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Enterprise Risk Management: Strategic Antecedents, Risk Integration, and Performance

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Abstract

The current literature on the adoption of enterprise risk management (ERM) abstracts from the issue of its strategic context. Accounting for the interplay between ERM and various individual risk management (IRM) practices, this paper presents a theoretical basis to study the strategic determinants, risk integration, and value creation of ERM. We tested hypotheses with data from the U.S. property and casualty insurance industry. Our results show that insurers with more reinsurance purchase and greater geographic diversification are more likely to adopt ERM. After ERM initiation, the magnitude of certain IRM adjustments is substantial. The market responds negatively to ERM adoption. ERM displays a strong negative correlation with firm value with a discount of 5% (4%) in terms of Tobin's *Q* (ROA).

1. Introduction

Enterprise risk management (ERM) represents a fundamental shift in the way that firms deal with risk. Through a holistic approach, ERM identifies and measures diverse risk factors and coordinates risk management activities across all operating units of an organization, as opposed to the traditional practice whereby each business unit separately assesses its particular risks and decides how to mitigate them on its own.

Recent surveys show that the concept of ERM has been rapidly embraced by the business community (e.g., Kleffner et al. 2003; Fraser et al. 2008), and accordingly scholarly interest in this phenomenon is growing. Studies in this line of research have so far linked ERM to firm characteristics. For example, Beasley et al. (2005) observe that the extent to which a firm commits to ERM is determined by its size and executive support. Through an empirical analysis of senior risk officer appointments during 1992–2005, Pagach and Warr (2007) find that financial leverage plays an important role in ERM adoption, with high-leverage firms being more likely to apply ERM than firms with low-leverage ratios. Researchers have also looked at how ERM relates to the structure of board of directors. In analyzing firms in the segment of pharmaceutical preparations, Desender (2009) detects that the percentage of independent outside directors does not necessarily influence ERM adoption. Board independence affects ERM only when there is a separation of CEO and board chairman positions.

Yet surprisingly little attention has been paid to the strategic context within which ERM is motivated and carried out. By definition, a better understanding of ERM requires a perspective that emphasizes the importance of integration among a firm's broad range of risks as well its specialized individual risk management (IRM) strategies—namely, strategies that are designed for separate silos of firm risks

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(e.g., insurance, diversification, asset allocation, or hedging through financial derivatives). The Committee of Sponsoring Organizations of the Treadway Commission (COSO) stresses ERM as ''a process . . . applied in strategy setting and across the enterprise'' (2004, p. 2). However, despite the presumed role of ERM in ''commingling'' various IRMs, we are not aware of any research investigating how IRMs act as catalysts for ERM formation. In addition, no research has empirically explored whether ERM elicits modification of IRM practices. Considering that ERM integrates IRMs, the adoption of ERM should intuitively have an impact on the firm's existing IRM operations.

Understanding the connection between ERM and IRMs is not only important in its own right but may also provide insights into how ERM contributes to firm performance. Given their common function in handling risks, the effect of one practice (ERM) will tend to be contingent on the status of the other (IRMs). Unfortunately, studies on the value relevance of ERM programs have often neglected IRMs with an implicit assumption of mutual exclusivity of the two risk management approaches. Focusing on ERM alone is problematic because, as will be clear, IRMs may provoke ERM adoption. As such, without controlling for IRMs, the observed ERM effect might be simply a reflection of the impact of its underlying IRM drivers, leading to spurious results.

The purpose of this study is threefold: (1) to investigate whether the heterogeneity in IRMs across firms accounts for their different propensities toward adopting ERM, (2) to analyze the patterns of IRM adjustments subsequent to ERM adoption, and (3) to examine the influence of ERM on firm performance in the context of IRMs. We focus on ERM activities in the insurance industry because insurers, which are relatively homogeneous in terms of their investment, financing activities, and regulatory environments, are active in espousing ERM concepts (Grace et al. 2010), making them ideal candidates for such studies. Specifically we test our hypotheses using a longitudinal data set of 85 U.S. publicly traded property and casualty (PC) insurers. Our results broadly support the view that ERM and IRMs are closely related and have mutual impacts on each other. Thus, this paper extends the literature on ERM by being the first study to show the dynamics between ERM and other related organizational risk management strategies.

Our article also contributes to the debate regarding the value creation of ERM behaviors. Our results show that, after teasing out the impact of IRMs, the stock market responds negatively to insurers' ERM adoptions. One explanation for this finding is that ERM is still at its infancy stage (see Fig. 1 described in Section 3.1.), and its benefit, procedure, and mechanisms remain vague and ambiguous. As such, firms adopting ERM have to rely on experiential learning, conduct experiments, and accumulate knowledge through trials and errors, the process of which can be demanding and time consuming. Given its unclear utility, the market apparently views ERM, at the current state, as too costly to justify its implementation.

The remaining paper proceeds as follows. The next section of this article briefly reviews the risk management literature, followed by hypotheses development. We then describe our data, variables, and methods. This is followed by the discussion of the empirical results and robustness checks. The article concludes with a summary.

2. THEORY AND HYPOTHESES DEVELOPMENT

In this section we first review the literature on the rationale for risk management. We then discuss motivations for adopting ERM and formulate hypotheses on how the levels of various IRMs inspire ERM endeavors. Next, we develop hypotheses about the impact of ERM on IRM reconfiguration. Finally, we build hypotheses on the value effects of ERM.

2.1 Rationale for Risk Management

The literature on corporate risk management is vast and growing. A general consensus of this body of research is that although hedging is not necessary in an ''ideal'' world depicted by Modigliani and Miller, it is meaningful and conducive to firms in a real business context where market imperfections exist. Specifically, hedging can assist firms to (1) reduce financial distress costs (e.g., Smith and Stulz

1985; Lin et al. 2008; Lookman 2009), (2) alleviate underinvestment problems (Myers 1977), (3) increase tax savings (Adams et al. 2008), and (4) avoid costly external financing (Froot and O'Connell 2008).

Like industrial firms, insurance firms can reap benefits from engaging in risk management. Cummins et al. (1997) point out that insurers play two major roles in the market: risk warehousing and financial intermediation, each of which exposes the firms to substantial risks. First, by selling insurance policies, insurers pool risks from individuals and businesses and promise to pay claims upon the occurrence of specific loss events. This function, although a fundamental reason for their existence, can be a source of danger to insurers because the rationale of risk pooling is based on the independence of claim losses across policies. Other things equal, a high positive loss correlation would undermine the companies' underwriting capacity. Second, given the fact that insurers issue debt contracts on the one hand, and invest their surplus on the other, they also serve the role of financial intermediaries. Cummins et al. (1997, 2001) provide detailed description of this function, so we do not repeat it here. One conclusion the authors draw is that, as a consequence of their positions in the market, insurers are subject to considerable financial risks.

The literature has documented various approaches that firms apply to deal with risks. In the insurance industry where underwriting and financial risks are the dominant risks, probably the most commonly used IRMs are geographic diversification, business diversification, reinsurance, asset allocation, and financial derivatives. Each of the strategies tackles some distinct risk dimension, for which we provide intuition below.

Portfolio theory suggests that diversification helps to decrease risk because of the imperfect correlation among different regions or markets (e.g., Carson et al. 2008; Song and Cummins 2008). In support of this argument, Baele et al. (2007) and Carson et al. (2008) have shown that diversification decreases earnings volatility so that it makes well-diversified firms safer by lowering their probability of default. This insight has implications to insurers because, as noted, the underwriting ability of these firms depends on the loss correlation of their policies. By managing a diversified insurance portfolio, insurers are able to spread underwriting risks and prevent excessive exposure from a single source.

Notwithstanding the benefit of diversification, it has only limited efficacy against extreme events. To illustrate, a large-scale catastrophe such as the World Trade Center attacks on September 11, 2001, can affect diverse business lines, leading to correlated losses across large numbers of contracts and policies. As a result, reinsurance has been widely adopted in the insurance sectors. In 2003 alone, an amount of $146 billion premium, or over 13% of total PC direct premium written by the nonlife primary insurers worldwide, was ceded to reinsurers globally (Swiss Re 2004). By using reinsurance, insurers can transfer part of the risks to reinsurers and, thus, reduce the effect of unexpected high-end losses (or underwriting tail risks).

Financial risks pose a major threat to insurers as well. In fact, ''the loss of value of investments (alone) was the cause of about 10 per cent of insurance insolvencies in the U.S. in the past 20 years'' (Fitzpatrick 2001, p. 24). Investment losses are often caused by poor asset management or overinvestment in risky assets. As such, asset allocation is becoming increasingly important for financial risk management in the insurance industry and constitutes a fundamental strategy to handle this risk. Still, some financial risks, such as interest rate risk and exchange rate risk (two of the primary risks that insurers face), are systematic risks that are beyond the firms' control (Cummins et al. 1997, 2001). Fortunately, the variety of financial instruments and over-the-counter products (such as options, futures, forwards, and swaps) available in the financial market presents a solution to hedge against these risks.

Whereas the aforementioned IRMs provide useful means for risk management, each of the strategies rests on a silo-based approach, with a concentration on only one of the various aspects of organizational risks. Recently researchers introduced ERM as an alternative approach. Rather than treating them as statistically independent, ERM considers inherent connections among individual risks and manages them in a holistic fashion by integrating, diversifying, and prioritizing risk in different dimensions. Conceptually, the consolidated approach of ERM may add value to firms in a couple of ways. First, by assessing all risks, firms can develop a complete picture of their own risk portfolios. This allows the firms to explore natural hedging among different classes of risks, which is ignored by IRMs. Rosenberg and Schuermann (2006) find that the total risk of an organization is not equal to the sum of individual risks. Based on data from banking holding companies, their simulation shows that an integration of separate risks can reduce the overall level of organizational risk up to about 40%. Second, not all risks are of equal importance, not even to the same firm. Through ERM, firms can prioritize risk factors according to their own risk appetites. This process and the corresponding knowledge generated can guide organizational behaviors, improve operational efficiency, and allow firms to better allocate their resources to optimize their effort in risk management and decision making.

2.2 How IRMs Act as Catalysts for ERM Formation

Insurance companies purchase reinsurance to limit large losses and/or to meet regulatory solvency requirements. However, reinsurance is expensive, generally offered with a premium over and above the expected risk transferred (Cummins et al. 2008a). The high price of reinsurance relative to the expected loss could be explained by the information asymmetry between insurers and reinsurers (Jean-Baptiste and Santomero 2000). In addition, due to a series of massive catastrophes that occurred in the last two decades,[1] quantities of reinsurance supply fall and prices rise in the aftermath of large losses. Examining the catastrophe reinsurance market, Froot (2001) finds that insurers pay several times the expected loss of their ceded risk.

As a consequence, despite its widespread use, the high cost of reinsurance is a concern to insurers. ERM consolidates various risks across the entire organization and, thus, reduces the amount of risk to be ceded. This function of ERM offers the potential for cost savings by lowering the need for reinsurance usage (Shamieh 2007). Insurers that buy more reinsurance protection are more likely to initiate ERM because they tend to benefit more from its adoption. Consequently, we hypothesize the following:

H1a: Insurers with a larger amount of reinsurance purchased are more likely to adopt ERM.

In the presence of market imperfections, companies are motivated to hedge risk with financial derivatives (Smith and Stulz 1985). A 1998 survey of major nonfinancial firms revealed that more than 50% of the firms rely on some form of financial derivatives to manage price- and market-related risks (Bodnar et al. 1998). However, using 1994 data, Cummins et al. (1997) report that only 7% of PC insurers and 12% of life insurers engage in derivatives transactions. Based on more updated data from 2000 to 2006, a recent study by Song and Cummins (2008) shows that the average derivatives usage rate is merely 2.5% of total firms in the PC insurance industry.

The above observations indicate that although financial derivatives have been widely utilized by industrial firms, they have not been fully exploited by insurance companies. Compared to those with no or limited use of derivatives, insurers that are active in the derivatives market tend to be more conscious about financial risks in that the requirement of selection of appropriate financial instruments and the corresponding actions for execution necessitate a deep understanding of movements and correlations of financial market forces. Along this line of reasoning, firms that hedge more with derivatives may extract more benefits and incur lower costs from ERM implementation because, given their level of awareness and knowledge in financial risk correlations, they are more likely to have a faster learning curve to find subtle connections between financial risks and other risks in organizational systems. This makes these firms more likely to adopt ERM. Thus,

H1b: Insurers with a higher degree of financial derivative usages for hedging are more likely to adopt ERM.

[1] Among the long list of major catastrophes during the period are Hurricane Andrew in 1992, the Northridge (CA) Earthquake in 1994, the September 11 terrorist attacks in 2001, and Hurricane Katrina in 2005, to mention just a few.

Allocating more funds to risky assets, while increasing the expected return can introduce higher uncertainty and downside risk to insurers. As the insurance industry is constrained by the capital requirements, an increase in asset risk would induce an increase in capital and associated costs to reflect the higher probability of bankruptcy (Cummins and Sommer 1996). ERM is designed to support optimal asset allocation in a broad manner: Rather than simply diversifying away asset risk, it coordinates various asset and liability risks. Accordingly, it tends to lower downside risk and reduce bankruptcy and regulatory costs. As insurers with riskier asset portfolios are subject to higher capital costs, we expect that they are more likely to adopt ERM because they can get more cost reduction from implementing ERM than those with safer asset portfolios. This logic leads to the following hypothesis:

H1c: Insurers with riskier asset portfolios are more likely to adopt ERM.

The existing literature has suggested that diversification holds special potential value as a natural hedging mechanism (Cummins et al. 2001; Song and Cummins 2008; Elango et al. 2008). Diversification reduces the impact of losses that are either location- or business-specific (Cummins and Nini 2002); yet, as a cost, this strategy augments the level of risk complexity that the company faces (Wagner 2010). By expanding its business (or geographic) frontiers, an insurer encounters new risk factors that can be inherently different from what have been incorporated in its existing risk portfolio. Diversification also imposes a need for a more sophisticated organizational structure to facilitate interdepartmental knowledge exchange, task coordination, and effective resource allocation (Lang and Stulz 1994). The increased complexity of organizational structure makes firm behaviors more opaque to investors and more difficult to monitor, leaving room for opportunistic behaviors (Laeven and Levine 2007). In this sense, there is a tradeoff between underwriting risks and operational risks to diversifying insurers. ERM aims at streamlining risk coordination. The increased risk complexity of diversifiers suggests that these firms have a higher propensity to adopt ERM because they are more likely to gain from managing all risks comprehensively. Therefore, we propose the following two hypotheses:

H1d: Insurers with a larger degree of geographic diversification are more likely to adopt ERM.

H1e: Insurers with a larger degree of business diversification are more likely to adopt ERM.

2.3 Post-ERM Adjustment of IRMs

ERM is not a substitute for IRMs, but creates synergies for the latter by incorporating them within one integrated framework (COSO 2004; Beasley et al. 2008). In other words, ERM acts as a central planner to coordinate and reformulate all IRMs.

As noted earlier, cost savings play an essential role in motivating ERM programs. A successful ERM strategy can streamline operation, reduce redundancy, and consolidate risk management, thereby minimizing costly risk transfer. Indeed, some insurance managers have explicitly stated in public that, through a sound ERM program, they have successfully reduced costs by greater risk retention and less reinsurance purchase (e.g., Safeco Corporation). The coverage period of a reinsurance contract is typically one year (Froot 2001); thus, insurers can promptly bring their reinsurance level closer to the optimal enterprise-wide level after initiating ERM.

PC insurers, as financial intermediaries, are subject to significant interest rate risk because of their investment in bonds and real estate. They are also exposed to exchange rate risk because of increasing globalization of insurance and financial risks (Cummins et al. 1997, 2001). As stated above, in the U.S. insurance industry, financial derivatives play only a trivial role in hedging asset risk. ERM helps identify and quantify all types of risks underestimated or ignored by insurers. Therefore, we predict ERM programs will foster more derivative usage for hedging purpose. In addition to financial derivatives, PC insurers can reduce investment risk internally via asset allocation, which composes another critical part of a corporate-wide ERM program. ERM determines the best investment and asset portfolio that provides minimum risk for a given level of firm return. As such, we expect ERM adoption will reduce asset portfolio risk.

In contrast to the aforementioned IRMs, it is much more difficult and unmanageable for a firm to change business lines and underwriting regions in the initial phase of an ERM program. Insurers may be required by regulators to underwrite specific lines of insurance in particular regions. In addition, the insurers may face substantial transaction costs if they expand to or exit from a market or a business line too quickly. Issues such as costly external financing at expansion, fire sale of assets when exiting from a market or a business line in haste, and difficulty of accessing needed information and expertise are barriers for ERM insurers to rapidly move away from the prior level of diversification at the time of ERM adoption. Accordingly, we conjecture that geographic diversification and product diversification are persistent in the short run, and it is less likely for ERM adopters to change either type of diversification right after embarking on an ERM program. Hence, we enunciate our hypothesis on the post-ERM adjustments of IRMs as follows:

H2: In the short run, ERM decreases the degree of reinsurance purchase and the level of overall asset volatility, increases the level of financial derivative usage, but retains the levels of diversification—product-wise and geographically.

2.4 Effects of ERM on Firm Value

Two alternative views have been proposed on the value creation of ERM: (1) ERM has a positive effect on firm value and (2) ERM has an adverse effect on firm value. Whereas some practitioners (e.g., Goldman Sachs and Allstate Inc.) assert that ERM is economically justified, a survey conducted by Fraser et al. (2008) finds that only 8% of the sample firms implement ERM to ''enhance shareholder or firm value.''

Proponents of ERM argue that ERM is conducive because it balances risk and resources in a seamless manner (Nocco and Stulz 2006). In the context of the insurance industry, ERM may enhance asset-liability management, achieve better pricing for policyholders with a stable loss profile, temper the severity of hard markets, and reduce the possibility of extreme soft market price cutting (Zaccanti 2009). Furthermore, insurers may benefit from ERM through improved ratings (Samanta et al. 2004), more cost savings (Shamieh 2007), and better compliance with solvency regulation. In particular, during financial turbulences, strong ERM practices may ensure insurers to act and recover quickly. For example, the well-designed ERM programs of ANZ, Goldman Sachs, and Barclays helped steer the firms through the recent financial crisis and make them relatively more successful than most of their peers (Samanta 2009).

In contrast, critics of ERM claim that ERM is still at its early stage, whose true value and utility are yet to be understood through repeated trials and errors, experiments, and knowledge accumulation and consolidation (Samanta 2009). This argument is strengthened by the 2008 collapse and bailout of American International Group (AIG), one of the first ERM adopters in the U.S. insurance industry. ERM can be costly, or even detrimental, if motivated by managerial hubris (Roll 1986). When blindly following the wave of ERM adoption, managers are likely to underestimate the difficulty and cost of initiating and maintaining ERM programs or overestimate their own abilities to coordinate and aggregate various IRMs and risks. As such, an ERM program that is conceived as beneficial to the firm could simply be a poor decision with misjudged benefits and costs. In addition, if applied inappropriately (e.g., lack of integration), ERM programs may lead to an additional layer of bureaucracy. Thus the implied opportunity cost and the explicit setup and operation costs incurred amid the long-process of ERM implementation can in fact destroy firm value. Consequently, the above arguments suggest two competing hypotheses:

H3a: ERM has a positive effect on firm value.

H3b: ERM has a negative effect on firm value.

3. EMPIRICAL EVIDENCE

3.1 Data and Variable Construction

The initial sample for our empirical analysis consists of all 105 publicly traded PC insurers in the U.S. market during the period 2000–2007.[2] Accounting and derivatives related data are obtained from the National Association of Insurance Commissioners (NAIC) annual statements, and market-based measures are constructed by using data from Compustat.[3] Credit information is from A. M. Best's *Key Rating Guide*. The final sample includes 507 observations for 85 unique PC insurance firms for which the required data are available in this eight-year period. We provide a list of our ERM and non-ERM sample firms in Appendix A.

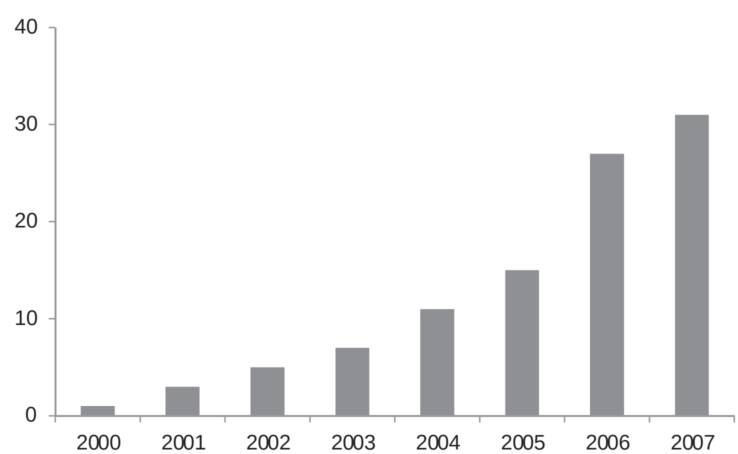
We follow procedures suggested by Beasley et al. (2008), Hoyt and Libenberg (2009), and Pagach and Warr (2007, 2011) to perform a detailed search of financial reports, newswires, and other media for evidence of insurers' ERM activities.[4] Figure 1 demonstrates the cumulative number of insurers adopting ERM, and it shows that, among the 85 unique PC insurers, 31 companies adopted ERM programs during our study period. In October 2005, Standard & Poor's introduced a set of criteria for assessing ERM at insurers (Standard and Poor's 2006). This explains the rapid increase in the number of ERM insurers from 2005 to 2006 since the insurers are motivated to enhance their ratings by adopting ERM in response to the passage of Standard and Poor's ERM rating system.

3.1.1 Risk Management Variables—ERM and IRMs

We define an indicator variable *ERM* with the value of 1 if the insurer is engaged in ERM in year t and 0 otherwise (t = 2000, 2001, . . . , 2007). We also consider five IRM activities commonly used by insurance companies: reinsurance, geographic diversification, product diversification, asset allocation, and derivatives. In particular, reinsurance, product diversification, and geographic diversification are

Figure 1

Cumulative Number of Sample Publicly Traded Property and Casualty Insurers Engaged in ERM (2000–2007)



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[2] There is only limited number of ERM adoptions before 2000. Thus, we focus on the period from 2000 to 2007.

[3] We draw the sample with the SIC code 6331, which represents the PC insurers.

[4] More specifically, we use SEC filings, LexisNexis, company websites, and Google to perform keyword searches for each insurer. Our search strings include the following phrases and their acronyms: ''enterprise risk management,'' ''chief risk officer,'' ''risk committee,'' ''strategic risk management,'' ''consolidated risk management,'' ''holistic risk management,'' and ''integrated risk management.''

mechanisms to manage underwriting risks, and asset allocation and the usage of derivatives are for hedging financial risks.

The first IRM variable, *Reinsurance*, is defined as the ratio of reinsurance ceded to the sum of direct business written and reinsurance assumed (Cole and McCullough 2006). The second IRM measure, G_DIV_i, captures an insurer's geographic diversification. It equals 1 minus the geographical Herfindal index:

$$G\_DIV_i = 1 - \sum_j \left(\frac{DPW_{i,j}}{DPW_i}\right)^2,$$

where $DPW_{i,j}$ is the premium written for insurer i in state j and DPW_i is the total premium written for insurer i. A higher value of G_DIV suggests that the insurer underwrites business in more regions. The third IRM variable, product diversification (P_DIV_i), is similarly defined as follows:

$$P\_DIV_i = 1 - \sum_l \left(\frac{DPW_{i,l}}{DPW_i}\right)^2,$$

where $DPW_{i,l}$ is the premium written for insurer i in line of business l.

The fourth IRM variable, *AVOL*, reflects the insurer's asset allocation strategy and measures the level of asset portfolio risk. *AVOL* equals asset return volatility estimated with the equation

$$AVOL = \left(\sum_i \sum_j w_i w_j \sigma_{ij}\right)^{1/2},$$

where w_i and w_j are the investment weights in assets i and j; σ_{ij} is covariance between assets i and j. Notice that when $i = j$, σ_{ij} is just the variance of asset i.[5] A higher value of *AVOL* implies that the insurer invests more funds in risky assets such as stocks.

The last IRM variable, level of derivative usage (denoted as *Derivative*), equals an insurer's notional amount of all derivative positions for hedging purpose held at year end, normalized by its total assets. Although direct information about the notional amounts for equity options and bond options is not available, following Song and Cummins (2008), we use number of traded contracts and strike price to generate approximate notional values for those contracts.[6]

3.1.2 Firm Value Measurement

Tobin's *Q* is a prospective market-based value measure, which reflects future expectations of investors. It is a useful performance variable for our study because the benefits of ERM may not be apparent in the short run. In this paper we define *Tobin's Q* as the market value of equity plus the book value of liabilities divided by the book value of assets (Yermack 1996; Cummins et al. 2006). Cummins et al. argue that this definition of *Tobin's Q* is appropriate for insurance companies because the book value of their assets is a close approximation of replacement costs. In addition to *Tobin's Q*, to provide further evidence, we also examine the valuation effects of ERM via return on asset (*ROA*), an accounting-based performance measure. We also test the effect of ERM on another performance measure in the insurance industry—*Underwriting ROA*, defined as underwriting income divided by total assets, which will be discussed in the robustness check section.

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[5] The volatility of assets, *AVOL*, is based on seven asset return series. The rate of return series are as follows: (1) equities—the total return on the Standard & Poor's 500 Stock Index; (2) government bonds—the Merrill Lynch U.S. government bond index total return; (3) corporate bonds—the Merrill Lynch U.S. corporate bond index total return; (4) real estate—the National Association of Real Estate Investment Trusts (NAREIT) total return; (5) mortgages—the Merrill Lynch mortgage-backed securities total return; (6) cash and invested assets—the four-week U.S. T-bill security market index total return; and (7) other assets—total return estimated from the NAIC Infopro P/C database.

[6] Notional amount for equity options are approximated as number of contracts × strike price × 100. Notional amount for bond options is approximated as number of contracts × par value per contract.

3.1.3 Other Firm-Specific Variables

The significance of information asymmetry on risk management decisions has received great attention in the literature (Géczy et al. 1997). The problem of information asymmetry in reinsurance transactions can be mitigated by a long-term contracting relationship between insurers and reinsurers because repeated interactions promote trust and allow for better communication, which can translate to a lower price (e.g., Jean-Baptiste and Santomero 2000; Doherty and Smetters 2005; Lin et al. 2009). We measure the level of information asymmetry by calculating the *Reinsurance Sustainability Index*, which is defined as the proportion of premiums ceded over a three-year period to reinsurance providers that are present in all three years.[7] In particular, a high value of this index signals low levels of information asymmetry problem and reinsurance cost, which could diminish the need for ERM. Thus, one would expect a negative relationship between ERM adoption and this index.

The insurance industry is one of the most heavily regulated industries in the economy. Price regulation can cause insufficient capital level, thereby affecting insurers' risk management decisions. Hence, we include in our analysis a price-regulation variable, *% Premium in Price Regulated Lines*, which is defined as the ratio of premiums in price-regulated lines (i.e., personal auto and workers' compensation) to total premium (Cummins et al. 2008b; Grace and Leverty 2010).

Claims of property lines of business tend to occur in a relatively short period following policy issuance. To control for the possibility that insurers with a higher percentage of premiums in short-tail business transfer more risk to alleviate potential problems caused by, for example, catastrophe events and liquidity risk, we include a control variable, *Percentage of Premiums in Property Lines of Business*, which is measured as the percentage of premium written in property lines of business.[8]

Catastrophic losses can create shocks large enough to impact the entire PC industry and thereby exhaust internal funds of many insurers, resulting in costly external finance and financial distress. Thus, it is intuitive to believe that catastrophe-prone insurers are more likely to adopt ERM, because ERM might be a cost-effective means to handle extreme risk by reducing the need for external funding. *Exposures to Catastrophe Risk* is defined as premiums from all catastrophe-prone insurance lines of business in states boarding the Gulf Coast and the Atlantic Ocean plus earthquake insurance premiums from all states divided by total premiums (Cummins et al. 2008b).[9]

Firms with good financial ratings have high franchise value, so they may suffer significant reputation cost if an adverse event takes place (Song and Cummins 2008). ERM and various IRMs aim at mitigating (if not eliminating) negative risk outcomes. Thus, highly rated insurers would be motivated to manage risk to maintain their credit standing. We transform each letter credit rating into a cardinal scale to define our credit rating variable, *Best's Rating*. The highest credit rating "A++" or "A+" is assigned a value of 1, then "A" or "A−" a value of 2, etc.[10] Therefore, a lower value of this variable represents a better financial status.

We include a proxy for business complexity. This proxy counts the number of four-digit Standard Industrial Classification (SIC) codes in which an insurer does business (McShane et al. 2011). The expected signs of this variable on ERM adoption and firm performance are ambiguous. Business com-

[7] Specifically, the value of the index for each primary insurer in year t is based upon the $[t - 3, t]$ window, and this value shows whether and to what extent primary insurers keep long-term relationships with the same reinsurers (Garven and Grace 2007; Lin et al. 2009).

[8] Specifically, the property lines of business include automobile physical damage, special property, fidelity and surety, and a miscellaneous line consisting of accident and health, credit, and financial and mortgage guarantee.

[9] Catastrophe-prone insurance includes the following lines of business from the NAIC annual statement: earthquake, fire, allied lines, farm owners, homeowners, commercial multiple peril, inland marine, and auto physical damage. The variable is defined as the ratio of total premium written in specific lines and in specific states to the total premium collected in a firm. The lines and states are earthquake from all states and the fire, allied lines, multiple peril crop, inland marine, private passenger auto physical damage, commercial auto physical damage, homeowners, and farm owners in the states of Alabama, Connecticut, Delaware, Florida, Georgia, Louisiana, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, South Carolina, Texas, and Virginia. Premiums written in different lines and states are needed to create this variable. The information is collected from three different exhibits of NAIC annual reports.

[10] We convert rating "B++" or "B+" to the value of 3, rating "B" or "B−" to 4, rating "C++" or "C+" to 5, rating "C" or "C−" to 6, rating "D" to 7, and rating "E," "F," or "S" to 8.

plexity can lower returns because of higher costs of coordinating corporate subunits (Harris et al. 1982; Myerson 1982) and monitoring managerial decisions (Bodnar et al. 1999). However, there are equally plausible reasons to believe that operating in different sectors creates value arising from synergy (Morck and Yeung 1998) and flexibilities (Denis et al. 2002).

We also control other firm characteristics with the following variables: three-year premium growth rate, financial leverage, and firm size. The variable *3-year premium growth rate* signals a firm's growth potential and is measured by annual total premium growth rate in a three-year period. Firms that face more growth opportunities might be distracted from ERM attempts (Pagach and Warr 2007). Leverage is approximated using the ratio of book value of liabilities to book value of assets or using the ratio of book value of liabilities to the sum of book value of liabilities and market value of equities. Firm size is estimated by the natural logarithm of the book value of total assets. We provide detailed definitions and data sources for all variables in Appendix B.

3.2 Descriptive Statistics

Table 1 reports the descriptive statistics for the sample. On average, 18.5% of the firms use ERM programs. For the whole sample of insurers, reinsurance ratios, derivative usage, and asset return volatility are at average values of 22.9%, 0.3%, and 4.2%, respectively. The mean level of geographic diversification is 77.2%, and the mean level of product diversification is 68.2%.

Table 1 also compares the means and medians of various IRMs, firm value, and other firm characteristics variables between ERM and non-ERM insurers. The results show that on average ERM insurers purchase less reinsurance (19.2%) than non-ERM insurers (23.8%), but the difference is insignificant. Average derivative usage by ERM insurers is 1.5%, significantly higher than that of non-ERM insurers, 0.1%. In addition, ERM insurers are more diversified in terms of lines of business and underwriting regions than non-ERM insurers at the significance level of 1%, but we do not find a significant difference between ERM and non-ERM insurers in terms of asset return volatility.

As for firm performance, ERM insurers have higher *Tobin's Q, ROA,* and *Underwriting ROA* than non-ERM insurers. On average, *Tobin's Q* (*ROA*; *Underwriting ROA*) of ERM insurers is 1.142 (0.039; 0.013) compared to 1.082 (0.021; −0.013) for non-ERM insurers. Median firm size is $2,077 million. The median size of ERM insurers ($12,650 million) is significantly greater than the median size of non-ERM insurers ($1,532 million). The average credit rating score for the entire sample is 1.875, equivalent to a rating between A and A+. ERM insurers have better credit rating than non-ERM insurers because they present smaller values of this variable. Moreover, ERM insurers have lower premium growth rates over the last three years and operate in more industries.

Finally, we compare debt-to-total capital ratio, liabilities-to-invested assets ratio, invested assets-to-total assets ratio, and debt coverage ratio of ERM and non-ERM firms. No significant differences are seen in debt-to-total capital ratio and liabilities-to-invested assets ratio between ERM and non-ERM firms. On the other hand, ERM firms on average invest fewer assets than non-ERM firms (0.790 vs. 0.817), and ERM firms have a higher median value of debt coverage ratio than non-ERM firms (13.511 vs.10.236).

The pairwise correlation matrix for the variables employed in the regressions is shown in Table 2. As reported, ERM is positively correlated with the use of financial derivatives, asset return volatility, and the degrees of product and geographic diversification, while negatively correlated with the reinsurance ratio. Results suggest a potential substitute relation between the adoption of ERM and reinsurance, while a possible complement relation between ERM and the other IRMs.

To provide a complete illustration of the determinants of ERM adoption, risk integration effects of ERM, and firm value creation from ERM, we further conduct regression analyses on a multivariate basis by controlling firm-specific characteristics. Collinearity is checked using variance inflation factors (VIFs). Most of the VIF values are below 2 with the maximum at 2.85. Hence, collinearity is not a problem in our regressions.

Table 1

Descriptive Statistics and Univariate Differences (2000–2007)

	All Insurers			ERM = 1			ERM = 0			Difference	
	No.	Mean	Median	No.	Mean	Median	No.	Mean	Median	Mean	Median
Risk management variables											
ERM firm indicator	507	0.185	0								
Reinsurance	507	0.229	0.122	94	0.192	0.110	413	0.238	0.122	−0.045*	−0.012
Derivative	507	0.003	0.000	94	0.015	0.000	413	0.001	0.000	0.014*	0.000***
Geographical diversification	507	0.772	0.904	94	0.902	0.938	413	0.742	0.874	0.161***	0.064***
Product diversification	507	0.682	0.762	94	0.750	0.824	413	0.667	0.751	0.083***	0.073***
Asset return volatility	507	0.042	0.040	94	0.042	0.040	413	0.041	0.040	0.001	0.001
Firm performance and characteristics variables											
Return on assets	507	0.024	0.028	94	0.039	0.040	413	0.021	0.024	0.018***	0.017***
Underwriting return on assets	507	−0.008	−0.002	94	0.013	0.013	413	−0.013	−0.004	0.025***	0.017***
Tobin's *Q*	507	1.093	1.063	94	1.142	1.085	413	1.082	1.051	0.059***	0.034***
Reinsurance sustainability index	507	0.727	0.847	94	0.793	0.872	413	0.712	0.842	0.081***	0.030***
Total assets ($ million)	507	9,265	2,077	94	25,740	12,650	413	5,515	1,532	20,225***	11,119***
BV of liabilities/BV of assets	507	0.645	0.663	94	0.646	0.663	413	0.645	0.663	0.001	0.000
BV of liabilities/(BV of liabilities + MV of equities)	507	0.699	0.711	94	0.699	0.728	413	0.699	0.705	0.000	0.023
Three-year premium growth rate	507	0.151	0.085	94	0.098	0.053	413	0.163	0.099	−0.065***	−0.046***
Best's rating	507	1.875	2.000	94	1.409	1.037	413	1.981	2.000	−0.572***	−0.963***
No. of SIC codes in which insurer operates	507	1.590	1.000	94	1.968	2.000	413	1.504	1.000	0.464***	1.000***
% premium in price-regulated lines	507	0.285	0.261	94	0.275	0.261	413	0.287	0.260	−0.011	0.001
% premium in property lines of business	507	0.107	0.093	94	0.100	0.095	413	0.109	0.091	−0.009	0.005
% premium in catastrophe states and lines	507	0.198	0.167	94	0.197	0.170	413	0.199	0.166	−0.002	0.004
Debt-to-total capital ratio	507	2.013	1.963	94	2.056	1.965	413	2.003	1.963	0.054	0.003
Liabilities-to-invested assets ratio	507	0.794	0.800	94	0.811	0.813	413	0.790	0.797	0.021	0.016
Invested assets-to-total assets ratio	507	0.812	0.826	94	0.790	0.821	413	0.817	0.827	−0.027***	−0.006***
Debt coverage ratio	397	38.220	10.904	78	14.561	13.511	319	44.005	10.236	−29.444	3.275**

Note: Statistical significance of difference in means and in medians is based on a *t*-test and nonparametric Wilcoxon rank sum test, respectively.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

Table 2
Correlation Matrix (2000–2007)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
ERM firm indicator	(1)	100%																	
Reinsurance	(2)	−6%	100%																
Derivative	(3)	16%	0%	100%															
Geographical diversification	(4)	23%	10%	6%	100%														
Product diversification	(5)	14%	−8%	4%	39%	100%													
Asset return volatility	(6)	4%	−10%	1%	14%	15%	100%												
Return on assets	(7)	15%	−16%	5%	6%	4%	15%	100%											
Underwriting return on assets	(8)	18%	−14%	3%	4%	−5%	6%	87%	100%										
Tobin's *Q*	(9)	15%	−13%	2%	−10%	−13%	8%	23%	30%	100%									
Reinsurance sustainability index	(10)	11%	−2%	4%	13%	20%	10%	16%	12%	8%	100%								
Total assets ($ million)	(11)	39%	−10%	18%	25%	23%	17%	15%	9%	13%	16%	100%							
BV of liabilities/BV of assets	(12)	0%	9%	0%	11%	−12%	−41%	−33%	−25%	−10%	2%	−4%	100%						
Three-year premium growth rate	(13)	−8%	9%	−3%	7%	−2%	2%	−6%	5%	15%	−25%	−4%	1%	100%					
Best's rating	(14)	−24%	18%	−7%	−26%	−24%	−32%	−42%	−40%	−26%	−24%	−28%	22%	−4%	100%				
No. of SIC codes in which insurer operates	(15)	27%	−13%	13%	28%	28%	17%	17%	10%	−3%	15%	18%	−1%	−9%	−26%	100%			
% premium in price-regulated lines	(16)	−2%	−26%	1%	−31%	−37%	−5%	−2%	0%	13%	−2%	0%	4%	−9%	17%	−4%	100%		
% premium in property lines of business	(17)	−4%	−13%	0%	9%	14%	18%	8%	5%	6%	−1%	−2%	−25%	−1%	−9%	−3%	−18%	100%	
% premium in catastrophe states and lines	(18)	0%	−3%	0%	−19%	28%	1%	4%	−3%	3%	−9%	−1%	−18%	−3%	6%	9%	−17%	14%	100%

Note: Correlations above |9%| are significantly at $P < 0.05$; $n = 507$, two-tailed tests.

3.3 Empirical Models and Results

We apply a probit regression model to examine the incentives of ERM adoption accounting for the effects of existing IRMs. We also test how insurance companies systematically adjust IRMs after ERM adoption by implementing a simultaneous equations model. Finally, to investigate whether ERM adoption enhances firm value, we utilize a two-stage treatment-effect model.

3.3.1 Probit Model: The Determinants of ERM Adoption

Probit model (1) identifies the factors that motivate insurers to adopt ERM:

$$Pr(ERM_{i,t} = 1) = F(\alpha_0 + \alpha_1 \times Reinsurance_{i,t-1} + \alpha_2 \times Derivative_{i,t-1} + \alpha_3 \times G\_DIV_{i,t-1} + \alpha_4 \times P\_DIV_{i,t-1} + \alpha_5 \times AVOL_{i,t-1} + \beta_i' Z_{i,t} + \eta_t + \varepsilon_{i,t}). \quad (1)$$

As noted before, $ERM_{i,t}$ is a binary variable that takes on a value 1 for ERM firm i in year t and 0 otherwise. F is a cumulative standard normal distribution function indicating the likelihood of adopting ERM, which is a function of five IRMs, namely, reinsurance, derivatives, geographic diversification, product diversification, and asset allocation and other control variables. To ensure that our results are not simply driven by reverse causality, that is, adopting ERM changes the states of IRMs, we construct these IRM measures one year before the initiation of ERM. $Z_{i,t}$ is a vector of variables controlling insurer-specific characteristics, and η_t is the fixed effect for year t.

Models (1), (2), (3), (4), and (5) in Table 3 present the results of analyses in which each IRM is examined separately, and model (6) is the full model with all five IRMs included. Controlling for firm characteristics and year effects, the results provide evidence that insurers using more reinsurance are more likely to adopt ERM, consistent with Hypothesis 1a on the positive effect of reinsurance usage on ERM adoption. Reinsurance is costly, so insurers with a high level of reinsurance usage are motivated to implement ERM because ERM can realize integration benefit via risk pooling and reduce costly reinsurance.

In addition, the positive relationship between ERM and geographic diversification shown in models (3) and (6) of Table 3 is in line with Hypothesis 1d. As noted earlier, diversification increases firms' risk complexity (Lang and Stulz 1994; Laeven and Levine 2007). The presence of ERM facilitates risk coordination and thus motivates geographically diversified insurers to embrace this new risk management concept. However, we find no evidence of significant relationship between product diversification and ERM adoption. This suggests that insurers view ERM as an efficient way to integrate geographic- but not for product-related risks. Furthermore, among different IRM mechanisms, financial risk management through the use of derivatives or asset allocation shows no significant effects on ERM initiation. In sum, our findings reveal that IRMs related to underwriting risks (reinsurance and geographic diversification) outweigh those on financial risks in determining a PC insurer's ERM adoption.

The coefficients for the firm characteristics variables in all models of Table 3 are generally consistent with the existing literature. We observe a negative and significant impact of the reinsurance sustainability variable, *Reinsurance Sustainability Index*, in various regression specifications of Table 3. This supports the argument that a long-term contracting relation between insurers and reinsurers decreases information asymmetry problem, reduces reinsurance loadings, and thus offsets any potential benefits generated from ERM for reinsurance purposes (Jean-Baptiste and Santomero 2000; Lin et al. 2009). Accordingly, insurers with a high reinsurance sustainability index are less likely to pursue ERM.

We find larger firms are more likely to engage in ERM because they have the institutional size to support the administrative cost of an ERM program, thus achieving the economy of scale. Furthermore, better credit rating is positively associated with ERM adoption. This finding is consistent with the argument that highly rated firms may lose substantial franchise values if an adverse event occurs (Song and Cummins 2008). ERM makes potential threats more transparent, risk integration more efficient, and possible reputation loss less severe.

Leverage is commonly used to measure financial distress (Smith and Stultz 1985). Nevertheless, to insurers, besides leverage, exposure to catastrophe risks also increases insolvency risk (Lin et al. 2009).

Table 3
Determinants of ERM Adoption: Probit Model (2000–2007)

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	−16.689***	−14.130***	−13.905***	−14.487***	−14.445***	−15.294***
	(2.17)	(2.13)	(1.98)	(1.98)	(2.13)	(2.37)
IRM variables						
Lagged reinsurance	1.037**					1.020**
	(0.44)					(0.45)
Lagged derivative		5.925				4.201
		(10.05)				(5.70)
Lagged geographical diversification			1.690**			2.204***
			(0.66)			(0.75)
Lagged product diversification				−0.100		−0.059
				(0.58)		(0.61)
Lagged asset return volatility					−0.143	−10.816
					(12.48)	(14.14)
Firm characteristics variables						
Reinsurance sustainability index	−1.305***					−1.475***
	(0.40)					(0.42)
Log(BV of assets)	0.578***	0.440***	0.381***	0.458***	0.453***	0.492***
	(0.08)	(0.07)	(0.07)	(0.07)	(0.07)	(0.09)
BV of liabilities/BV of assets	1.627	1.505	0.881	1.536	1.546	0.457
	(1.05)	(1.01)	(1.05)	(1.01)	(1.11)	(1.22)
Three-year premium growth rate	0.035	0.309	0.313	0.309	0.316	0.012
	(0.36)	(0.35)	(0.35)	(0.36)	(0.36)	(0.34)
Best's rating	−0.460***	−0.338**	−0.424**	−0.335**	−0.340**	−0.595***
	(0.17)	(0.17)	(0.18)	(0.17)	(0.17)	(0.19)
No. of SIC codes in which insurer operates	0.585***	0.547***	0.523***	0.565***	0.562***	0.562***
	(0.14)	(0.13)	(0.14)	(0.13)	(0.13)	(0.15)
% premium in price-regulated lines	0.810**	0.319	0.803*	0.288	0.331	1.341**
	(0.41)	(0.37)	(0.42)	(0.43)	(0.37)	(0.53)
% premium in property lines of business	0.284	−0.475	−0.672	−0.393	−0.464	−0.310
	(1.54)	(1.51)	(1.49)	(1.55)	(1.51)	(1.57)
% premium in catastrophe states and lines	0.614	0.737	1.382*	0.752	0.736	1.436*
	(0.61)	(0.65)	(0.73)	(0.66)	(0.65)	(0.75)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Diagnostics						
Model fit statistics: $-2 \log L$	262.6	276.8	270.8	278.5	278.5	251.1
Test—H_0: $\beta = 0$ (likelihood ratio)	223.6***	209.4***	215.4***	207.7***	207.7***	235.1***
No. of observations	507	507	507	507	507	507

Notes: Standard errors are reported in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

Our result in model (6) of Table 3 suggests that to PC insurers, the financial stress from the exposures to catastrophe risks is more important than the leverage in determining their ERM adoption.

3.3.2 Simultaneous Equations Model: Effects of ERM on Risk Integration

The simultaneous equations model consists of five equations that represent financial risk management from derivative utilization (*Derivative*) and asset allocation (*AVOL*), and underwriting risk management from reinsurance usage (*Reinsurance*), geographic diversification (*G_DIV*), and product diversification (*P_DIV*):

$$Reinsurance_{i,t} = \alpha_{1,0} + \alpha_{1,1} \times Derivative_{i,t} + \alpha_{1,2} \times G\_DIV_{i,t} + \alpha_{1,3} \times P\_DIV_{i,t} + \alpha_{1,4} \times AVOL_{i,t} + \beta_1 \times ERM_{i,t-1} + \gamma'_{1,i} Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t}, \quad (2)$$

$$Deriviative_{i,t} = \alpha_{2,0} + \alpha_{2,1} \times Reinsurance_{i,t} + \alpha_{2,2} \times G\_DIV_{i,t} + \alpha_{2,3} \times P\_DIV_{i,t} + \alpha_{2,4} \times AVOL_{i,t} + \beta_2 \times ERM_{i,t-1} + \gamma'_{2,i} Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t}, \quad (3)$$

$$G\_DIV_{i,t} = \alpha_{3,0} + \alpha_{3,1} \times Reinsurance_{i,t} + \alpha_{3,2} \times Derivative_{i,t} + \alpha_{3,3} \times P\_DIV_{i,t} + \alpha_{3,4} \times AVOL_{i,t} + \beta_3 \times ERM_{i,t-1} + \gamma'_{3,i}Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t}, \quad (4)$$

$$P\_DIV_{i,t} = \alpha_{4,0} + \alpha_{4,1} \times Reinsurance_{i,t} + \alpha_{4,2} \times Derivative_{i,t} + \alpha_{4,3} \times G\_DIV_{i,t} + \alpha_{4,4} \times AVOL_{i,t} + \beta_4 \times ERM_{i,t-1} + \gamma'_{4,i}Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t}, \quad (5)$$

$$AVOL_{i,t} = \alpha_{5,0} + \alpha_{5,1} \times Reinsurance_{i,t} + \alpha_{5,2} \times Derivative_{i,t} + \alpha_{5,3} \times G\_DIV_{i,t} + \alpha_{5,4} \times P\_DIV_{i,t} + \beta_5 \times ERM_{i,t-1} + \gamma'_{5,i}Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t}, \quad (6)$$

where υ_i is the fixed effect for insurer i and η_t is the fixed effect for year t. ERM fine-tunes coordination among IRMs. The specification of our simultaneous equations model takes into account these ERM effects while capturing the relations among five IRM programs. To ensure that our results are not simply driven by reverse causality, we construct the variable *ERM* one year before each IRM decision is made. Following Graham and Rogers (2002), we use a two-stage estimation procedure in our simultaneous equations model, and the results are presented in Table 4.[11]

As shown in Table 4, the lagged *ERM* indicator is negatively and significantly related to reinsurance purchase. The results provide evidence that ERM reduces reinsurance usage because it allows a firm to acknowledge the interaction of risks. Specifically, the reinsurance ratio decreases by 3.7 percentage points post-ERM adoption. This is a significant reduction given the average reinsurance ratio of non-ERM insurers is only 0.229.

The regression results also provide support for the argument that insurers hedge more with derivatives after implementing ERM. The coefficient of the lagged ERM variable is positive and significant in the derivative regression. This suggests that ERM illuminates neglected but important financial risks and propel insurers to hedge them with derivatives, provided the existing level of derivative usage in the insurance industry is unsatisfactorily low (Cummins et al. 1997; Song and Cummins 2008). In addition, the results of the asset allocation regression (5) suggest that after implementing ERM, the insurers optimize the mean-variance tradeoff of their asset portfolios and the asset-liability management through asset allocation: Implementing ERM leads to a more diversified asset allocation represented by the lower level of asset volatility, to some extent reducing the insurers' capital and regulatory compliance costs.

However, we find no significant effects of ERM on either geographic or product diversification in Table 4. This can be explained by the relatively short period of ERM implementation as of 2007 (Fig. 1). The managerial decisions on diversification in lines of business or in geographic regions depend on a firm's blueprint, a change of which entails a large amount of time, energy, negotiation, and resources. Therefore, in the short run, ERM does not lead to observable adjustments in both dimensions of diversification. Different from geographic and product diversifications, reinsurance policies, financial derivatives, and asset allocation can be adjusted promptly because of their short-term or liquid contracting features, so we observe ERM insurers have a notable change in these three IRMs.

In terms of the interdependency of the five IRMs, we observe no significant relationship between reinsurance ratio and derivative level, geographic diversification, or product diversification, whereas reinsurance is negatively related to asset return volatility. In addition, more geographically (product-) diversified insurers tend to underwrite more diversified lines of business (in more diversified regions).

[11] For the first-stage *Derivative* specification, we estimate a Tobit regression because the dependent variable, *Derivative*, is censored at zero. The first-stage *Reinsurance*, *G_DIV*, *P_DIV,* and *AVOL* equations are estimated with ordinary least-squares (OLS). In the second stage, structural equations are estimated using the predicted *Reinsurance*, *Derivative*, *G_DIV*, *P_DIV,* and *AVOL* from the first stage as the independent variables. Specifically, our endogenous variables in the simultaneous equations are five predicted IRMs, and the exogenous variables include the year dummies, firm dummies, and firm characteristics variables in Table 4. Other instrumental variables include the lagged terms of the aforementioned exogenous variables except the year and firm dummies. To conserve space, we focus the discussions on the second stage of the simultaneous equations system.

Table 4

Risk Integration Effects of ERM: Simultaneous Equations Model (2000–2007)

	Reinsurance (1)	Derivative (2)	Geograph Diversification (3)	Product Diversification (4)	Asset Return Volatility (5)
Intercept	−0.482**	0.117***	0.408***	−0.524***	−0.009
	(0.22)	(0.01)	(0.11)	(0.15)	(0.01)
ERM variable					
Lagged ERM firm indicator	−0.037***	0.002***	0.006	−0.009	−0.001***
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
IRM variables					
Reinsurance′		−0.007	−0.025	0.015	−0.014***
		(0.01)	(0.03)	(0.05)	(0.00)
Derivative′	−2.049		−4.116***	5.910***	0.132***
	(1.13)		(0.43)	(0.52)	(0.03)
Geographical diversification′	−0.220	−0.116***		1.135***	0.027***
	(0.19)	(0.01)		(0.07)	(0.00)
Product diversification′	0.081	0.099***	0.674***		−0.027***
	(0.15)	(0.01)	(0.04)		(0.00)
Asset return volatility′	−28.267***	0.854***	6.172***	−10.367***	
	(2.25)	(0.23)	(1.38)	(1.76)	
Firm characteristics variables					
Reinsurance sustainability index	0.008	−0.003***	−0.019***	0.026	0.001***
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
Log(BV of assets)	0.078***	−0.005***	−0.010*	0.029***	0.002***
	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
BV of liabilities/BV of assets	0.095**	−0.004	0.037*	−0.038	−0.001
	(0.04)	(0.00)	(0.02)	(0.03)	(0.00)
Three-year premium growth rate	0.000	0.001	−0.007*	0.011**	0.001**
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
Best's rating	0.013***	0.000	−0.005**	0.001	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
No. of SIC codes in which insurer operates	0.000	−0.001	−0.001	0.002	0.000
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
% premium in price-regulated lines	0.056**	−0.003	−0.031**	0.007	0.002***
	(0.02)	(0.00)	(0.01)	(0.02)	(0.00)
% premium in property lines of business	−0.301***	−0.021***	−0.121***	0.193***	−0.002
	(0.07)	(0.01)	(0.04)	(0.05)	(0.00)
% premium in catastrophe states and lines	0.036	0.001	−0.006	−0.007	−0.002*
	(0.04)	(0.00)	(0.02)	(0.03)	(0.00)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Diagnostics					
Adjusted R^2	0.985	0.970	0.996	0.989	0.984
No. of observations	507	507	507	507	507

Notes: This table shows the results of second-stage OLS or Tobit estimations of five IRMs on explanatory variables including the predicted value of reinsurance ratio (Reinsurance′), the predicted value of derivatives usage (Derivatives′), the predicted value of geographic diversification (Geographic diversification′), the predicted value of product diversification (Product diversification′), and the predicted value of asset return volatility (Asset return Volatility′). Standard errors are reported in parentheses.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Derivative usage increases with product diversification but decreases with geographic diversification. Finally, allocating more funds to riskier assets (i.e., a higher asset return volatility) is associated with more derivative usage. These results provide some supports for either the complementary hypothesis or the substitution hypothesis on the possible relationships between various IRMs (Cummins et al. 2001).

Among various firm characteristics variables, insurers with a higher leverage operate with more reinsurance and higher geographic diversification. This implies that the insurers use reinsurance and diversification to mitigate potential financial distress problems from using more debt.

3.3.3 Treatment-Effect Model: Effects of ERM on Firm Value

To test the effects of ERM on firm value, we need to address the endogeneity of ERM adoption. This endogeneity problem arises from ''selection bias,'' which can be solved by using a treatment-effect model (Heckman and Vytlacil 2000). We employ the treatment-effect model by estimating equations (7) and (8) simultaneously:

$$ERM^*_{i,t-1} = \alpha_0 + \alpha_1 \times Reinsurance_{i,t-2} + \alpha_2 \times Derivative_{i,t-2} + \alpha_3 \times G\_DIV_{i,t-2} + \alpha_4 \times P\_DIV_{i,t-2} + \alpha_5 \times AVOL_{i,t-2} + \beta_i' Z_{i,t-1} + \eta_{t-1} + \varepsilon_{i,t-1}, \quad (7)$$

$$ERM_{i,t-1} = 1 \text{ if } ERM^*_{i,t-1} > 0 \text{ and } ERM_{i,t-1} = 0 \text{ if } ERM^*_{i,t-1} \leq 0,$$

$$Firm\ Value_{i,t} = \delta_0 + \delta_1 \times ERM_{i,t-1} + \delta_2 \times Reinsurance_{i,t-1} + \delta_3 \times Derivative_{i,t-1} + \delta_4 \times G\_DIV_{i,t-1} + \delta_5 \times P\_DIV_{i,t-1} + \delta_6 \times AVOL_{i,t-1} + \lambda_i' Z_{i,t} + \nu_6 \times self\text{-}selection_{i,t-1} + \upsilon_i + \eta_t + u_{i,t}, \quad (8)$$

where the error terms (ε, u) are assumed to follow a bivariate normal distribution. The self-selection equation (7) is a probit regression predicting the probability of adopting ERM. The latent variable *ERM** in (7) represents the unobservable expected net benefit from undertaking ERM, which determines the observable binary choice variable *ERM*. That is, the insurer adopts ERM ($ERM_{i,t-1} = 1$) only when the net benefit is positive ($ERM^*_{i,t-1} > 0$) but chooses not to do so ($ERM_{i,t-1} = 0$) if the net benefit is zero or negative ($ERM^*_{i,t-1} \leq 0$). In the firm value equation (8), the performance measure *Firm Value* is modeled as a function of the lagged binary choice *ERM*, a vector of the observed firm characteristics variables *Z*, and a self-selection parameter, *self-selection*, calculated from the self-selection regression (7). We estimate the net benefits of being an ERM insurer on *Firm Value* in a *treatment-effect model* using a two-step consistent estimation procedure. In our specifications, the performance variable, *Firm Value*, is either *Tobin's Q* or *ROA*.

Effects of ERM on Firm Value Creation—Tobin's Q. Studies by Nocco and Stultz (2006) and Pagach and Warr (2007, 2010) have examined the sole effects of ERM on firm value. We extend this line of research by controlling the effects of various IRMs. Incorporating these IRMs in the firm value regression (8) is important because it addresses the potential endogeneity problem that the IRMs may also determine *Tobin's Q*, while they are correlated with the firm's ERM adoption in the same year. In addition, to account for the overall shift of ERM adoption across time, we estimate the self-selection equation with year fixed effects. For the firm value equation, we control both year and firm fixed effects. Results are summarized in Table 5.[12]

Model (1) in Table 5 examines *Tobin's Q* for ERM and non-ERM insurers. The result provides evidence supporting the firm value reduction hypothesis (Hypothesis 3b). To PC insurers, the adoption of ERM decreases *Tobin's Q* by 0.056, which is consistent with Pagach and Warr (2007, 2010). Models (2), (3), (4), (5), and (6) augment Model (1) by incorporating different IRMs: reinsurance, derivatives, geographic diversification, product diversification, and asset allocation, respectively. Model (7) considers the effects of ERM along with all five IRMs. Results from all the models indicate that ERM consistently has a significant and negative effect on firm value. In addition, managing underwriting risks through geographic diversification could significantly reduce insurers' *Tobin's Q*. The results support the strategic focus hypothesis as shown in Elango et al. (2008). On the other hand, we observe positive effects of reinsurance and negative effects of high asset portfolio risk on firm value. The usage of derivatives does not create value for PC insurers, consistent with the oil and gas industry findings of Jin and Jorin (2006). As presented in Table 5, the market evaluates positively on insurers' risk management efforts via reinsurance purchase, while ERM appears to lower the levels of reinsurance, as shown in

[12] Estimates from the ERM choice model (7) are based on the data from 1999 to 2006 since the variable ERM_{t-1} is one-year before the value variable *Tobin's* Q_t in equation (8) is constructed. The results of the self-selection equation (7) are similar to those in Table 3. To conserve space, we do not report these results.

Table 5

Effects of ERM on log(Tobin's Q): Treatment-Effect Model (2000–2007)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	0.097	0.110	0.098	0.168*	0.111	0.160*	0.236**
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.10)
ERM variable							
Lagged ERM firm indicator	−0.056***	−0.052***	−0.056***	−0.055***	−0.057***	−0.055***	−0.050***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
IRM variables							
Lagged reinsurance		0.055***					0.060***
		(0.02)					(0.02)
Lagged derivative			−0.018				−0.003
			(0.08)				(0.07)
Lagged geographical diversification				−0.123***			−0.130***
				(0.04)			(0.04)
Lagged product diversification					−0.022		0.001
					(0.03)		(0.03)
Lagged asset return volatility						−1.558***	−1.266**
						(0.54)	(0.53)
Firm characteristics variables							
Reinsurance sustainability index	−0.017	−0.019*	−0.017	−0.016	−0.017	−0.017	−0.019*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Log(BV of assets)	0.056***	0.056***	0.056***	0.061***	0.056***	0.058***	0.062***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
BV of liabilities/(BV of liabilities + MV of equities)	−0.798***	−0.815***	−0.798***	−0.778***	−0.795***	−0.817***	−0.811***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Three-year premium growth rate	0.023**	0.027***	0.023**	0.024***	0.024***	0.021**	0.026***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
No. of SIC codes in which insurer operates	−0.010	−0.008	−0.010	−0.010	−0.010	−0.009	−0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
% premium in price-regulated lines	0.014	0.026	0.014	−0.010	0.009	0.016	0.004
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
% premium in property lines of business	0.212**	0.204**	0.212**	0.198**	0.220**	0.180**	0.162*
	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)
% premium in catastrophe states and lines	0.007	0.008	0.007	−0.008	0.010	−0.001	−0.014
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Self-selection parameter	0.032***	0.031***	0.032***	0.032***	0.033***	0.032***	0.031***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diagnostics							
Rho	0.713	0.705	0.717	0.720	0.725	0.717	0.714
Wald χ^2	3,960.3	4,055.1	3,957.8	4,043.8	3,953.8	4,032.5	4,220.8
No. of observations	507	507	507	507	507	507	507

Notes: Standard errors are reported in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

Table 4. This finding may partially explain why ERM does not create value from the investors' perspective.

In addition, we conduct the analysis by controlling for other value determinants. A higher premium growth over the last three years enhances insurers' market value, whereas a higher leverage reduces insurers' value. We also find a positive relation between firm size and value as suggested by Jin and Jorion (2006). Diagnostic tests indicate that the treatment-effect model is appropriate, with evidence

Table 6
Effects of ERM on Return on Assets: Treatment-Effect Model (2000–2007)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	−0.116	−0.100	−0.114	−0.125	−0.113	−0.126	−0.122
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
ERM variable							
Lagged ERM firm indicator	−0.041***	−0.040***	−0.041***	−0.040***	−0.040***	−0.041***	−0.038**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
IRM variables							
Lagged reinsurance		0.014					0.019
		(0.01)					(0.01)
Lagged derivative			−0.019				−0.018
			(0.06)				(0.06)
Lagged geographical diversification				−0.062**			−0.082***
				(0.03)			(0.03)
Lagged product diversification					0.016		0.034
					(0.02)		(0.02)
Lagged asset return volatility						0.104	0.246
						(0.36)	(0.36)
Firm characteristics variables							
Reinsurance sustainability index	0.004	0.004	0.004	0.005	0.005	0.004	0.005
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Log(BV of assets)	0.014**	0.013**	0.014**	0.017***	0.013**	0.014**	0.016**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
BV of liabilities/BV of assets	−0.209***	−0.208***	−0.209***	−0.199***	−0.210***	−0.209***	−0.195***
	(0.04)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)
Three-year premium growth rate	−0.003	−0.002	−0.003	−0.003	−0.003	−0.003	−0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Best's rating	−0.005	−0.005	−0.005	−0.006	−0.005	−0.004	−0.006
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
No. of SIC codes in which insurer operates	−0.005	−0.005	−0.005	−0.005	−0.005	−0.005	−0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
% premium in price-regulated lines	0.014	0.017	0.014	0.002	0.017	0.014	0.010
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
% premium in property lines of business	−0.069	−0.070	−0.069	−0.072	−0.075	−0.067	−0.085
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
% premium in catastrophe states and lines	−0.057*	−0.057*	−0.057*	−0.069**	−0.058*	−0.056*	−0.073**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Self-selection parameter	0.015*	0.015*	0.016*	0.015*	0.015*	0.015*	0.015*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diagnostics							
Rho	0.507	0.510	0.520	0.509	0.494	0.506	0.496
Wald χ^2	750.1	753.1	748.4	763.5	753.5	750.5	779.0
No. of observations	507	507	507	507	507	507	507

Notes: Standard errors are reported in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

that the self-selection parameter is significant. The Hausman test for exogeneity of *ERM* with respect to *Tobin's Q* is rejected.[13]

Effects of ERM on Firm Performance—ROA. To further understand whether ERM provides benefits, we conduct an analysis based on *ROA*, an accounting-based performance measure. Results in Table 6 draw a consistent conclusion that ERM adoption has a significant and negative impact on *ROA*, which echoes the findings on *Tobin's Q* in Table 5 and thus confirms the firm-value reduction hypothesis described in Hypothesis 3b. Specifically, on average the *ROA* of ERM insurers is about 0.04 lower than that of non-ERM insurers, all else equal. As suggested by Beasley et al. (2008) and Pagach and Warr (2010), large start-up and administrative costs associated with the ERM program constrain insurers from pursuing their optimal investment policy, thereby reducing firm value.

In terms of the effects of IRMs on firm performance, geographic diversification has a negative and significant effect on the accounting-based firm value (*ROA*). Moreover, higher leverage and higher percentage of premium in catastrophe states and lines are negatively associated with *ROA*. It suggests that the uncertainty of an insurer, either from the capital structure or from the underwriting business, reduces the accounting-based firm performance.

4. SENSITIVITY TESTS

We conduct two additional variants of our primary analyses to check the robustness of our findings on the effects of ERM on firm value. First, we rerun our analyses on the treatment-effect model to examine whether results are robust to other *Firm Value* measures such as *Underwriting ROA*. *Underwriting ROA* captures the profitability of an insurer from insurance operations, as contrasted with that realized from investments. Importantly, the underwriting profit provides the first layer of capital to insurers. Table 7 reports the estimates of this model, which closely mirror our results in Tables 5 and 6. We find that the impact of ERM on *Underwriting ROA* is negative and significant for different model specifications. The results further confirm Hypothesis 3b.

Second, as noted earlier, we define *ERM* as an indicator variable based on a detailed search of financial reports, newswires, and other media for evidence of insurers' ERM activities, which equals 1 if an insurer engaged in ERM in year t and 0 otherwise (t = 2000, 2001, . . . , 2007). To further investigate whether our results are robust to different ERM-quality firms when we compare firm performance of ERM and non-ERM firms, we use a newly available measure published by Standard and Poor's. Standard and Poor's (2007) published the first ERM rating report for North American insurers in 2007, which is the last year in our sample period. In that report Standard and Poor's assigned each ERM insurer a ratings over four categories—Weak, Adequate, Strong, and Excellent, which we translate into four dummy variables: *ERM1* = 1 if ERM rating is Weak, 0 otherwise; *ERM2* = 1 if ERM rating is Adequate, 0 otherwise; *ERM3* = 1 if ERM rating is Strong, 0 otherwise; and *ERM4* = 1 if ERM rating is Excellent, 0 otherwise. We omit non-ERM firms in the regressions as the baseline category. Our final sample includes 68 observations in 2007, and the results are shown in Table 8. In regressions (1)–(4), weak ERM firms (*ERM1* = 1) have lower firm performance relative to non-ERM firms, while adequate ERM firms (*ERM2* = 1), strong ERM firms (*ERM3* = 1), and excellent ERM firms (*ERM4* = 1) do not have a significantly different firm value from non-ERM firms. However, in 2007 we do not find there is a significant difference in *Tobin's Q* between various ERM-quality firms and non-ERM firms. This might not be a surprising result given that the signaling effect of Standard and Poor's inclusion of ERM into its credit rating system and the information conveyed through ERM scores could alleviate investors' concerns about the increased operating costs and complexity associated with ERM. Although we do not observe a difference in *Tobin's Q* among different ERM-quality firms right after the first ERM rating report in 2007, we expect that the market would reckon good ERM practices afterward with more

[13] The treatment-effect model is also appropriate for the firm value equation (8) with *ROA* and *Underwriting ROA* as the dependent variables, discussed below.

Table 7

Effects of ERM on Underwriting Return on Assets: Treatment-Effect Model (2000–2007)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	−0.299*	−0.301*	−0.297*	−0.314**	−0.298*	−0.264	−0.281*
	(0.16)	(0.16)	(0.16)	(0.15)	(0.16)	(0.16)	(0.16)
ERM variable							
Lagged ERM firm indicator	−0.044***	−0.044***	−0.045***	−0.043***	−0.044***	−0.044***	−0.043***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
IRM variables							
Lagged reinsurance		−0.002					0.005
		(0.01)					(0.01)
Lagged derivative			−0.026				−0.022
			(0.06)				(0.06)
Lagged geographical diversification				−0.102***			−0.113***
				(0.03)			(0.03)
Lagged product diversification					0.004		0.030
					(0.02)		(0.02)
Lagged asset return volatility						−0.364	−0.220
						(0.39)	(0.39)
Firm characteristics variables							
Reinsurance sustainability index	0.009	0.009	0.009	0.010	0.009	0.009	0.010
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Log(BV of assets)	0.021***	0.021***	0.021***	0.026***	0.021***	0.020***	0.024***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
BV of liabilities/BV of assets	−0.256***	−0.256***	−0.255***	−0.238***	−0.256***	−0.256***	−0.237***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Three-year premium growth rate	0.007	0.007	0.007	0.006	0.007	0.006	0.006
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Best's rating	0.005	0.005	0.005	0.003	0.005	0.004	0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
No. of SIC codes in which insurer operates	−0.005	−0.005	−0.004	−0.005	−0.004	−0.004	−0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
% premium in price-regulated lines	0.033*	0.033*	0.033*	0.014	0.034*	0.034*	0.020
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
% premium in property lines of business	−0.048	−0.048	−0.048	−0.054	−0.049	−0.055	−0.071
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
% premium in catastrophe states and lines	−0.026	−0.026	−0.026	−0.046	−0.027	−0.028	−0.051
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Self-selection parameter	0.019**	0.019**	0.019**	0.019**	0.019**	0.019**	0.019**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diagnostics							
Rho	0.586	0.586	0.602	0.593	0.583	0.590	0.589
Wald χ^2	1,002.3	1,002.4	999.4	1,041.1	1,003.0	1,004.0	1,049.6
No. of observations	507	507	507	507	507	507	507

Notes: Standard errors are reported in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

reliable and timely rating information released by Standard and Poor's. We leave this for future research. Nevertheless, these results complement our findings in Tables 5, 6, and 7: The ERM firms, on average, do not have a better performance than the non-ERM firms.

Although the above analysis based on ERM ratings reaches somewhat similar conclusions to those shown in Tables 5, 6, and 7, the results should be interpreted cautiously since they are based on single-year data because of the limit on data availability. The one-year analysis cannot reveal important information on the evolution of ERM adoption, the interplay between ERM and IRMs, and the dynamic impact of ERM on firm value over the period of interest when ERM concept started to gain momentum.

Table 8

Effects of Different ERM Ratings on Firm Performance: OLS Model (2007)

	ROA		Underwriting ROA		log(Tobin's Q)	
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.040	0.050	0.092	0.074	0.368***	0.427***
	(0.07)	(0.08)	(0.08)	(0.09)	(0.06)	(0.08)
S&P ERM score dummies						
= 1 if ERM rating = Weak, 0 otherwise	−0.079***	−0.065***	−0.086***	−0.066**	0.020	0.038
	(0.02)	(0.02)	(0.03)	(0.02)	(0.05)	(0.04)
= 1 if ERM rating = Adequate, 0 otherwise	−0.013	−0.003	−0.020	−0.007	0.023	0.036
	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)
= 1 if ERM rating = Strong, 0 otherwise	−0.005	0.002	0.003	0.009	0.036	0.037
	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)
= 1 if ERM rating = Excellent, 0 otherwise	0.001	0.003	0.001	−0.001	−0.047	−0.059
	(0.02)	(0.02)	(0.03)	(0.03)	(0.05)	(0.05)
IRM variables						
Lagged reinsurance		−0.014		−0.007		−0.038
		(0.02)		(0.02)		(0.04)
Lagged derivative		−0.427		−0.544		−0.369
		(0.32)		(0.36)		(0.64)
Lagged geographical diversification		−0.020		−0.009		0.124***
		(0.02)		(0.02)		(0.04)
Lagged product diversification		−0.053**		−0.088***		−0.102**
		(0.02)		(0.02)		(0.05)
Lagged asset return volatility		−0.911		−1.164		−2.119*
		(0.67)		(0.75)		(1.26)
Firm characteristics variables						
Reinsurance sustainability index	−0.007	−0.009	0.004	−0.001	0.016	0.012
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Log(BV of assets)	0.002	0.006	−0.003	0.004	0.018***	0.019***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Leverage	−0.077*	−0.092**	−0.060	−0.083*	−0.691***	−0.709***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.07)	(0.07)
Three-year premium growth rate	−0.008	−0.003	0.010	0.015	0.087**	0.081**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
No. of SIC codes in which insurer operates	0.014**	0.016**	0.019**	0.022***	−0.007	−0.010
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
% premium in price-regulated lines	−0.001	−0.029	0.008	−0.027	−0.015	−0.030
	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
% premium in property lines of business	−0.025	0.042	−0.012	0.089	−0.128	−0.141
	(0.06)	(0.06)	(0.07)	(0.07)	(0.12)	(0.13)
% premium in catastrophe states and lines	0.010	0.014	−0.019	0.000	0.076	0.176***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.06)	(0.05)
Diagnostics						
Adjusted R^2	0.140	0.215	0.117	0.262	0.672	0.740
No. of observations	68	68	68	68	68	68

Notes: Standard errors are reported in parentheses. When dependent variable = *ROA* or *Underwriting ROA*, *Leverage* equals BV of liabilities/BV of assets; when dependent variable = log(*Tobin's Q*), *Leverage* equals BV of liabilities/(BV of liabilities + MV of equities).
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

In this sense, our results in Section 3 based on the full sample, spanning from 2000 to 2007, provide a more complete picture.

5. CONCLUSIONS

This paper focuses on several important but previously neglected areas of ERM, namely, the impacts of IRMs on ERM initiation and IRM reconfiguration after ERM adoption. We also correct the potential bias caused by the ignorance of IRMs when investigating the firm value effect of ERM. We argue that IRMs can be catalysts or deterrents for a firm to engage in ERM, contingent on its existing level and cost of IRM utilization. Furthermore, upon launching an ERM program, the firm will coordinate and fine-tune IRMs to reflect the core spirit of ERM. Specifically, by indentifying and integrating various risks, ERM decreases costly IRMs, such as reinsurance, but increases those that are underimplemented, such as derivative usage. To the best of our knowledge, this is the first study to examine the dynamics between ERM and IRMs, two correlated risk management concepts.

We test our predictions based on the U.S. publicly traded PC insurers from 2000 to 2007. The findings of the paper support our hypotheses that insurers with higher reinsurance ratio and greater geographic diversification are more likely to implement ERM. These insurers may realize more benefits from ERM so that they are more motivated to embrace this new mechanism.

Our results also shed new light on the role of ERM in IRM adjustments. ERM insurers appear to decrease reinsurance purchase and reduce asset portfolio volatility but increase derivatives positions. They, however, do not make significant changes in geographic or product diversification, at least in the short run. In sum, our findings imply that after ERM adoption, the insurers reduce cost of reinsurance through less reinsurance purchase and cost of financial risks via more derivative usage and less volatile asset portfolios. This may be good news for investors of firms that currently undertake ERM.

Yet the bad news is that the stock market reacts negatively to this new phenomenon despite its conceptual benefits. We observe ERM lowers insurers' *Tobin's Q, ROA,* and *Underwriting ROA*. This may be because it is difficult for investors to decipher the value of ERM since ERM complicates risk management processes (Fraser et al. 2008). Furthermore, the market may view ERM as a costly program whose potential benefits hardly justify its costs (Beasley et al. 2008; Pagach and Warr 2010). Finally, our analyses based on Standard and Poor's ERM ratings also conclude that ERM implementation does not create value, and the weak ERM insurers have much lower *ROA* and *Underwriting ROA* than non-ERM firms in 2007. This indicates that a poorly implemented ERM program is detrimental to the firm.

The above findings of this study highlight regulatory implications for reporting and solvency requirements. Overseeing ERM requires a comprehensive and longitudinal assessment of all dimensions of firm risks and corresponding risk management practices. Although not a regulatory agency, Standard and Poor's has taken a leading role in assessing risk management culture, systems, processes, and practice within an insurer and reporting an insurer's ERM program quality. Given the complexity, plus the potential downside of ERM, the regulators can reinforce the efforts of Standard and Poor's by establishing regulations that require transparency of information and adequate consumer protection to best serve the public's interest. More transparent and tractable risk reporting is likely to be beneficial in facilitating market understanding and monitoring of ERM activities. Enhanced risk information will also provide new information on the firm's performance and financial stability, which facilitates regulatory oversight of company operation and safeguards the interests of customers.

APPENDIX A

LIST OF ERM AND NON-ERM SAMPLE FIRMS

Non-ERM Firms	ERM Firms[a]
21st Century Holding Company	ACE Limited
21st Century Insurance Group	Alfa Corporation
Affirmative Insurance Holdings, Inc.	Allianz SE
Allcity Insurance Company	Allstate Corporation
Alleghany Corporation	American International Group, Inc.
Allied World Assurance Company Holdings	Amerisafe, Inc.
AMCOMP, Inc.	Atlantic American Corporation
American Financial Group, Inc.	Berkshire Hathaway, Inc.
American Safety Insurance Holdings, Ltd.	Chubb Corporation
Argonaut Group, Inc.	Cincinnati Financial Corporation
Axis Capital Holdings	CNA Financial Corporation
Baldwin & Lyons, Inc.	Fairfax Financial Holdings
Bancinsurance Corporation	Hartford Financial Services Group, Inc.
Commerce Group, Inc.	Kingsway Financial Services, Inc.
Covanta Holding Corporation	Navigators Group, Inc.
Cumberland Technologies, Inc.	Odyssey Re Holdings Corporation
Direct General Corporation	Old Republic International Corporation
Donegal Group, Inc.	Philadelphia Consolidated Holding Corporation
Eastern Insurance Holdings, Inc.	PMA Capital Corporation
EMC Insurance Group, Inc.	Progressive Corporation
Everest Re Group, Ltd.	Quanta Capital Holdings, Ltd.
First Mercury Financial Corporation	RenaissanceRe Holdings, Ltd.
GAINSCO, Inc.	RLI Corporation
Hallmark Financial Services, Inc.	Safeco Corporation
Hanover Insurance Group, Inc.	Selective Insurance Group, Inc.
Harleysville Group, Inc.	State Auto Financial Corporation
Highlands Insurance Group, Inc.	Transatlantic Holdings, Inc.
Horace Mann Educators Corporation	Travelers
Infinity Property & Casualty Corporation	United Fire & Casualty Company
James River Group, Inc.	Unitrin, Inc.
Markel Corporation	White Mountains Insurance Group, Ltd.
Meadowbrook Insurance Group, Inc.	
MEEMIC Holdings, Inc.	
Mercer Insurance Group, Inc.	
Merchants Group, Inc.	
Mercury General Corporation	
Midland Company	
Millea Holdings, Inc.	
National Atlantic Holdings	
National Security Group, Inc.	
North Pointe Holdings Corporation	
Ohio Casualty Corporation	
Paula Financial/DE	
ProAssurance Corporation	
Procentury Corporation	
Royal & Sun Alliance Insurance Group	
Safety Insurance Group, Inc.	
Seabright Insurance Holdings	
Specialty Underwriters	
Unico American Corporation	
United America Indemnity, Ltd.	
Vesta Insurance Group, Inc.	
W. R. Berkley Corporation	
Zenith National Insurance Corporation	

[a] As of 2007.

APPENDIX B

VARIABLE DEFINITIONS AND DATA SOURCES

Variable	Definition and Data Sources
ERM	= 1 for firm-years, ≥ year of first identifiable ERM activity, 0 otherwise. Data sources: Lexis-Nexis, SEC filings, other media.
ERM1	= 1 if ERM rating = Weak, 0 otherwise. Data source: Standard and Poor's (2007).
ERM2	= 1 if ERM rating = Adequate, 0 otherwise. Data source: Standard and Poor's (2007).
ERM3	= 1 if ERM rating = Strong, 0 otherwise. Data source: Standard and Poor's (2007).
ERM4	= 1 if ERM rating = Excellent, 0 otherwise. Data source: Standard and Poor's (2007).
Reinsurance	Ratio of reinsurance ceded to the sum of direct business written and reinsurance assumed. Data source: NAIC Infopro P/C.
Derivative	Notional amount of all derivative positions for hedging purpose held at year end, normalized by its total assets. Data source: NAIC Schedule DB P/C.
Geographical diversification	Equals 1 minus geographical Herfindal index. Data source: NAIC Infopro P/C.
Product diversification	Equals 1 minus product Herfindal index. Data source: NAIC Infopro P/C.
Asset return volatility	Annualized volatility of assets is estimated from seven asset return series from 1991Q1 to 2007Q4. Data sources: Quarterly returns of the Standard & Poor's 500 Stock Index, Merrill Lynch U.S. government bond index, Merrill Lynch U.S. corporate bond index, Merrill Lynch mortgage-backed security index, and four-week U.S. T-bill security market index are from Thomson's Datastream database; monthly returns of the U.S. Real Estate Index are from the National Association of Real Estate Investment Trusts (NAREIT); and quarterly returns of other assets are estimated from the NAIC Infopro P/C.
Return on assets	Net income divided by total assets. Data source: NAIC Infopro P/C.
Underwriting return on assets	Underwriting income divided by total assets. Data source: NAIC Infopro P/C.
Tobin's *Q*	Market value of equity plus the book value of liabilities divided by the book value of assets. Data source: Compustat.
Reinsurance sustainability index	Proportion of premiums ceded over a three-year period to reinsurance providers that are present in all three years. Data source: NAIC Infopro P/C.
Total assets ($ million)	Book value of total assets. Data sources: NAIC Infopro P/C and Compustat.*
BV of liabilities/BV of assets	Ratio of book value of liabilities to book value of assets. Data source: NAIC Infopro P/C.
BV of liabilities/(BV of liabilities + MV of equities)	Ratio of book value of liabilities to the sum of book value of liabilities and market value of equities. Data source: Compustat.
Three-year premium growth rate	Annual total premium growth rate in a three-year period. Data source: NAIC Infopro P/C.
Best's rating	The highest Best's credit rating "A++" or "A+" is assigned a value of 1, "A" or "A−" a value of 2, "B++" or "B+" a value of 3, "B" or "B−" a value of 4, "C++" or "C+" a value of 5, "C" or "C−" a value of 6, "D" a value of 7, and "E" or "F" or "S" a value of 8. Data source: A. M. Best credit rating database.
Number of SIC codes in which insurer operates	Number of four-digit Standard Industrial Classification (SIC) codes in which the insurer does business. Data source: Compustat Segment Database.
Percent premium in price-regulated lines	Ratio of premiums in price-regulated lines (primarily personal auto and workers' compensation) to total premium. Data source: NAIC Infopro P/C.
Percent premium in property lines of business	Percentage of premium written in property lines of business. Data source: NAIC Infopro P/C.
Percent premium in catastrophe states and lines	Premiums from all catastrophe-prone insurance lines of business in states boarding the Gulf Coast and the Atlantic Ocean plus earthquake insurance premiums from all states divided by total premiums. Data source: NAIC Infopro P/C.
Debt-to-total capital ratio	Total book liabilities divided by total book equities. Data source: NAIC Infopro P/C.
Liabilities-to-invested assets ratio	Total book liabilities divided by total invested assets. Data source: NAIC Infopro P/C.
Invested assets-to-total assets ratio	Total invested assets divided by total assets. Data source: NAIC Infopro P/C.
Debt coverage ratio	Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA) divided by interest expenses. Data source: Compustat.

* When dependent variable = Return on assets or underwriting return on assets, total assets are obtained from NAIC Infopro P/C; when dependent variable = log(Tobin's *Q*), total assets are obtained from Compustat.

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REFERENCES

ADAMS, M., P. HARDWICK, AND H. ZOU. 2008. Reinsurance and Corporate Taxation in the United Kingdom Life Insurance Industry. *Journal of Banking & Finance* 32: 101–115.

BAELE, L., O. DE JONGHE, AND R. VANDER VENNET. 2007. Does the Stock Market Value Bank Diversification? *Journal of Banking & Finance* 31: 1999–2023.

BEASLEY, M., D. PAGACH, AND R. WARR. 2008. Information Conveyed in Hiring Announcements of Senior Executives Overseeing Enterprise-Wide Risk Management Processes. *Journal of Accounting, Auditing & Finance* 23: 311–332.

BEASLEY, M. S., C. RICHARD, AND D. R. HERMANSON. 2005. Enterprise Risk Management: An Empirical Analysis of Factors Associated with the Extent of Implementation. *Journal of Accounting and Public Policy* 24: 521–531.

BODNAR, G. M., G. S. HAYT, AND R. C. MARSTON. 1998. 1998 Wharton Survey of Financial Risk Management by US Non-Financial Firms. *Financial Management* 27: 70–91.

BODNAR, G. M., C. TANG, AND J. WEINTROP. 1999. Both Sides of Corporate Diversification: The Value Impacts of Global and Industrial Diversification. Working Paper. Johns Hopkins University, Baltimore.

CARSON, J., E. ELYASIANI, AND I. MANSUR. 2008. Market Risk, Interest Rate Risk, and Interdependencies in Insurer Stock Returns: A System-GARCH Model, *Journal of Risk and Insurance* 75: 873–892.

COLE, C. R., AND K. A. MCCULLOUGH. 2006. A Reexamination of the Corporate Demand for Reinsurance. *Journal of Risk & Insurance* 73: 169–192.

COMMITTEE OF SPONSORING ORGANIZATIONS OF THE TREADWAY COMMISSION (COSO). 2004. Enterprise Risk Management-Integrated Framework: Executive Summary. http://www.coso.org/documents/coso_executivesummary.pdf.

CUMMINS, J., G. DIONNE, R. GAGNÉ, AND A. NOUIRA. 2008a. The Costs and Benefits of Reinsurance. Working Paper. Temple University, Philadelphia, and HEC, Montreal.

CUMMINS, J. D., C. LEWIS, AND R. WEI. 2006. The Market Impact of Operational Risk Events for U.S. Banks and Insurers. *Journal of Banking and Finance* 30: 2605–2634.

CUMMINS, J. D., Y. LIN, AND R. D. PHILLIPS. 2008b. Capital Allocation and the Pricing of Financially Intermediated Risks: An Empirical Investigation. Working Paper. Temple University, Philadelphia, University of Nebraska, Lincoln, and Georgia State University, Atlanta.

CUMMINS, J. D., AND G. P. NINI. 2002. Optimal Capital Utilization by Financial Firms: Evidence from the Property-Liability Insurance Industry. *Journal of Financial Services Research* 21: 15–53.

CUMMINS, J. D., R. D. PHILLIPS, AND S. D. SMITH. 1997. Corporate Hedging in the Insurance Industry: The Use of Financial Derivatives by U.S. Insurers. *North American Actuarial Journal* 1(1): 13–39.

CUMMINS, J. D., R. D. PHILLIPS, AND S. D. SMITH. 2001. Derivatives and Corporate Risk Management: Participation and Volume Decisions in the Insurance Industry. *Journal of Risk and Insurance* 68: 51–91.

CUMMINS, J. D., AND D. W. SOMMER. 1996. Capital and Risk in Property—Liability Insurance Markets. *Journal of Banking and Finance* 20: 1069–1092.

DENIS, D. J., D. K. DENIS, AND K. YOST. 2002. Global Diversification, Industrial Diversification, and Firm Value. *Journal of Finance* 57: 1951–1979.

DESENDER, K. A. 2009. On the Determinants of Enterprise Risk Management Implementation. *Enterprise IT Governance, Business Value and Performance Measurement,* Nan Si Shi and Gilbert Silvius, eds., IGI Global.

DOHERTY, N., AND K. SMETTERS. 2005. Moral Hazard in Reinsurance Markets. *Journal of Risk and Insurance* 72: 375–392.

ELANGO, B., Y. MA, AND N. POPE. 2008. An Investigation into the Diversification-Performance Relationship in the U.S. Property-Liability Insurance Industry. *Journal of Risk and Insurance* 75: 567–591.

FITZPATRICK, J. H. 2001. Comments on ''Financial Regulation for the New Millennium: The Case for Liberal Reinsurance Regulation.'' *Geneva Papers on Risk and Insurance* 26(1): 23–26.

FRASER, J. R. S., K. SCHOENING-THIESSEN, AND B. J. SIMKINS. 2008. Who Reads What Most Often? A Survey of Enterprise Risk Management Literature Read by Risk Executives. *Journal of Applied Finance* 18: 73–91.

FROOT, K. 2001. The Market for Catastrophe Risk: A Clinical Examination. *Journal of Financial Economics* 60: 529–571.

FROOT, K., AND P. O'CONNELL. 2008. On the Pricing of Intermediated Risks: Theory and Application to Catastrophe Reinsurance. *Journal of Banking & Finance* 32: 69–85.

GARVEN, J. R., AND M. F. GRACE. 2007. Adverse Selection in Reinsurance Markets. Working Paper. Baylor University and Georgia State University.

GÉCZY, C., B. A. MINTON, AND C. SCHRAND. 1997. Why Firms Use Currency Derivatives. *Journal of Finance* 52: 1323–1354.

GRACE, M. F., AND J. T. LEVERTY. 2010. Political Cost Incentives for Managing the Property-Liability Insurer Loss Reserve. *Journal of Accounting Research* 48: 21–49.

GRACE, M. F., J. T. LEVERTY, R. PHILLIPS, AND P. SHIMPI. 2010. The Value of Investing in Enterprise Risk Management. Working Paper. Georgia State University and University of Iowa.

GRAHAM, J. R., AND D. A. ROGERS. 2002. Do Firm's Hedge in Response to Tax Incentives? *Journal of Finance* 57: 815–839.

HARRIS, M., C. D. KRIEBEL, AND A. RAVIV. 1982. Asymmetric Information, Incentives and Intrafirm Resource Allocation. *Management Science* 28: 604–620.

HECKMAN, J. J., AND E. J. VYTLACIL. 2000. The Relationship between Treatment Parameters within a Latent Variable Framework. *Economics Letters* 66: 33–39.

HOYT, R., AND A. LIEBENBERG. 2009. The Value of Enterprise Risk Management. Working Paper. University of Georgia.

JEAN-BAPTISTE, E. L., AND A. M. SANTOMERO. 2000. The Design of Private Reinsurance Contracts. *Journal of Financial Intermediation* 9: 274–297.

JIN, Y., AND P. JORION. 2006. Firm Value and Hedging: Evidence from U.S. Oil and Gas Producers. *Journal of Finance* 61: 893–919.

KLEFFNER, A. E., R. B. LEE, AND B. MCGANNON. 2003. The Effect of Corporate Governance on the Use of Enterprise Risk Management: Evidence from Canada. *Risk Management and Insurance Review* 6: 53–73.

LAEVEN, L., AND R. LEVINE. 2007. Is There a Diversification Discount in Financial Conglomerates? *Journal of Financial Economics* 85: 331–367.

LANG, L. H. P., AND R. M. STULZ. 1994. Tobin's Q, Corporate Diversification, and Firm Performance. *Journal of Political Economy* 102: 1248–1280.

LIN, C. M., R. D. PHILLIPS, AND S. D. SMITH. 2008. Hedging, Financing, and Investment Decisions: Theory and Empirical Tests. *Journal of Banking & Finance* 32: 1566–1582.

LIN, Y., J. YU, AND M. PETERSON. 2009. Risk Management in the Network Economy. Working Paper. University of Nebraska, Lincoln, and University of Nevada, Las Vegas.

LOOKMAN, A. A. 2009. Bank Borrowing and Corporate Risk Management. *Journal of Financial Intermediation* 18: 632–649.

MCSHANE, M. K., A. NAIR, AND E. RUSTAMBEKOV. 2011. Does Enterprise Risk Management Increase Firm Value? *Journal of Accounting, Auditing, and Finance* 26: 641–658.

MORCK, R., AND B. YEUNG. 1998. Why Investors Sometimes Value Size and Diversification: The Internalization Theory on Synergy. Working Paper. University of Alberta.

MYERS, S. 1977. Determinants of Corporate Borrowing. *Journal of Financial Economics* 5: 147–175.

MYERSON, R. B. 1982. Optimal Coordination Mechanisms in Generalized Principal-Agent Problems. *Journal of Mathematical Economics* 10: 67–81.

NOCCO, B., AND R. M. STULZ. 2006. Enterprise Risk Management: Theory and Practice. *Journal of Applied Corporate Finance* 18(4): 8–20.

PAGACH, D., AND R. WARR. 2007. An Empirical Investigation of the Characteristics of Firms Adopting Enterprise Risk Management. Working Paper. North Carolina State University, Raleigh.

PAGACH, D., AND R. WARR. 2010. The Effects of Enterprise Risk Management on Firm Performance. Available at SSRN: http://ssrn.com/abstract=1155218.

PAGACH, D., AND R. WARR. 2011. The Characteristics of Firms That Hire Chief Risk Officers. *Journal of Risk and Insurance* 78: 185–211.

ROLL, R. 1986. The Hubris Hypothesis of Corporate Takeovers. *Journal of Business* 59(2): 197–216.

ROSENBERG, J., AND T. SCHUERMANN. 2006. A General Approach to Integrated Risk Management with Skewed, Fat-Tailed Risks. *Journal of Financial Economics* 79: 569–614.

SAMANTA, P. 2009. ERM: A Strategic Tool for Hedging Performance Disruptions. *Journal of Risk Management in Financial Institutions* 2: 232–237.

SAMANTA, P., T. AZARCHS, AND J. MARTINEZ. 2004. *The PIM Approach to Assessing the TRM Practices of Financial Institutions*. New York, NY: Standard and Poor's/McGraw-Hill.

SHAMIEH, C. 2007. Implementing EC—Recent Experience. SOA/Tillinghast Insurance Seminar on Economic Capital, American International Group. http://riskisopportunity.com/files/pdf/2007-chicago-shamieh.pdf.

SMITH, C., AND R. STULZ. 1985. The Determinants of Firms' Hedging Policies. *Journal of Financial and Quantitative Analysis* 20: 391–405.

SONG, Q., AND J. D. CUMMINS. 2008. Hedge the Hedgers: Usage of Reinsurance and Derivatives by PC Insurance Companies. Working Paper. Temple University, Philadelphia,.

STANDARD AND POOR'S. 2006. Credit FAQ: Enterprise Risk Management One Year On. New York: Standard and Poor's.

STANDARD AND POOR'S. 2007. Enterprise Risk Management: North American Insurers and Reinsurers in Line with Global Trends. New York: Standard and Poor's.

SWISS RE. 2004. Understanding Reinsurance: How Reinsurers Create Value and Manage Risk. Zurich: Swiss Re.

WAGNER, W. 2010. Diversification at Financial Institutions and Systemic Crises. *Journal of Financial Intermediation* 19: 373–386.

YERMACK, D. 1996. Higher Market Valuation of Companies with a Small Board of Directors. *Journal of Financial Economics* 40: 185–211.

ZACCANTI, B. 2009. ERM Bolsters Evolution of Insurance RM. *National Underwriter, Property & Casualty Risk & Benefits Management* 113(15): 29, 35.

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