281**	–0.286**			–0.776*	–0.748*		
	(0.122)	(0.120)			(0.428)	(0.425)		
Single * Delta ROA (t–1)	–0.132	–0.142			–0.559	–0.499		
	(0.141)	(0.159)			(0.644)	(0.665)		
Mutual * Delta ROA (t–1)			–0.200	–0.204			–0.405	–0.368
			(0.166)	(0.165)			(0.457)	(0.462)
Non–Mutual * Delta ROA (t–1)			–0.292**	–0.299**			–0.921*	–0.892*
			(0.125)	(0.123)			(0.490)	(0.486)
ROA (t–1)	0.106	0.098	0.096	0.088	0.127	–0.007	0.116	–0.021
	(0.176)	(0.182)	(0.169)	(0.176)	(0.493)	(0.535)	(0.471)	(0.512)
Capital to Assets (t–1)	–0.099	–0.116	–0.096	–0.113	–0.303	–0.331	–0.294	–0.322
	(0.070)	(0.072)	(0.069)	(0.071)	(0.192)	(0.200)	(0.190)	(0.199)
Liquidity (t–1)	0.024	0.010	0.024	0.010	0.127	0.067	0.129	0.070
	(0.057)	(0.061)	(0.057)	(0.060)	(0.170)	(0.185)	(0.169)	(0.183)
Size (t–1)	0.004	0.003	0.004	0.003	0.003	0.002	0.003	0.002
	(0.004)	(0.005)	(0.004)	(0.005)	(0.013)	(0.014)	(0.013)	(0.014)
HHI (t–1)	0.005	–0.003	0.005	–0.003	0.018	0.029	0.018	0.029
	(0.019)	(0.042)	(0.019)	(0.041)	(0.054)	(0.120)	(0.053)	(0.118)
Tax (t–1)	–0.685*	–0.600	–0.681*	–0.594	–1.051	–0.782	–1.068	–0.790
	(0.407)	(0.421)	(0.403)	(0.417)	(1.148)	(1.259)	(1.140)	(1.246)

Group (t–1)	0.055**	0.046	0.055**	0.046	0.127*	0.123*	0.126*	0.121*
	(0.025)	(0.029)	(0.024)	(0.028)	(0.070)	(0.068)	(0.070)	(0.067)
Mutual (t–1)	–0.041***	–0.040***	–0.041***	–0.040***	–0.117***	–0.105**	–0.116***	–0.105**
	(0.014)	(0.014)	(0.014)	(0.014)	(0.038)	(0.040)	(0.038)	(0.040)
Public (t–1)	–0.044***	–0.049**	–0.044***	–0.049**	–0.100**	–0.089	–0.102**	–0.090
	(0.015)	(0.019)	(0.015)	(0.019)	(0.041)	(0.056)	(0.041)	(0.056)
Line of business controls	No	Yes	No	Yes	No	Yes	No	Yes
Year dummy variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R–squared	0.125	0.129	0.125	0.129	0.064	0.069	0.064	0.070
Adjusted *R*–squared	0.100	0.093	0.100	0.093	0.037	0.031	0.038	0.031
Number of observations	657	657	657	657	657	657	657	657

Notes: The dependent variable in Models (1) and (2) is the change in the Average Risk Management Quality Index from year (t–1) to year (t+1), and the dependent variable in Models (3) and (4) is the change in the Holistic Risk Management Index from year (t–1) to year (t+1). OLS estimates are based on the full panel data set. All independent variables are measured in year t–1. *Delta ROA* is the one-year change in ROA. *ROA* is equal to net income divided by total assets. *Capital to Assets* is equal to the ratio of the equity capital to total assets. *Liquidity* is the ratio of liquid assets to liabilities. *Size* is the natural logarithm of total assets. *HHI* is the Herfindahl concentration index of direct premiums written across business lines. *Tax* is the total amount of taxes paid divided by total assets. *Group* is equal to 1 if insurer is affiliated with a group, 0 otherwise. *Mutual* is 1 if insurer is a mutual, 0 otherwise. *Public* is equal to 1 if insurer is organized as an insurer under public law, 0 otherwise. Line of business controls are calculated by dividing premiums written in each line of business by total premiums written. Year dummies are included in each regression. Standard errors are adjusted for firm-level clustering and appear in parentheses below each coefficient estimate. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 9. New CEOs and Changes in Firms' Risk Management Quality

	ΔRMquality		ΔRMholistic	
	(1)	(2)	(3)	(4)
Intercept	0.005	0.048	0.134	0.254
	(0.040)	(0.064)	(0.125)	(0.170)
Delta ROA (t–1)	–0.238**	–0.252**	–0.686*	–0.684*
	(0.113)	(0.108)	(0.406)	(0.393)
New CEO * Delta ROA (t–1)	–0.207	–0.140	–0.544	–0.283
	(0.302)	(0.322)	(1.023)	(1.087)
New CEO	–0.003	–0.003	–0.007	–0.007
	(0.015)	(0.016)	(0.046)	(0.046)
ROA (t–1)	0.099	0.087	0.111	–0.046
	(0.172)	(0.178)	(0.485)	(0.519)
Capital to Assets (t–1)	–0.066	–0.082	–0.223	–0.240
	(0.069)	(0.070)	(0.192)	(0.191)
Liquidity (t–1)	0.030	0.010	0.133	0.062
	(0.059)	(0.061)	(0.175)	(0.185)
Size (t–1)	0.004	0.003	0.002	–0.000
	(0.005)	(0.005)	(0.014)	(0.015)
HHI (t–1)	0.008	0.001	0.021	0.010
	(0.019)	(0.044)	(0.054)	(0.123)
Tax (t–1)	–0.630	–0.548	–0.955	–0.660
	(0.412)	(0.429)	(1.175)	(1.284)
Group (t–1)	0.059**	0.051*	0.137*	0.132*
	(0.025)	(0.029)	(0.071)	(0.068)
Mutual (t–1)	–0.045***	–0.043***	–0.123***	–0.104**
	(0.014)	(0.015)	(0.039)	(0.041)
Public (t–1)	–0.048***	–0.053***	–0.111***	–0.100*
	(0.015)	(0.019)	(0.041)	(0.056)
Line of business controls	No	Yes	No	Yes
Year dummy variables	Yes	Yes	Yes	Yes
R-squared	0.129	0.134	0.064	0.072
Adjusted *R*-squared	0.103	0.096	0.036	0.031
Number of observations	644	644	644	644

Notes: The dependent variable in Models (1) and (2) is the change in the Average Risk Management Quality Index from year (t–1) to year (t+1), and the dependent variable in Models (3) and (4) is the change in the Holistic Risk Management Index from year (t–1) to year (t+1). OLS estimates are based on the full panel data set. All independent variables are measured in year t–1. *Delta ROA* is the one-year change in ROA. *ROA* is equal to net income divided by total assets. *Capital to Assets* is equal to the ratio of the equity capital to total assets. *Liquidity* is the ratio of liquid assets to liabilities. *Size* is the natural logarithm of total assets. *HHI* is the Herfindahl concentration index of direct premiums written across business lines. *Tax* is the total amount of taxes paid divided by total assets. *Group* is equal to 1 if insurer is affiliated with a group, 0 otherwise. *Mutual* is 1 if insurer is a mutual, 0 otherwise. *Public* is equal to 1 if insurer is organized as an insurer under public law, 0 otherwise. Line of business controls are calculated by dividing premiums written in each line of business by total premiums written. Year dummies are included in each regression. Standard errors are adjusted for firm-level clustering and appear in parentheses below each coefficient estimate. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively.

CONCLUSION

ERM is the approach of managing all risks faced by a firm in an integrated, holistic fashion. This research examines factors that influence a firm's decision to start an ERM program. The analysis utilizes a direct survey–based measure of ERM adoption and takes a dynamic perspective. The detailed survey data also allow us to construct two continuous measures of risk management quality.

Our main results are that negative changes in past firm performance increase a firm's probability to adopt ERM and are accompanied by significant improvements in the quality of a firm's risk management process. Overall, these results are consistent with the prediction of the managerial career concerns view and managerial incentives generally. Managers with high initial reputation can survive an early period of poor performance and are still considered to be reasonably good managers. Thus, the career concerns view predicts that a manager with high initial reputation should only adopt ERM after a period of poor performance. Of course, this career concerns mechanism should be stronger for firms with relatively high forced CEO turnover rates after periods of bad performance, and the results of our subsample analysis support that view.

Having two continuous measures of a firm's risk management quality in addition to an ERM indicator variable allows us to examine whether firms' statements that they adopt ERM are accompanied by actual improvements in the quality of their risk management process or are just lip service to the ERM concept. Our result that ERM announcements are actually accompanied by an improved risk management process provide justification for the use in prior studies of an ERM indicator variable based on firm announcements. Overall, our research contributes to the literature on corporate risk management by providing further details on firms' decisions to move their risk management toward an enterprise-wide approach.

APPENDIX: ERM COMPONENTS FROM SURVEY

The average risk management quality index defined in Equation (2) as well as the holistic risk management index defined in Equation (3) are based on the following seven components of an ERM system:

1. Identification of firm's risk appetite = (targetrating + riskstrategy) / 2

- *targetrating* = indicator variable equal to 1 if company determines how much risk they are willing to assume (e.g., in the form of an acceptable ruin probability or a target rating), 0 otherwise.
- *riskstrategy* = indicator variable equal to 1 if company has a risk strategy (in the context of the overall corporate strategy) that defines how risks should be handled, 0 otherwise.

2. Risk aggregation = (investrisk + liquidrisk + underwrisk + concentrisk + catastrisk + operatrisk + stratrisk + reputrisk + corrmodel + copulas) / 10

- *investrisk* = indicator variable equal to 1 if company's aggregate risk model includes investment risk, 0 otherwise.
- *liquidrisk* = indicator variable equal to 1 if company's aggregate risk model includes liquidity risk, 0 otherwise.
- *underwrisk* = indicator variable equal to 1 if company's aggregate risk model includes underwriting risks in different business lines, 0 otherwise.
- *concentrisk* = indicator variable equal to 1 if company's aggregate risk model includes concentration risk, 0 otherwise.
- *catastrisk* = indicator variable equal to 1 if company's aggregate risk model includes catastrophe claim risk, 0 otherwise.
- *operatrisk* = indicator variable equal to 1 if company's aggregate risk model includes operational risk, 0 otherwise.
- *stratrisk* = indicator variable equal to 1 if company's aggregate risk model includes strategic risk, 0 otherwise.
- *reputrisk* = indicator variable equal to 1 if company's aggregate risk model includes reputation risk, 0 otherwise.
- *corrmodel* = indicator variable equal to 1 if company models correlations between individual risks in the risk aggregation process, 0 otherwise.

- *copulas* = indicator variable equal to 1 if company uses copulas (non-linear correlations) to model dependencies in the risk aggregation process, 0 otherwise.

3. *Risk capital allocation = (units + risktypes + regions + products + investrisk + liquidrisk + underwrisk + concentrisk + catastrisk + operatrisk + stratrisk + reputrisk + diversification) / 13*

- *units* = indicator variable equal to 1 if company allocates risk capital to more than one business unit/department, 0 otherwise.
- *risktypes* = indicator variable equal to 1 if company allocates risk capital to more than one type of risk, 0 otherwise.
- *regions* = indicator variable equal to 1 if company allocates risk capital to more than one region, 0 otherwise.
- *products* = indicator variable equal to 1 if company allocates risk capital to more than one product, 0 otherwise.
- *investrisk* = indicator variable equal to 1 if company considers investment risk in the capital allocation process, 0 otherwise.
- *liquidrisk* = indicator variable equal to 1 if company considers liquidity risk in the capital allocation process, 0 otherwise.
- *underwrisk* = indicator variable equal to 1 if company considers underwriting risks in different business lines in the capital allocation process, 0 otherwise.
- *concentrisk* = indicator variable equal to 1 if company considers concentration risk in the capital allocation process, 0 otherwise.
- *catastrisk* = indicator variable equal to 1 if company considers catastrophe claim risk in the capital allocation process, 0 otherwise.
- *operatrisk* = indicator variable equal to 1 if company considers operational risk in the capital allocation process, 0 otherwise.
- *stratrisk* = indicator variable equal to 1 if company considers strategic risk in the capital allocation process, 0 otherwise.
- *reputrisk* = indicator variable equal to 1 if company considers reputation risk in the capital allocation process, 0 otherwise.
- *diversification* = indicator variable equal to 1 if company's capital allocation procedure takes portfolio or diversification effects into account, 0 otherwise.

4. Performance measurement = (measure + divisions + perfimpact) / 3

- *measure* = indicator variable equal to 1 if company measures business success with one or several (performance-)measure(s), 0 otherwise.
- *divisions* = indicator variable equal to 1 if company uses performance measurement for divisions/departments within the company, 0 otherwise.
- *perfimpact* measures to what degree assumed risks influence measured performance in the company. The original survey response is on a seven-point Likert scale (from 1 = no influence to 7 = very strong influence); the *perfimpact* variable is standardized to be 1 for the scale value 7.

5. Incentive contracts = (compensation + compimpact) / 2

- *compensation* = indicator variable equal to 1 if manager compensation depends on performance measures, 0 otherwise.
- *compimpact* measures to what degree assumed risks have an impact on manager compensation. The original survey response is on a seven-point Likert scale (from 1 = no impact to 7 = very strong impact); the *compimpact* variable is standardized to be 1 for the scale value 7.

6. Risk management culture = (employees + training + intranet + system + suggestion + decision + strategy) / 7

- *employees* measures to what degree "employees are familiar with the risk management concept." The original survey response is on a seven-point Likert scale (from 1 = no impact to 7 = very strong impact); the *employees* variable is standardized to be 1 for the scale value 7.
- *training* measures to what degree "in-house training addresses risk management." The original survey response is on a seven-point Likert scale (from 1 = no impact to 7 = very strong impact); the *training* variable is standardized to be 1 for the scale value 7.
- *intranet* measures to what degree an intranet platform is used to support risk management. The original survey response is on a seven-point Likert scale (from 1 = no impact to 7 = very strong impact); the *intranet* variable is standardized to be 1 for the scale value 7.
- *system* measures to what degree "there is an employee suggestion system on risk management." The original survey response is on a seven-point Likert scale (from 1 = no impact to 7 = very strong

impact); the *system* variable is standardized to be 1 for the scale value 7.

- *suggestion* measures to what degree "employees' suggestions related to risk management are considered." The original survey response is on a seven-point Likert scale (from 1 = no impact to 7 = very strong impact); the *suggestion* variable is standardized to be 1 for the scale value 7.
- *decision* measures to what degree "employees consider risks in their decisions." The original survey response is on a seven-point Likert scale (from 1 = no impact to 7 = very strong impact); the *decision* variable is standardized to be 1 for the scale value 7.
- *strategy* = indicator variable equal to 1 if company has a strategy for risk management culture, 0 otherwise.

7. Audit = (independent + right + legal + corporate + quality + data + efficiency) / 7

- *independent* = indicator variable equal to 1 if company's risk management process is evaluated by an independent department (e.g., internal audit), 0 otherwise.
- *right* = indicator variable equal to 1 if company's internal audit function has the unrestricted right to conduct evaluations, 0 otherwise.
- *legal* = indicator variable equal to 1 if company evaluates the compliance with legal and regulatory requirements, 0 otherwise.
- *corporate* = indicator variable equal to 1 if company evaluates the compliance with corporate guidelines and policies, 0 otherwise.
- *quality* = indicator variable equal to 1 if company evaluates the quality of the risk management process, 0 otherwise.
- *data* = indicator variable equal to 1 if company evaluates the relevance and quality of the data used in the risk management process, 0 otherwise.
- *efficiency* = indicator variable equal to 1 if company evaluates the efficiency of the risk management process, 0 otherwise.

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