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Does Enterprise risk management enhance operating performance?☆

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ABSTRACT

The Committee of Sponsoring Organizations (COSO) Enterprise Risk Management (ERM) framework (COSO-ERM) indicates that the development of an enterprise-wide risk assessment and management process is designed to "provide reasonable assurance regarding the achievement of entity objectives." We examine this issue and hypothesize that firms with mature ERM processes should achieve greater operational performance than those with less mature risk management processes. This study relies on internal audit function management survey responses matched with archival firm level data to gain a better understanding of the expected operating performance impact of the multi-stage ERM implementation process. After controlling for board governance and other known effects, we find that firms with higher levels of ERM process maturity are characterized by higher operating performance than their industry peers utilizing performance metrics closely related to the earnings process. Our study provides support for the linkage of enhanced operating performance associated with the maturity of ERM processes and suggests other potential areas of ERM research.

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1. Introduction

Financial and insurance industries have long understood the value of quantitative analysis of operational information in estimating loan and claim risk in business practices (e.g. granting loans, setting interest rates and premiums). Firms within the financial and insurance industries have historically invested in processes and technologies to identify and estimate risk exposure. These processes use data analysis to assist with monitoring risk exposures and maximize risk-based business decisions. Despite these investments, the banking industry, expected to be a leader in risk assessment and management practices, has had several firms experience major failures managing organizational risk. More specifically, the reputation for bank risk-taking strategies has been criticized as a leading contributor to the recent Great Recession (December 2007 – June 2009[1]). There also have been other notable examples of operational practices having significant impacts on banks in recent years. For example, Barings Bank (1995) and J.P. Morgan Chase (2012) each allowed a single employee excessive authority to make extremely risky equity trades. Although J.P. Morgan Chase was able to absorb a $5.8 Billion loss[2] (original estimates of losses were as high as $9 Billion[3]), Barings Bank was not able to survive the risky trades made by Nick Leeson and was sold for £1. While not having a global economic impact, several other major firms have experienced significant losses as a result of gaps and failures within their risk management strategy and the security of customer information.[4]

In order to address the lack of a systematic enterprise-wide risk management plan, in 2004, the Committee of Sponsoring Organizations (COSO) of the Treadway Commission created an Enterprise Risk Management framework (COSO-ERM). COSO-ERM defines Enterprise Risk

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[1] http://www.nber.org/cycles/sept2010.html

[2] http://www.bloomberg.com/news/2012-09-06/jpmorgan-said-to-face-escalating-senate-probe-into-cio-s-losses.html

[3] http://www.bloomberg.com/news/2012-06-28/jpmorgan-slips-on-report-of-trading-loss-widening-to-9-billion.html

[4] T.J. Maxx, Sony PlayStation and many other firms have realized the significance of loss that may be associated with technological risk that hackers pose to customer data. The grounding of a significant portion of the Southwest Airlines fleet demonstrates the risk of compliance risk. The business impacts of environmental risk have been noted with Hurricane Katrina, Deepwater Horizon, and Hurricane Sandy to name just a few. Competitive risk and technological changes have also lead to recent struggles for household named firms (e.g. Kodak, Kmart, and Blockbuster). Regulatory and political risks also create burdens for businesses.

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Management (ERM) as an enterprise-wide risk assessment and management process designed to "provide reasonable assurance regarding the achievement of entity objectives." Although adoption of risk management may not specifically change the level of organizational risk, it likely impacts the actual measurement and monitoring of risk throughout the firm. As a result of targeting specific levels of risk, firms are likely to reduce downside operating performance volatility while accomplishing their ordinary business goals and objectives which include generating profits and providing shareholder value. Moreover, COSO's definition of ERM implies that firms implementing ERM processes should be more likely to achieve enhanced operating and market performance, yet this empirical link remains unclear. Recently, Monda and Giorgino (2013) note that empirical studies have provided little evidence on the effect of ERM on firm value. In addition to the noted empirical limitations, they state that "despite the theoretical motivations, if and to what extent ERM adds value is yet to be proven." While McShane, Nair, and Rustambekov (2011), Baxter, Bedard, Hoitash, and Yezegel (2013) rely on the financial services industry to examine ERM benefits, Monda and Giorgino (2013, p. 3) further indicate the limitation of such studies to financial institutions which differ substantially from industrial firms in institutional type and operations.

In general, there are three major types of financial institutions; depository institutions that accept and manage deposits and make loans (e.g. banks, credit unions, and mortgage loan firms) secondly, contractual institutions (e.g. insurance companies and pension funds) and lastly, investment institutions (e.g. investment banks, underwriters, brokerage firms). Prior economic and finance literature suggests that financial firms differ from non-financial firms in financial leverage, investment opportunities, and external governmental regulation, all of which have implications for profitability, risk assessment and price setting behavior (Armstrong, Guay, Mehran, & Weber, 2016). The financial system that delivers these functions is comprised of an ever evolving configuration of financial institutions, securities markets, securities laws and enforcement budgets, information intermediaries, financial regulation, and relations between political and financial institutions (Bushman, 2014).

In addition to the general differences of financial firms and institutions indicated that suggests a broader industry perspective for assessing ERM process benefits taken in this study, we also focus on operating metrics closely aligned with the earnings process. There are several key differences that can create estimation issues and differences in valuation and profitability or operating metrics in research studies utilizing financial firms versus non-financial firms (such as in this study) as succinctly outlined by the financial expert Damodaran (2011). The first is that financial service firms operate under heavy regulation with various capital constraints that impact operating strategy. Another difference is related to divergent accounting rules between financial service and non-financial firms related to asset valuation and earnings reporting. A third difference is the concept of debt within the financial services industry compared to the non-financial services industry. Within the financial services industry, debt would be more similar to an input operating source (e.g. raw material) than to a source of financing with the industries have significant differences in leverage ratios. In sum, all of these factors suggest that ERM results for financial firms may not be comparable to non-financial firms. We suggest that the broader sample examined in this study has the potential to yield further insights in the relation between ERM adoption and operating performance.

While general literature on ERM exists, one important limitation is that several previous studies have relied on the use of Chief Risk Officer (CRO) appointments as a proxy for ERM adoption (Beasley, Pagach, & Warr, 2008; Pagach & Warr, 2010 and Pagach & Warr, 2011; Hoyt & Liebenberg, 2011). Although the announcement of CRO appointment may indicate ERM adoption, lack of CRO announcement appointment does not necessarily indicate that ERM has not been implemented. Furthermore, appointment of a CRO does not guarantee that an "enterprise-wide" risk management process will be implemented. The CRO position may be focused narrowly on hazard or hedging risk as opposed to the overall risk exposure of the firm. A notable exception to the use of CRO in identifying ERM adopters is Gordon, Loeb, and Tseng (2009).

Gordon et al. (2009) focuses on a more robust measure of ERM effectiveness by searching 10-K and 10-Q covering fiscal year 2005 to identify terms related to ERM adoption (e.g. enterprise risk management, strategic risk management, corporate risk management, risk management committee, risk committee, and chief risk officer) which reduced the major criticism of only identifying firms with CROs. Further, Gordon et al. (2009) research documents a broader portrait of the ERM performance link by including an analyses of several mediating variables based on firm and capital market characteristics. Specifically, Gordon et al. (2009) demonstrate that using excess market returns as an ERM performance metric and focusing on ERM implementation in 2005, a subset of their 112 firm sample (high performing firms) is associated with contextual factors such as industry competition, firm complexity, firm size and board monitoring and have a significant effect on the effectiveness of ERM. However, their sample includes over 50% of observations from three highly regulated industries (Utility (34.8%), Financial Trading (11.6%), and Insurance (8.0%). While Gordon et al. (2009) provides a significant contribution to the ERM literature, Monda and Giorgino (2013) note that many of the prior ERM studies suffer from measurement error as a result of using a binary variable as a proxy for ERM adoption.

We build on this prior research and distinguish our study from the previously noted ERM literature limitations in the following four ways. First, in contrast to the previous studies, our three year analyses period subsequent to COSO-ERM 2004 allows us to examine additional ERM implementation and maturity performance effects as we capture the internal assessed maturity level of the ERM processes.[5] Specifically, we add incrementally to the current ERM literature through the use of a more direct and informative measure of ERM adoption, including the maturity stage of implementation captured by conducting a survey. Secondly, addressing a recent criticism of the importance of assessing firm performance effects,[6] we evaluate the effectiveness of ERM adoption as well as its multi-stage processes with accounting/operating performance metrics (return on assets (ROA) and return on equity (ROE)) closely related to the earnings process. These two traditional measures of operational performance; (ROA and ROE) have been hypothesized as a potential benefit of ERM adoption and the ERM maturation processes. Thirdly, while at least two previous empirical studies have examined ERM maturity, both studies have limited their investigation to financial institutions and insurers (e.g. McShane et al. (2011), Baxter et al. (2013)). In contrast, we conduct our analyses with a broad industry sample rather than a sample comprised primarily of firms in the financial services or regulated industries, given significant differences in operating and profit setting behavior as previously discussed. We suggest that expanded industry scope in this study has the potential to provide additional insights on the linkage between ERM adoption, its maturity and operating performance. Finally, also in a departure from previous research, using ERM adoption proxies such as the identification of a Chief Risk Officer or associated risk management terms, this study relies upon direct responses from 174 public firms gathered in 2009 from surveys of Internal Audit Function (IAF) management to capture the ERM process maturity for the three fiscal year period between 2006 and 2008 to specifically identify the maturity of ERM processes of responding firms. We evaluate the performance effect of ERM maturity processes by matching the IAF survey response data with archival

[5] Beasley, Clune, and Hermanson (2005) also collect information on ERM STAGE (maturity of activities) to gain an understanding of the types of organizations implementing ERM. However the study does not evaluate performance of those that implemented ERM.

[6] Koufteros, Verghese, and Lucianetti (2014) argue that missing from the literature is a judicious examination of how firms actually use performance measurement to orchestrate a responses to organizational challenges and whether such uses do in fact enhance operational performance over time.

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financial and market valuation data from the Standard and Poor's (S&P) Compustat database.

After controlling for board governance and other known performance effects, in a sample of 162 firms (427 firm-year observations), we find that firms with higher levels of ERM process maturity are characterized by higher operating performance than their industry peers utilizing performance metrics closely related to the earnings process. More specifically, the results support our expectation. We document that the adoption of ERM processes and enhanced maturity of ERM processes are positively associated with industry median-adjusted operational performance based on return on assets and equity. Therefore the ERM processes' positive effect on operating performance is likely to also improve the management of cash flows and be linked to enhanced market performance as found by Gordon et al. (2009). This implies that market stakeholders, management, and firm boards are rewarded not only for implementing ERM but also for a multi-year period after adoption.

The next section presents a review of prior literature related to ERM benefits (including reduced stock price volatility and earnings volatility and higher firm value) as well as studies associated with various operational performance measures, followed by development and formal identification of the research hypotheses. The research methodology and data are discussed in the fourth section followed by the conclusions and potential contributions of the study.

2. Literature review

Prior studies have considered various hedging and insurance practices and qualitative and quantitative measurement of risk prior to formal definition and development of risk management frameworks. Although various definitions of ERM exist, one of the most prevalent is published in the Enterprise Risk Management – Integrated Framework-Executive Summary Framework (2004), p. 4) published by the Committee of Sponsoring Organizations (COSO) of the Treadway Commission (COSO-ERM) defines ERM as:

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

The COSO-ERM Integrated Framework (2004) indicates that in order for management to maximize firm value, it must develop objectives and strategy that increase the probability of the firm meeting growth benchmarks and achieving satisfactory market returns, within an acceptable level of risk through the efficient deployment of resources. In fulfilling organizational objectives, the COSO-ERM Framework identifies six capabilities that ERM encompasses: a) Aligning risk appetite and strategy, b) Enhancing risk response decisions, c) Reducing operational surprises and losses, d) Identifying and managing multiple and cross-enterprise risks, e) Seizing opportunities, and f) Improving deployment of capital. Each of these six capabilities can be mapped into the COSO-ERM Integrated Framework definition.

Therefore, an effective ERM process not only considers "downside risk", frequently referred to as "risk", but also attempts to enhance firm value through evaluation of business opportunities, "upside risk." Downside risk is frequently associated with insurance and hedging activities to reduce financial losses and processes to mitigate regulatory risk. Alternatively, upside risk primarily focuses on business strategy, research and development investment, and operational innovations and efficiencies.

Despite being frequently interchangeably used with (Financial) Risk Management (insurance and hedging), COSO-ERM not only considers the impact of financial risk, but considers a broader yet categorical focus of the firm's risk management areas. More specifically, the COSO-ERM framework categorizes risk identification, assessment, and response to four categories of organizational objectives; strategic, operational, reporting, and compliance risk.[7] Detailed information relating to risks identified through the ERM process is used to assess the level of risk within the firm. Once identified and assessed, the firm evaluates the assessed level of risk against its risk tolerance levels to determine the appropriate risk response (avoid, accept, share, or mitigate via control procedures). Independent of the risk response selected, the firm should continuously monitor and update the likelihood and impact of the risk as well as additional risks identified. Finally, for the ERM process to be effective, sufficient communication of risks at the appropriate level and throughout the entire firm is necessary.[8] Antikarov (2012, p. 5) notes that "risk and opportunity are inseparable," therefore elimination of risk exposure is not a feasible strategy to value creation. As a result, "a company must take on the right risks, retain and manage them" in order to create value for shareholders.

2.1. Benefits of implementing ERM

Implementing ERM requires a significant investment by firms; however the operational benefits of decreased costs and increased revenues are not always readily identifiable. Relying on the disclosure of appointments of Chief Risk Officers (CRO) as a proxy for ERM adoption, Lam (2001) finds that firms are able to "reduce losses and earnings volatility" and improve return on capital and shareholder value by implementing ERM. Also using CRO appointments as a proxy for the implementation of an ERM process, Pagach and Warr (2010) find that firms adopting ERM experience a reduction in the volatility of earnings but do not find general support for ERM creating value across several additional measures. Beasley et al. (2008) find that the market response to ERM adoption, as proxied by CRO appointment, is firm specific. Using the Delphi Survey methodology, Monda and Giorgino (2013) indicate that ERM is more than just appointing a CRO, and identify several other important aspects of effective ERM processes including reporting independence of the risk management function, extent of risk management resources, identification of ownership of risk, and definition and communication of roles.

Tonello (2007) contends that an effective ERM implementation considers the consequences of downside risk (negative consequences of events) and methods for mitigating or avoiding such risk, as well as identification and analysis of upside risk frequently referred to as opportunities. Tonello (2007) suggests that ERM attempts to balance (optimize) the threats and opportunities that may lead to cost reductions through the increased integration of risk assessment and management. This would lead to more profitable investment decisions and a more objective basis for resource allocation. These cost reductions and improved investment decisions increase firm cash flows and can provide additional operational benefits.

Consistent with this line of reasoning, Pagach and Warr (2010) and Tonello (2007) suggest that benefits of balancing the entire set of firm

[7] The focus of the objectives relate to the following: Strategic is focused on support of long-term goals and organizational mission; Operations consider efficiency and effectiveness of business processes and use of resources; Reporting relates to the quality and availability of both internal and external reporting; and Compliance is focused on observance with laws, regulations, and firm policy.

[8] Prior to COSO-ERM (2004), Simons (1999) identified three categories of internal pressures to consider in measuring organizational risk; growth, culture, and information management. Two separate categories within the Simons (1999) Risk Calculator, growth and culture are heavily related to the Internal Environment component of the COSO-ERM (2004) framework. Furthermore, Simons (1999) identifies the importance of interactive monitoring and communication throughout the organizational structure as well as the importance of internal controls within the organization as key instruments in managing organizational risk. Although Simons (1999) does not specifically identify financial reporting and regulatory compliance as risk objectives, each is an important consideration in meeting operational and strategic objectives.

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risk leads to less volatile earnings that are associated with lower stock price volatility. More recently, using a cross-section of financial sector firms, Baxter et al. (2013) find that Standard & Poor's ERM Quality ratings have a positive association with operating performance and firm value. McShane et al. (2011) find a positive association between the Standard & Poor's ERM Quality rating and firm value (Tobin's Q) within the insurance industry. However, McShane et al. (2011) find that it is not advanced ERM ratings that drive the results, but instead the midpoint rating (adequate with positive trend) that is significantly different from those with "weak" or "adequate".[9]

Lundqvist (2014) provides a summary table of ten ERM studies, with six being classified as "Value Creation." Two of the six are noted as not supporting an association between ERM and firm value, while a third, Gordon et al. (2009) is classified as contingent on contextual variables. Gordon et al. (2009) use a two-stage model to predict which firms are better suited for ERM processes and find that one-year stock returns are negative for firms that are not good matches for ERM processes. However, several limitations of the study include the dependency on the use of key words within the 2005 10-K and 10-Q filings to identify firms as a having implemented ERM. The sample of many prior studies have been heavily based on financial, insurance, or utilities due either to these groups being early adopters and disclosers of CRO hiring or ERM activities (Hoyt & Liebenberg, 2011; Beasley et al., 2008; Gordon et al., 2009; Pagach & Warr, 2010, 2011) or data available via S&P ERM Ratings (McShane et al., 2011; Baxter et al., 2013).[10] Each of these industries have been traditionally heavily regulated thereby being associated with more mature risk management processes compared to most other industries.

Using Barings Bank and J.P. Morgan Chase as examples, Barton, Shenkir, and Walker (2012) note that "ERM programs require continuous and robust oversight and fine-tuning" and management should not ignore risk as a result of positive historical performance and lack of prior significant events. Cohen, Krishnamoorthy, and Wright (2014) conduct interviews of members of the governance triad (CFO, Audit Committee, and Audit Firm Partners) and find that within midsize firms in their study, the use of ERM has primarily focused on financial reporting and internal control risk associated with monitoring and mitigating risk related to agency theory. Cohen et al. (2014) suggest that moving towards a resource dependence theory implementation would provide greater value through more effective management of corporate strategy and business risk. Consistent with their suggestion, we attempt to use a more holistic approach of ERM based on each of the four COSO-ERM objectives. We build upon the work of prior studies related to ERM, and extend the consideration of operating performance benefits of ERM maturity for non-financial firms that are in general less regulated with different business and risk models compared to firms operating in the financial services and insurance industries.

2.2. Operational performance measures

In order to develop our performance metrics, we rely upon previous performance literature (e.g. Ittner, Larcker, & Randall, 2003; Chen, Cheng, & Hwang, 2005). A survey-based study by the Milliman Risk Institute (2014) indicates that for ERM trendsetters, the top 5 ways ERM creates value for firms include improved performance management, improved risk-adjusted decision making, enhanced board oversight, improved capital efficiencies, and higher quality of strategic planning. With the exception of capital efficiency, the other four measures are not readily captured from public information. As a result, we focus on return on assets and equity. Prior studies have found differences or changes in firm characteristics to be associated with changes in operational performance measures (e.g. ROA and ROE) closely related to the earnings process. Maiga and Jacobs (2008), find that the adoption of just-in-time inventory management systems is associated with enhanced operating performance. Using industry-adjusted ROA as a proxy for operating performance, Core, Guay, and Rusticus (2006) find that firms with greater shareholder rights outperform firms with lesser shareholder rights. Holm, Kumar, and Plenborg (2016) find that firms that implement customer accounting systems are associated with temporarily higher ROA compared to the industry. More closely related to this study, Brown and Caylor (2009) find that enhanced governance, as proxied by their Governance-Score measure (Gov-Score), is positively associated with industry-adjusted measures of ROA and ROE. This study builds on these prior findings and attempts to mitigate previous data limitations and expand industry focus beyond financial and insurance sectors in evaluating the relationship between the assessed ERM process maturity and operating performance.

3. Hypothesis development

COSO-ERM (2004), Lam (2001), Tonello (2007), and many others suggest that effective risk management should lead to enhanced operational performance. Despite these explicit predictions, to our knowledge, only two studies (Baxter et al., 2013; McShane et al., 2011) have evaluated the influence of ERM processes on operating performance. However the samples of the aforementioned studies were primarily limited to firms within financial and insurance sectors and due to extensive industry regulations are not generalizable to other industries. This study expands on these prior studies by evaluating the influence of the ERM process maturity stage on operating performance across a broad sample of industries. Although our study is most closely related to McShane et al. (2011) in consideration of ERM maturity, our sample window is longer, more diversified across industries other than insurance and focuses on operating performance as opposed to firm value (Tobin's Q). As a result our study is generalizable to various industries and is focused on operational performance that should allow for more control in managing risk.

3.1. Operational performance benefits

Organizations can establish a low level risk appetite in order to reduce downside losses at the cost of reducing opportunities for investing in upside profitable opportunities. Alternatively, in attempting to achieve high returns, firms can focus myopically on upside opportunities while not completely evaluating the potential for extreme losses. The integration of risk identification, assessment, and response throughout the entire organization allows firms with mature ERM processes to attempt to mitigate tunnel vision on profitability thereby reducing the likelihood of accepting too much risk and exposing the firm to excessive downside risk. While this approach may discourage firms from investing in potential risky high return projects, it is also expected to mitigate against extreme loss events. Consistent with the sixth premise of the COSO-ERM Framework, improving the deployment of capital, we argue that ERM adoption will lead to increased return on capital (ROA and ROE).

Therefore firms with mature ERM processes will logically experience higher operating performance (e.g. ROA) than firms that have not implemented ERM. Furthermore, firms with more mature or advanced ERM activities should also experience higher ROA than those in earlier

[9] Similar to our sample, McShane et al. (2011) had very few observations (5 of 72 total observations) at the most advanced end of the maturity scale. Such a small number of observations may have reduced the power and the likelihood of finding results for firms with the most mature ERM processes.

[10] The McShane et al. (2011) and Hoyt and Liebenberg (2011) samples were restricted to the insurance industry while Baxter et al. (2013) included insurance and financial institutions. The representation of firm years in financial, insurance, and utilities in the Beasley et al. (2008), Gordon et al. (2009), and Pagach and Warr (2010, 2011) studies ranged from 55 to 71%. Due to such high industry concentration and the regulation of these industries, the results of the aforementioned studies have limited generalizability.

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stages or not having adopted ERM practices. This leads to our basic hypothesis stated in the alternative form:

H1. There is a cross-sectional positive association between ERM maturity and industry-adjusted ROA and ROE.

4. Methodology and sample selection

Barton et al. (2012) indicate that for ERM to be effective, it cannot be stagnant, but instead it "should be organic and alive." Consistent with this point, we use a unique data set obtained via a web-based survey of internal audit management of U.S. based publicly traded firms that provides an assessment of ERM maturity for each year during a three year period.[11] Survey responses were then matched to archival financial statement data obtained from the Compustat database. We construct an operating performance panel dataset and use regression models over the three year period from 2006 to 2008 corresponding to the survey data.

As a result of rare public disclosure of ERM process maturity[12] prior to Standard & Poor's incorporating ERM Quality Ratings into their credit rating process for financial and insurance institutions in 2006, researchers primarily used the appointment of Chief Risk Officers as a proxy for the adoption of ERM processes. As a result, prior studies have been limited by potentially noisy proxies and limited generalizability. The current study attempts to reduce and control for potential noise by obtaining survey responses from Internal Audit Function management regarding whether the firm has specifically implemented ERM and the stage of ERM maturity for fiscal years 2006 through 2008. The maturity level related to each of COSO-ERM's four objectives (Strategy, Operations, Reporting, and Compliance) is also captured by survey responses.

4.1. ERM operational performance model

We follow Brown and Caylor's (2009) industry-adjusted performance model approach used to evaluate the impact of governance variables on performance and add several additional control variables from Holm et al. (2016) and Gordon et al. (2009). In this study, we test the association between operating performance metrics (industry-adjusted ROA and ROE) and the level of ERM process maturity as reported by survey respondents. ERM processes take multiple years to implement and the expectation is that each year, ERM processes would be more likely to remain stable or improve rather than regress.[13] We control for several statistical issues. Due to the diversity of industries as well as the changing economic conditions included in our sample, consistent with Brown and Caylor (2009), we adjust our operational performance measures by computing the industry median ROA and ROE. Consistent with Brown and Caylor (2009), we base our industry-adjustment on the 4-digit Global Industry Classification Standard (GICS) code.[14] Using the industry median-adjusted Return on Assets ($IndAdjROA_{i,t}$) and industry median-adjusted Return on Equity ($IndAdjROE_{i,t}$) as our operational performance metrics, we test the association between operating performance and the assessed maturity of ERM processes based on survey responses.

Applying our model, we evaluate the association between operational performance measures ($IndAdjROA_{i,t}$ and $IndAdjROE_{i,t}$) and test variables of interest that measure the assessed overall ($ERMOVR_{i,t}$) ERM process maturity, as well as the ERM process maturity as it relates to the four COSO objectives; operational ($ERMOPS_{i,t}$), strategic ($ERMSTRAT_{i,t}$), reporting ($ERMRPT_{i,t}$), and compliance ($ERMCOMP_{i,t}$). Observations based on survey responses include firms that have adopted ERM processes as well as those firms responding that they have not implemented ERM processes, our control group.[15] We transform the ordinal $ERMOVR_{i,t}$ maturity variable into a set of six binary variables, $ERM0_{i,t}$, $ERM1_{i,t}$, $ERM2_{i,t}$, $ERM3_{i,t}$, $ERM4_{i,t}$, and $ERM5_{i,t}$, corresponding to the assessed maturity level to evaluate whether an increasing positive relationship exists between the level of maturity and industry-adjusted operating performance. Lastly we code the square of $ERMOVR_{i,t}$, $ERMOVR^2_{i,t}$ to evaluate the potential of non-linearity of ERM maturity.

Consistent with Brown and Caylor (2009), we control for other factors expected to be related to operational performance including prior period performance ($ROA_{i,t-1}$ and $ROE_{i,t-1}$), firm growth opportunities ($lnBKMKT_{i,t}$) and size ($lnMVE_{i,t}$). Based on the industry-adjustment of the dependent variable, we use the firm specific non-adjusted lagged period ROA ($ROA_{i,t-1}$) or ROE ($ROE_{i,t-1}$) to control for prior period performance. To control for firm growth opportunities, we scale the natural log of firm book value by the natural log of market value of equity. We use the natural log of market value of equity ($lnMVE_{i,t}$) to control for firm size.[16] We also control for revenue growth ($SALE\_GROWTH_{i,t}$), the ratio of equity to assets ($EQRATIO_{i,t}$), and industry competition ($HHI\_GIC_{i,t}$) to control for additional variables found in Holm et al. (2016) to be associated with operating performance. Lastly, we control for two corporate governance variables, number of Board Meetings ($BOD\_MTG_{i,t}$) included in Gordon et al. (2009) and the ratio of independent board members to total board members ($BOD\_IND_{i,t}$). Utilizing control variables from Brown and Caylor (2009), Holm et al. (2016), and Gordon et al. (2009), we test the hypothesized operating performance benefits associated with ERM implementation, using the following model as presented in Eq. (1) below for our main analysis.[17]

$$\begin{aligned} IndAdjROA_{i,t}\ (\mathrm{ROE}_{i,t}) = {} & \alpha_{1+}\beta_1 \mathrm{ERMMaturityMeasure}_{i,t} \\ & + \beta_2 ROA(\mathrm{ROE})_{i,t-1} + \beta_3\ \ln BKMKT_{i,t} \\ & + \beta_4\ \ln MVE_{i,t} + \beta_5 SALE\_GROWTH_{i,t} \\ & + \beta_6\ EQRATIO_{i,t} + \beta_7 HHI\_GIC_{i,t} \\ & + \beta_8 BOD\_MTG_{i,t} + \beta_9 BOD\_IND_{i,t} + \varepsilon \end{aligned} \quad (1)$$

[11] Survey responses were captured in 2009 with respondents providing a rating of the maturity of their firms *Overall* ERM processes, as well as the maturity related to each objective (strategy, operations, reporting, compliance) for each year (2006, 2007, and 2008). See question 2 in Section IV of the survey questions in Appendix B.

[12] As of March 1, 2010, the SEC now requires firms to discuss the Board of Directors oversight of risk within the organization. Although within this disclosure some firms may or may not state that ERM has been implemented, there are no specific requirements to do so or provide any indication of when it was implemented or the maturity level rating of the processes (SEC 2009).

[13] In untabulated analysis, we note a positive and significant correlation between the $ERMOVR_{i,t}$ maturity variable and fiscal year dummy variables (FY2006, FY2007, FY2008) for the time period of the survey. In addition, we also perform an analysis of the correlation across current and lagged years within firms and find an increasing trend.

[14] In robustness tests, we adjust by 2-digit SIC code used in Barth, Beaver, and Landsman (1998) and find qualitatively similar results.

[15] We thank the assigned editor for pointing out that management of firms that would not expect the benefits of adoption to exceed the costs would not adopt ERM. As a result, firms electing not to adopt ERM should not likely differ in operating performance compared to those that do. This consideration would lessen the likelihood of results supporting our hypothesis. An additional consideration is that firms that have improved performance may be either more likely to respond to our survey or bias their response upward in favor of support of our hypotheses.

[16] Other recent studies evaluating firm performance (Ramaswamy & Waegelein, 2003; Cheng, Evans, & Nagarajan, 2008; and Jiao & Ye, 2013) have considered additional control variables specifically related to their study. As with these prior studies, we control for industry differences within our dependent variable by adjusting our operating performance measures (ROA and ROE) by the respective median industry measure. Common amongst the control variables within these studies is firm size and lagged operating performance. Brown and Caylor (2009) focused specifically on evaluating the association between specific components of corporate governance and operating performance. Considering that risk management is a component of corporate governance, we present our main results based on the Brown and Caylor (2009) model and the additional control variables discussed above.

[17] In untabulated results, we also use the Brown and Caylor (2009) model with the exclusion of the 51 individual Governance Provision measures and find qualitatively similar results.

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where the dependent variables and hypothesized independent variables of primary interest are defined as:

IndAdjROA$_{i,t}$ – Industry-adjusted ROA – the difference between firm i's ROA and the median average ROA of available firms within the same 4 digit Global Industry Classification Standard (GIC group) code as firm *i*, at time *t*, where ROA is defined as follows:
ROA$_{i,t}$ – income before extraordinary items (available for common stockholders - Compustat Annual Data Item 237) scaled by total assets (Compustat Annual Data Item 6).
IndAdjROE$_{i,t}$ – Industry-adjusted ROE – the difference between firm i's ROE and the median average ROE of available firms within the same industry classification (GIC group) as firm *i*, at time *t*, where ROA is defined as follows:
ROE$_{i,t}$ – income before extraordinary items (available for common stockholders - Compustat Annual Data Item 237) scaled by the sum of the total common book value of equity (Compustat Annual Data Item 60) and deferred taxes (Compustat Annual Data Item 74).
ERMMaturityMeasure$_{i,t}$ – one of six measures (*ERMOVR*$_{i,t}$, *ERMOPS*$_{i,t}$, *ERMSTRAT*$_{i,t}$, *ERMRPT*$_{i,t}$, *ERMCOMP*$_{i,t}$, ERM1–ERM5) of the ERM process maturity level assessed on a six-point ordinal scale by survey respondents assuming one of the following six values defined by Control Objectives for Information Related Technology (COBIT): The value of 5, for "Optimized"; 4, for "Managed and Measurable"; 3, for "Defined Process"; 2, for "Repeatable but Intuitive"; 1, for "Initial/Adhoc"; and 0, for "Non-Existent" ERM processes.[18]

- *ERMOVR*$_{i,t}$ - ERM Overall is a measure of the survey respondents rating of the overall ERM maturity based on a six point scale provided above for year t.
- *ERMOPS*$_{i,t}$, — ERM Operations is a measure of the survey respondents assessed rating of the maturity of ERM processes related to Operational risk for year t.
- *ERMSTRAT*$_{i,t}$, — ERM Strategy is a measure of the survey respondents assessed rating of the maturity of ERM processes related to Strategic risk for year t.
- *ERMRPT*$_{i,t}$, — ERM Reporting is a measure of the survey respondents assessed rating of the maturity of ERM processes related to Reporting risk for year t.
- *ERMCOMP*$_{i,t}$, — ERM Compliance is a measure of the survey respondents assessed rating of the Compliance maturity of ERM processes related to risk for year t.
- ERM1–ERM5$_{i,t}$ – is a set of six dummy variables coded as 1 when the *ERMOVR* maturity level equals that of the trailing number, ERM1, ERM2, ERM3, ERM4, ERM5; else coded 0.
- *ERMOVR*$^2_{i,t}$ – is a dummy variable coded as the squared value of *ERMOVR* for year t.

with control variables defined as:

ROA$_{i,t-1}$– the lagged value of ROA.
ROE$_{i,t-1}$ – the lagged value of ROE.
lnBKMKT$_{i,t}$ – the natural log of the ratio of Book Value of Equity (Compustat Annual Data Item 60 (CEQ) + Compustat Annual Data Item 74 (TXDB)) to market value of equity (Compustat Annual Data Item 199(PRCC)) ∗ (Compustat Annual Data Item 25(CSHO)).
lnMVE$_{i,t}$ – the natural log of market value of equity (Compustat Annual Data Item 199(PRCC)) ∗ (Compustat Annual Data Item 25(CSHO)).
SALE_GROWTH$_{i,t}$ – 1 year change in sales (Compustat Annual Data Item 117(SALE)) computed as ((SALE — SALE$_{t-1}$) / SALE$_{t-1}$);
EQRATIO$_{i,t}$ – the ratio of book value of equity Compustat Annual Data Item 60 (CEQ) to total assets (Compustat Annual Data Item 6 (AT));
HHI_GIC$_{i,t}$ – Herfendahl Index for Industry Concentration based on 2-digit GIC Group (sum of the Square of Market Share for all firms within an industry where market share equals company sales((Compustat Annual Data Item 117(SALE))/total sales of all firms within the industry).
BOD_MTG$_{i,t}$ – the number of board meetings held for a given fiscal year (obtained from the Bloomberg database and hand collection from the SEC Edgar website at sec.gov).
BOD_IND$_{i,t}$ – the percentage of the board members that are considered independent board members for a given fiscal year (obtained from the Bloomberg database).

4.2. Sample selection

An on-line survey was sent via email to internal audit function management level employees at 1631 firms throughout the U.S. and other countries identified via web-based key word searches for internal audit management titles.[19] The survey and follow-up requests were emailed between July and October 2009. This resulted in 496 responses received from survey respondents (30.4% response rate) as a potential sample. However, thirty-nine firms did not provide an ERM maturity response for each of the five ERM objectives (*ERMOVR*, *ERMOPS*, *ERMSTRAT*, *ERMCOMP*, *ERMRPT*) for at least one year (2006, 2007, or 2008). Another 242 were firms not able to match to Compustat (e.g. not publicly traded firms or foreign firms not in Compustat) with complete responses. An additional 34 firms within the Finance and Insurance industries (SIC 6000–6999) were eliminated from the sample due to regulatory differences related to these industry segments. Seven firms were missing financial data from Compustat, while board data was not found for twelve firms needed to compute regression variables and were therefore eliminated resulting in a sample of 162 firms (427 firm year observations) for the ROA and ROE models (Table 1: Panel A). Although the number of firms included in our sample is consistent with prior studies (e.g. Gordon et al. (2009) 112 ERM firms matched to 112 non-ERM firms), the sample is larger (e.g. 427 firm year observations compared to 224 in Gordon et al. (2009)) as a result of multiple observations per firm (up to three observations). Panel B of Table 1 provides an overview of the sample including the number of responses and mean ERM process maturity level classified by GIC industry classification and fiscal year. Using all available Compustat observations within these industry classifications, we compute our industry-adjusted operating performance measures (*IndAdjROA*$_{i,t}$, *IndAdjROE*$_{i,t}$). The Industry classifications comprising the largest percentage of survey responses include Capital Goods (13%), Materials (12%) and Energy (10%).[20] The industries indicating the most mature ERM processes are Food, Beverage, and Tobacco (3.00), Commercial & Professional Services (2.67), and Real Estate (2.67), whereas Media (0.50), Telecommunication Services (0.75), and Pharmaceutical, Biotechnology, and Life Sciences (1.09) reported the lowest ERM Overall maturity.

5. Results

The descriptive statistics for the sample, presented in Table 2, provide an overview of the variables included in the study. Analysis of

[18] Expanded definitions of the stage of ERM process activities were included in the survey as a measure of the maturity of the ERM adoption. The descriptions used in the survey for these six classifications (adopted from COBIT) are as follows: 0 - Non-existent – Management processes are not applied at all; 1 – Initial/Adhoc – Processes are ad hoc and disorganized; 2 – Repeatable but Intuitive – Processes follow a regular pattern; 3 – Defined Process – Processes are documented and communicated; 4 - Managed and Measureable – Processes are monitored and measured; 5 – Optimized – Good processes are followed and automated.

[19] Keyword searches focused on Internal Audit Function titles including "Chief Audit Executive", "CAE", "Vice President of Internal Audit", "Internal Audit Vice President", "Director of Internal Audit", and "Internal Audit Director" using Google and Lexis/Nexus search engines.

[20] Banks (GIC 4010), Diversified Financials (GIC 4020), and insurance (GIC 4030) observations are excluded from the study as a result of industry regulation.

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Table 1
Sample section and industry distribution.

(Panel A): Sample selection and industry distribution.

	Observations
Total Firms Surveyed	1631
Total Survey Responses	496
Less Firms without ERM Response (for *ERMOVR*, OPS, STRAT, RPT, and COMP)	(39)
Less Firms not matched to Compustat Non-Public Firm/Foreign Firm Responses	(242)
Less Firms in the Finance or Insurance Industry	(34)
Less Firms missing Compustat data	(7)
Less Firms missing Board Data (*BOD_MTG*, *BOD_INDP*)	(12)
Final Sample Firms	162

Panel B: Sample industry distribution and assessed ERM overall maturity by year.

	FY2006		FY2007		FY2008		FY2006–FY2008		
Industry classification	N	*ERMOVR*	N	*ERMOVR*	N	*ERMOVR*	N	*ERMOVR*	% Total
Energy	11	1.636	15	1.533	16	2.250	42	1.833	10%
Materials	16	1.625	18	2.056	18	2.500	52	2.077	12%
Capital Goods	16	1.375	17	1.706	22	2.318	55	1.855	13%
Commercial & professional services	3	2.333	3	2.667	3	3.000	9	2.667	2%
Transportation	9	2.111	10	2.400	11	3.182	30	2.600	7%
Automobiles & components	3	2.333	4	2.000	3	2.333	10	2.200	2%
Consumer durables & apparel	10	1.500	10	2.200	7	2.857	27	2.111	6%
Consumer services	9	1.111	10	1.300	10	2.600	29	1.690	7%
Media	2	0.000	2	0.000	2	1.500	6	0.500	1%
Retailing	9	1.556	10	1.800	10	2.200	29	1.862	7%
Food & staples retailing	1	0.000	2	1.500	2	2.000	5	1.400	1%
Food, beverage & tobacco	2	3.000	2	3.000	2	3.000	6	3.000	1%
Household & personal products	1	2.000	1	2.000	2	2.500	4	2.250	1%
Health care equipment & services	3	1.333	4	2.000	5	2.400	12	2.000	3%
Pharma. biotech. & life sciences	4	0.750	4	0.750	3	2.000	11	1.091	3%
Real estate	2	2.000	2	3.000	2	3.000	6	2.667	1%
Software & services	4	0.750	7	1.714	6	1.833	17	1.529	4%
Technology hardware & equipment	7	1.571	7	2.143	8	2.250	22	2.000	5%
Semiconductors & semicond. equip.	4	2.000	4	2.500	4	2.500	12	2.333	3%
Telecommunication services	1	1.000	2	0.500	1	1.000	4	0.750	1%
Utilities	12	1.417	13	1.692	14	2.571	39	1.923	9%
Average mean *ERMOVR*/total observations	129	1.527	147	1.837	151	2.444	427	1.958	100%

N is the number of observations within each industry and period. *ERMOVR* is the survey participant assessed level of ERM process maturity based on a six-point ordinal scale, Detail of each maturity level is identified in Appendix A.

descriptive statistics indicates that the average market value of equity of the firms within the sample is approximately $7.4 billion with an average $IndAdjROA_{i,t}$ of 3.2% and $IndAdjROE_{i,t}$ of 13.9%. The average of the $ERMOVR_{i,t}$ variable is 1.96, which indicates that on average respondents indicated the maturity level of sample firms is "Repeatable but Intuitive" process maturity. As expected, the overall maturity level of firms is fairly consistent with that of the individual ratings of the COSO ERM objectives of Operations ($ERMOPS_{i,t}$ (1.88)), Strategy ($ERMSTRAT_{i,t}$ (1.82)), Reporting ($ERMRPT_{i,t}$ (2.20)), and Compliance ($ERMCOMP_{i,t}$ (2.19)).

Panel B of Table 2 provides mixed evidence of a positive association between overall ERM process maturity ($ERMOVR_{i,t}$) and enhanced operating performance. In general, firms assessing their ERM maturity ($ERMOVR_{i,t}$) as "2-Repeatable but Intuitive" perform worse than those assessing ERM process maturity as "1-Initial/Adhoc" and "0-Non-existent" in some cases.[21] One potential cause for this inconsistency is the high variation in the mean value of ROE across years and ERM maturity levels presented in Table 2 (Panel A and Panel B). On the surface, the lack of a consistent increasing ROA by ERM maturity level is in contrast to our hypothesis. To augment our analyses, we perform additional analysis to test our hypothesis.

Table 3 provides the Pearson correlation matrices for variables included in the operational performance models. The correlations between the industry-adjusted return on assets and equity ($IndAdjROA_{i,t}$ and $IndAdjROE_{i,t}$ respectively) and ERM maturity measures are neither consistently positive nor significant,[22] however the correlation between the lagged raw measure of ROA ($ROA_{i,t-1}$) and all measures of ERM maturity are both positive and significant (p-value < 0.1). The correlation between the lagged raw value of ROE ($ROE_{i,t-1}$) and ERM maturity are positive for all measures of ERM maturity, but only significant (p-value <0.1) for $ERMCOMP_{i,t}$. With the exception of industry concentration ($HHI\_GIC_{i,t}$), and measures of board governance ($BOD\_MTG_{i,t}$ and $BOD\_IND_{i,t}$) all control variables included in the model are significantly correlated with industry-adjusted Return on Assets ($IndAdjROA_{i,t}$), however, only the $lnBKMKT_{i,t}$, $EQRATIO_{i,t}$, and $BOD\_MTG_{i,t}$ are significantly correlated with industry-adjusted Return on Equity ($IndAdjROE_{i,t}$). The consistent positive correlation between ERM maturity measures and lagged Return on Assets ($ROA_{i,t-1}$) provides limited support of a positive association between ERM maturity and operating performance in support for first hypothesis.

5.1. Operating performance models

5.1.1. Industry-adjusted ROA

We test H1 by evaluating the association between ERM maturity and operating performance by estimating Eq. (1) on multiple assessed

[21] The sample only included 4 usable observations that indicated an optimized level of ERM process maturity (*ERM5*).

[22] The only significant correlation is between ERMRPT and IndAdjROE (p-value < 0.05).

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Table 2
Descriptive Statistics.

Panel A: Descriptive statistics – full sample by year.

Variable	FY2006		FY2007		FY2008		FY2006–FY2008	
	n = 129		n = 147		n = 151		n = 427	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
ERMOVR	1.527	1.341	1.837	1.314	2.444	1.258	1.958	1.354
ERMOPS	1.380	1.415	1.782	1.436	2.397	1.362	1.878	1.461
ERMSTRAT	1.248	1.250	1.762	1.305	2.351	1.287	1.815	1.355
ERMRPT	1.636	1.515	2.156	1.560	2.715	1.430	2.197	1.561
ERMCOMP	1.752	1.526	2.109	1.504	2.656	1.419	2.194	1.524
ERM0	0.287	0.454	0.190	0.394	0.093	0.291	0.185	0.389
ERM1	0.264	0.442	0.245	0.431	0.126	0.333	0.208	0.407
ERM2	0.194	0.397	0.231	0.423	0.272	0.446	0.234	0.424
ERM3	0.155	0.363	0.211	0.409	0.278	0.450	0.218	0.413
ERM4	0.093	0.292	0.116	0.321	0.219	0.415	0.145	0.353
ERM5	0.008	0.088	0.007	0.082	0.013	0.115	0.009	0.096
IndAdjROA	0.042	0.074	0.034	0.093	0.021	0.138	0.032	0.107
ROA_{t-1}	0.044	0.081	0.049	0.085	0.047	0.072	0.047	0.079
IndAdjROE	0.312	2.441	0.137	0.902	−0.006	0.669	0.139	1.498
ROE_{t-1}	0.139	0.501	0.342	2.317	0.160	0.879	0.217	1.482
lnBKMKT	−0.887	0.842	−0.820	0.849	−0.267	0.819	−0.645	0.881
lnMVE	8.047	1.481	7.952	1.504	7.459	1.638	7.806	1.564
SALE_GROWTH	0.129	0.221	0.059	0.159	0.098	0.224	0.094	0.204
EQRATIO	0.428	0.174	0.407	0.174	0.391	0.178	0.408	0.176
HHI_GIC	0.035	0.020	0.037	0.022	0.037	0.023	0.036	0.022
BOD_MTG	8.798	4.578	9.170	5.232	9.000	4.960	8.998	4.936
BOD_IND	0.788	0.121	0.803	0.103	0.817	0.097	0.804	0.107

The above table provides the mean and standard deviation (Std. Dev.) by year for all model variables by year and for the entire period based on the full Industry Adjusted ROA Sample (n = 427). All variables are defined in Appendix A. n is the number of observations within each correspondent periods.

Panel B: Mean ROA by ERM maturity (*ERMOVR*) and year (FY2006–FY2008).

ERMOVR	FY2006			FY2007			FY2008			FY2006–FY2008		
	n	ROA	IndAdj ROA	n	ROA	IndAdj ROA	n	ROA	IndAdj ROA	n	ROA	IndAdj ROA
0	37	0.039	0.032	28	0.034	0.044	14	−0.042	−0.007	79	0.023	0.029
1	34	0.065	0.052	36	0.043	0.030	19	0.014	0.013	89	0.045	0.035
2	25	0.052	0.054	34	0.023	0.022	41	0.010	0.010	100	0.025	0.025
3	20	0.054	0.028	31	0.061	0.041	42	0.010	0.030	93	0.037	0.033
4	12	0.069	0.037	17	0.054	0.037	33	0.048	0.047	62	0.054	0.042
5	1	0.121	0.083	1	−0.019	−0.022	2	−0.084	−0.079	4	−0.016	−0.025
Total/Mean	129	0.054	0.042	147	0.041	0.034	151	0.013	0.021	474	0.035	0.032

Panel C: Mean ROE by ERM maturity (*ERMOVR*) and year (FY2006-FY2008).

ERMOVR	FY2006			FY2007			FY2008			FY2006–FY2008		
	n	ROE	IndAdj ROE	n	ROE	IndAdj ROE	n	ROE	IndAdj ROE	n	ROE	IndAdj ROE
0	37	0.078	0.072	28	−0.029	−0.019	14	−0.180	−0.145	79	−0.006	0.001
1	34	0.146	0.133	36	0.087	0.075	19	−0.088	−0.089	89	0.072	0.062
2	25	1.138	1.140	34	0.103	0.102	41	0.074	0.074	100	0.350	0.350
3	20	0.166	0.140	31	0.146	0.126	42	−0.125	−0.105	93	0.028	0.024
4	12	0.163	0.131	17	0.656	0.638	33	0.159	0.158	62	0.296	0.285
5	1	0.232	0.193	1	−0.216	−0.219	2	−0.490	−0.485	4	−0.241	−0.249
Total/Mean	129	0.324	0.312	147	0.145	0.137	151	−0.014	−0.006	474	0.143	0.139

The above table provides the distribution of firms self-assessed level of overall ERM process maturity (*ERMOVR*) within each category within each year and in summary. The table also provides the mean *ROA*, industry-adjusted ROA (*IndAdjROA*), *ROE*, industry-adjusted ROE (*IndAdjROE*) for each maturity classification and year. For example there were only 4 responses across years (FY2006 (1), FY2007 (1), and FY2008 (2)) that indicated their firms ERM processes were a level "5-Optimized".

measures of ERM maturity. Our results are presented in Table 4 (Panel A (full sample) and Panel B (restricted sample based on $ROE_{i,t}$)). Consistent with hypothesis 1, the variables of interest in the regression, $ERMOVR_{i,t}$, $ERMOPS_{i,t}$, $ERMSTAT_{i,t}$, $ERMRPT_{i,t}$, and $ERMCOMP_{i,t}$, each yield a positive and significant (p-value <0.05) association with Industry-adjusted ROA. Additional analysis of binary coded maturity variables results indicate a difference in the association between overall ERM process maturity rated as "defined process" (*ERM3*) (significant at $p = 0.01$) and "managed and measurable" (*ERM4*) (significant at $p < 0.01$) compared to firms that assessed their ERM maturity as "non-existent" ERM (*ERM0*) maturity.[23] Squaring the $ERMOVR_{i,t}$ variable ($ERMOVR^2_{i,t}$) allows testing of a potential non-linear exponential relationship of ERM on operating performance. The last column of Table 4 provides the results of this test supporting a non-linear positive association (significance at p-value < 0.10). These results provide consistent support with the hypothesis that enhanced maturity of ERM processes is associated with greater operating performance. With respect to our control variables, we find a significant negative association between Industry-adjusted ROA and lagged ROA (ROA_{t-1}) and industry concentration (*HHI_GIC*). Size ($lnMVE_{i,t}$), Book to Market ($lnBKMKT_{i,t}$), and the ratio of Equity to Total Assets ($EQRATIO_{i,t}$) are positive and significant across all ROA models. Our other three control variables sales growth (*SALE_GROWTH*), the number of board meetings ($BOD\_MTG_{i,t}$), and board independence ($BOD\_IND_{i,t}$) are positive, but not significant in any of the variations of the models.

[23] Given the limited number of observations (4) where *ERMOVR* was assessed as a level of "optimal" (*ERM5*), we make no inferences as to the negative and insignificant coefficient.

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Table 3
Correlation table.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1)	*IndAdjROA*	1.000															
(2)	*IndAdjROE*	0.226	1.000														
		(0.000)															
(3)	*ERMOVR*	0.013	0.036	1.000													
		(0.786)	(0.454)														
(4)	*ERMOPS*	−0.001	0.012	0.866	1.000												
		(0.983)	(0.812)	(0.000)													
(5)	*ERMSTRAT*	−0.013	0.007	0.807	0.830	1.000											
		(0.789)	(0.885)	(0.000)	(0.000)												
(6)	*ERMRPT*	0.026	0.102	0.824	0.747	0.728	1.000										
		(0.597)	(0.035)	(0.000)	(0.000)	(0.000)											
(7)	*ERMCOMP*	0.008	−0.008	0.813	0.742	0.675	0.749	1.000									
		(0.861)	(0.869)	(0.000)	(0.000)	(0.000)	(0.000)										
(8)	ROA_{t-1}	0.197	0.055	0.126	0.167	0.094	0.131	0.137	1.000								
		(0.000)	(0.256)	(0.009)	(0.001)	(0.051)	(0.007)	(0.005)									
(9)	ROE_{t-1}	0.069	0.044	0.057	0.055	0.069	0.114	0.049	0.048	1.000							
		(0.152)	(0.361)	(0.240)	(0.261)	(0.155)	(0.019)	(0.311)	(0.325)								
(10)	*lnBKMKT*	−0.386	−0.368	0.031	0.060	0.089	0.035	0.010	−0.099	−0.169	1.000						
		(0.000)	(0.000)	(0.527)	(0.212)	(0.065)	(0.466)	(0.834)	(0.041)	(0.000)							
(11)	*lnMVE*	0.320	0.056	0.175	0.214	0.176	0.137	0.141	0.260 (0.000)	0.021	−0.332	1.000					
		(0.000)	(0.248)	(0.000)	(0.000)	(0.000)	(0.005)	(0.004)		(0.670)	(0.000)						
(12)	*SALE_GROWTH*	0.258	−0.016	−0.139	−0.111	−0.105	−0.107	−0.126	0.024	0.000	−0.110	0.016	1.000				
		(0.000)	(0.745)	(0.004)	(0.021)	(0.031)	(0.027)	(0.009)	(0.621)	(0.992)	(0.023)	(0.743)					
(13)	*EQRATIO*	0.151	−0.098	−0.011	−0.019	−0.020	0.018	0.035	0.147	−0.140	0.186	−0.026	0.121	1.000			
		(0.002)	(0.042)	(0.826)	(0.697)	(0.686)	(0.718)	(0.472)	(0.002)	(0.004)	(0.000)	(0.596)	(0.012)				
(14)	*HHI_GIC*	−0.004	−0.072	0.002	−0.013	−0.002	−0.004	0.081	0.008	−0.038	−0.057	−0.032	0.014	0.054	1.000		
		(0.927)	(0.135)	(0.974)	(0.789)	(0.964)	(0.934)	(0.093)	(0.865)	(0.431)	(0.244)	(0.511)	(0.772)	(0.267)			
(15)	*BOD_MTG*	0.003	0.099	−0.049	−0.033	−0.032	−0.033	−0.042	−0.006	0.068	−0.047	−0.061	−0.008	0.060	0.024	1.000	
		(0.946)	(0.042)	(0.314)	(0.502)	(0.510)	(0.492)	(0.387)	(0.910)	(0.163)	(0.329)	(0.208)	(0.870)	(0.215)	(0.617)		
(16)	*BOD_IND*	0.030	−0.014	0.199	0.207	0.205	0.182	0.171	0.042	−0.022	0.062	0.073	−0.092	−0.005	0.054	−0.003	1.000
		(0.531)	(0.775)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.385)	(0.643)	(0.204)	(0.134)	(0.056)	(0.919)	(0.261)	(0.956)	

The above table provides the Pearson correlation for all model variables. Appendix A provides the definition of each variable. p-Values are included in parentheses below correlation coefficients.

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Table 4
The Association between ERM and Industry adjusted ROA.

Panel A: – Unconstrained ROA model-industry adjustment by GIC Group Dependent Variable = *IndAdjROA*.

Variable	*ERMOVR*	*ERMOPS*	*ERMSTRAT*	*ERMRPT*	*ERMCOMP*	ERM1–ERM5	$ERMOVR^2$
ERMOVR	0.010**						
	[0.017]						
ERMOPS		0.012***					
		[0.007]					
ERMSTRAT			0.013***				
			[0.002]				
ERMRPT				0.010***			
				[0.004]			
ERMCOMP					0.013***		
					[0.001]		
ERM1						0.019	
						[0.151]	
ERM2						0.021	
						[0.111]	
ERM3						0.041***	
						[0.010]	
ERM4						0.053***	
						[0.003]	
ERM5						−0.005	
						[0.832]	
$ERMOVR^2$							0.002*
							[0.071]
ROA_{t-1}	−0.165***	−0.171***	−0.162***	−0.172***	−0.180***	−0.181***	−0.164***
	[0.002]	[0.001]	[0.002]	[0.001]	[0.000]	[0.001]	[0.003]
lngBKMKT	0.032**	0.029**	0.029**	0.031**	0.032**	0.031**	0.033**
	[0.025]	[0.048]	[0.043]	[0.028]	[0.023]	[0.026]	[0.022]
lnMVE	0.075***	0.073***	0.075***	0.074***	0.075***	0.075***	0.075***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
SALE_GROWTH	0.031	0.032	0.034	0.032	0.031	0.027	0.030
	[0.268]	[0.257]	[0.235]	[0.269]	[0.277]	[0.360]	[0.277]
EQRATIO	0.153**	0.167**	0.165**	0.155**	0.161**	0.160**	0.151**
	[0.042]	[0.026]	[0.024]	[0.033]	[0.027]	[0.029]	[0.046]
HHI_GIC	−3.007**	−3.072**	−3.083**	−2.983**	−3.122***	−2.974**	−2.901**
	[0.012]	[0.011]	[0.011]	[0.014]	[0.009]	[0.010]	[0.016]
BOD_MTG	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	[0.140]	[0.170]	[0.101]	[0.184]	[0.110]	[0.221]	[0.131]
BOD_INDP	0.070	0.062	0.061	0.069	0.074	0.075	0.076
	[0.237]	[0.297]	[0.307]	[0.248]	[0.211]	[0.203]	[0.205]
Constant	−0.569***	−0.552***	−0.567***	−0.562***	−0.577***	−0.578***	−0.564***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
R-squared	0.369	0.372	0.378	0.372	0.379	0.380	0.364
F-Value	8.334	8.436	8.606	9.001	9.073	7.272	8
Observations	427	427	427	427	427	427	427

Results in Panel A of Table 4 are from OLS Panel estimate of Eq. (1). The dependent variable for all models is the median industry (using GIC Groups) adjusted ROA. Variables of interest are *ERMOVR* the overall assessed maturity of ERM processes, *ERMOPS*, *ERMSTRAT*, *ERMRPT*, and *ERMCOMP* the assessed maturity of ERM processes related to Operations, Strategy, Compliance, and Reporting respectively; ERM1–5 are coded as 1 if *ERMOVR* maturity was assessed at the corresponding maturity level and 0 otherwise, and ERM-SQ is a non-linear transformation of the *ERMOVR* assessed maturity. The full sample model contains 427 firm-year observations based on 162 unique firms. Robust two-tailed p-values are presented in brackets, where ***p < 0.01, **p < 0.05, *p < 0.1.

Panel B: Constrained ROA model-industry adjustment by GIC Group Sample Restricted to firm-year observations where abs(ROE) < 0.30 Dependent Variable = *IndAdjROA*.

Variable	*ERMOVR*	*ERMOPS*	*ERMSTRAT*	*ERMRPT*	*ERMCOMP*	ERM1–ERM5	$ERMOVR^2$
ERMOVR	0.015***						
	[0.000]						
ERMOPS		0.015***					
		[0.000]					
ERMSTRAT			0.015***				
			[0.000]				
ERMRPT				0.013***			
				[0.000]			
ERMCOMP					0.015***		
					[0.000]		
ERM1						0.014*	
						[0.061]	
ERM2						0.027***	
						[0.003]	
ERM3						0.045***	
						[0.000]	
ERM4						0.071***	
						[0.000]	
ERM5						0.015	
						[0.100]	
$ERMOVR^2$							0.004***
							[0.000]
ROA_{t-1}	−0.136**	−0.153**	−0.140**	−0.149**	−0.167**	−0.131*	−0.120*

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Table 4 (*continued*)

Panel B: Constrained ROA model-industry adjustment by GIC Group Sample Restricted to firm-year observations where abs(ROE) < 0.30 Dependent Variable = *IndAdjROA*.

Variable	*ERMOVR*	*ERMOPS*	*ERMSTRAT*	*ERMRPT*	*ERMCOMP*	ERM1–ERM5	$ERMOVR^2$
	[0.046]	[0.025]	[0.034]	[0.031]	[0.012]	[0.067]	[0.089]
lnBKMKT	0.013	0.015	0.015	0.016	0.017	0.015	0.019
	[0.446]	[0.366]	[0.361]	[0.339]	[0.318]	[0.397]	[0.281]
lnMVE	0.034*	0.037**	0.039**	0.036**	0.037**	0.036**	0.038**
	[0.058]	[0.044]	[0.034]	[0.047]	[0.049]	[0.049]	[0.043]
SALE_GROWTH	0.036	0.032*	0.036**	0.034*	0.032*	0.032*	0.031*
	[0.037]	[0.053]	[0.042]	[0.060]	[0.073]	[0.065]	[0.055]
EQRATIO	0.153***	0.148**	0.138**	0.133**	0.140**	0.156***	0.146**
	[0.009]	[0.014]	[0.016]	[0.021]	[0.016]	[0.008]	[0.014]
HHI_GIC	−1.489*	−1.508*	−1.462*	−1.406	−1.515*	−1.528*	−1.331
	[0.079]	[0.084]	[0.080]	[0.113]	[0.073]	[0.078]	[0.116]
BOD_MTG	−0.000	−0.001	−0.000	−0.001	−0.000	−0.000	−0.000
	[0.382]	[0.294]	[0.456]	[0.258]	[0.430]	[0.456]	[0.408]
BOD_INDP	0.039	0.030	0.034	0.037	0.043	0.037	0.039
	[0.329]	[0.448]	[0.395]	[0.362]	[0.294]	[0.342]	[0.330]
Constant	−0.293**	−0.299**	−0.320***	−0.295**	−0.309**	−0.310**	−0.318**
	[0.015]	[0.014]	[0.010]	[0.015]	[0.016]	[0.013]	[0.012]
R-squared	0.316	0.317	0.324	0.308	0.313	0.331	0.307
F-Value	4.728	4.800	5.139	5.494	5.377		4.412
Observations	360	360	360	360	360	360	360

Results in Panel B of Table 4 are from OLS Panel estimate of Eq. (1). The dependent variable for all models is the median industry (using GIC Groups) adjusted ROA. Variables of interest are *ERMOVR* the overall assessed maturity of ERM processes, *ERMOPS*, *ERMSTRAT*, *ERMRPT*, and *ERMCOMP* the assessed maturity of ERM processes related to Operations, Strategy, Compliance, and Reporting respectively; ERM1–5 are coded as 1 if *ERMOVR* maturity was assessed at the corresponding maturity level and 0 otherwise, and ERM-SQ is a non-linear transformation of the *ERMOVR* assessed maturity. To minimize the influence of outliers, the reduced sample is restricted to firms with an absolute value of ROE that is <0.30 containing 360 firm-year observations based on 152 unique firms. Robust two-tailed *p*-values are presented in brackets, where ***p < 0.01, **p < 0.05, *p < 0.1.

To mitigate the risk that our results are attributable to performance that represents outliers, we restrict an alternative sample to firm-year observations where the absolute value of $ROE_{i,t}$ is <0.3.[24] Results of the constrained sample for Industry-adjusted ROA are presented in Panel B of Table 4. The coefficients on $ERMOVR_{i,t}$, $ERMOPS_{i,t}$, $ERMSTAT_{i,t}$, $ERMRPT_{i,t}$, and $ERMCOMP_{i,t}$, are both positive and significant (p-value < 0.01) for each variable of interest. Furthermore, the coefficients on the individual maturity levels, ERM2–ERM4 are positive and significantly (p-value <0.01) different from firms that assessed their ERM maturity as "non-existent" ERM (ERM0). Furthermore the coefficients increase according to the maturity level indicating increased maturity is associated with better performance.[25] Lastly, the coefficient on $ERMOVR^2_{i,t}$ is positive and significant (p-value < 0.01).

Overall the results of the constrained sample provide support for the robustness of the full-sample model in support of a positive association between ERM maturity and operating performance as measured as industry-adjusted ROA.

5.1.2. Industry-adjusted ROE

Panel A of Table 5 presents the results of the industry-adjusted ROE model. The coefficients of all variables of interest are positive, however none of the coefficients are significant and therefore do not support Hypothesis 1. Consistent with the *IndAdjROA* performance regression results, the lagged operating performance measure ($ROE_{i,t-1}$) is negative and significant in all models, while our measure of industry concentration ($HHI\_GIC_{i,t}$) though negative is not significant within the unconstrained industry-adjusted ROE model. Unlike the results of the full sample *IndAdjROA* model (Table 4 – Panel A), the coefficients on the control variables for growth ($lnBKMKT_{i,t}$) and size ($lnMVE_{i,t}$) are not significant in any of the model variations. One potential reason for the significant difference in results between the two measures ($IndAdjROA_{i,t}$ and $IndAdjROE_{i,t}$) is the much higher volatility of ROE as a performance measure.[26] As a result, consistent with the *IndAdjROA* model, we constrain the sample to firm-year observations with an absolute value of $ROE_{i,t}$ of <0.30.

In order to mitigate the influence of outliers, we estimate our model using the same restricted sample of firm-year observations previously discussed. Compared to the full-sample of the *IndAdjROE* model presented in Panel A of Table 5, the results of the constrained sample presented in Panel B of Table 5 are much different. The coefficients on the variables of interest (*ERMOVR*, *ERMOPS*, *ERMSTRAT*, *ERMRPT*, *ERMCOMP*, *ERM3*, *ERM4*, $ERMOVR^2$) are all positive and significant (p-value <0.05).[27] Furthermore, the coefficients on lagged ROE ($ROE_{i,t-1}$) are positive and significant compared to a significant negative coefficient in the unconstrained model. Although insignificant in the unconstrained model, the coefficients on size (*lnMVE*), revenue growth (*SALE_GROWTH*), and equity to asset ratio (*EQRATIO*) are each positive and significant in the constrained model, while the coefficients on industry competition (*HHI_GIC*) are significantly negative in the constrained model.

[24] We restrict on ROE because of it has greater volatility than ROA, but this restriction allows for a consistent presentation of samples (sample of 360 firm-year observations (representing 152 unique firms) compared to the full sample of 474 firm-year observations (representing 174 unique firms)) for both the ROA and the ROE reduced sample models. In untabulated results, we evaluate the influence of outliers by splitting the sample into low, medium, and high (using three equal splits of 1/3rd, as well as bottom quarter, middle half, and top quarter) based on $ROE_{i,t}$. Then we regress the model individually for each of the three groups. Results are consistent in that the coefficient on $ERMOVR_{i,t}$ is insignificant in the low $ROA_{i,t}$ and $ROE_{i,t}$ model, positive and significant in the middle models. The coefficient on $ERMOVR_{i,t}$ is insignificant in the $IndAdjROA_{i,t}$ model, but positive and significant in the $IndAdjROE_{i,t}$ model. These results provide additional evidence related to the need to consider outliers, especially for ROE models.

[25] As previously noted, though consistent with McShane et al. (2011), the limited number of observations (4) where *ERMOVR* was assessed as a level of "5-optimal" (*ERM5*) limits our ability to make inferences as to the direction or the lack of significance of the coefficient.

[26] Standard deviation of *ROE* with the full sample in 2006 was 2.317 (Table 2-Panel A, ROE_{t-1} for FY2007) compared with 0.085 for *ROA* during the same period.

[27] *ERMOVR*, *ERMOPS*, *ERMSTRAT*, *ERMRPT*, *ERMCOMP*, *ERM4*, and $ERMOVR^2$ are all significant at p-value <0.01. ERM3 is significant at p-value <0.05.

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Table 5
The Association between ERM and Industry adjusted ROE.

Panel A: Unconstrained ROE model-industry adjustment by GIC Group Dependent Variable = *IndAdjROE*.

Variable	*ERMOVR**	*ERMOPS***	*ERMSTRAT*	*ERMRPT*	*ERMCOMP*	ERM1–ERM5	$ERMOVR^2$
ERMOVR	0.157						
	[0.247]						
ERMOPS		0.130					
		[0.220]					
ERMSTRAT			0.108				
			[0.228]				
ERMRPT				0.084			
				[0.324]			
ERMCOMP					0.159		
					[0.197]		
ERM1						0.281	
						[0.418]	
ERM2						0.400	
						[0.278]	
ERM3						0.571	
						[0.254]	
ERM4						0.787	
						[0.209]	
ERM5						0.044	
						[0.938]	
$ERMOVR^2$							0.027
							[0.278]
ROE_{t-1}	−0.482***	−0.483***	−0.484***	−0.485***	−0.483***	−0.483***	−0.483***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
lnBKMKT	−1.137	−1.151	−1.131	−1.117	−1.134	−1.152	−1.112
	[0.400]	[0.397]	[0.401]	[0.407]	[0.399]	[0.398]	[0.405]
lnMVE	−0.449	−0.479	−0.457	−0.468	−0.462	−0.456	−0.452
	[0.666]	[0.652]	[0.662]	[0.659]	[0.660]	[0.664]	[0.665]
SALE_GROWTH	−0.242	−0.234	−0.218	−0.240	−0.245	−0.271	−0.257
	[0.593]	[0.599]	[0.622]	[0.593]	[0.585]	[0.565]	[0.569]
EQRATIO	1.857	1.985	1.888	1.810	1.946	1.951	1.813
	[0.370]	[0.354]	[0.367]	[0.383]	[0.362]	[0.353]	[0.377]
HHI_GIC	−24.151	−23.457	−22.584	−21.562	−24.342	−23.687	−22.496
	[0.163]	[0.163]	[0.167]	[0.175]	[0.154]	[0.158]	[0.173]
BOD_MTG	0.025	0.025	0.026	0.025	0.026	0.025	0.026
	[0.148]	[0.149]	[0.145]	[0.151]	[0.140]	[0.144]	[0.148]
BOD_INDP	2.179	2.160	2.241	2.306	2.256	2.200	2.268
	[0.113]	[0.111]	[0.115]	[0.120]	[0.116]	[0.121]	[0.109]
Constant	0.873	1.099	0.923	0.982	0.838	0.764	0.945
	[0.890]	[0.864]	[0.884]	[0.878]	[0.894]	[0.903]	[0.881]
R−squared	0.405	0.403	0.402	0.401	0.405	0.408	0.402
f	111.1	108.8	108.3	109.5	114.5	82.95	107.3
Observations	427	427	427	427	427	427	427

Results in Panel A of Table 5 are from OLS Panel estimate of Eq. (1). The dependent variable for all models is the median industry (using GIC Groups) adjusted ROE. Variables of interest are *ERMOVR* the overall assessed maturity of ERM processes, *ERMOPS*, *ERMSTRAT*, *ERMRPT*, and *ERMCOMP* the assessed maturity of ERM processes related to Operations, Strategy, Compliance, and Reporting respectively; ERM1–5 are coded as 1 if *ERMOVR* maturity was assessed at the corresponding maturity level and 0 otherwise, and ERM-SQ is a non-linear transformation of the *ERMOVR* assessed maturity. The full sample model contains 427 firm-year observations based on 162 unique firms. Robust two-tailed *p*-values are presented in brackets, where ***p < 0.01, **p < 0.05, *p < 0.1.

Panel B: Constrained ROA model-industry adjustment by GIC group sample restricted to firm-year observations where abs(ROE) < 0.30 Dependent Variable = *IndAdjROE*.

Variable	*ERMOVR*	*ERMOPS*	*ERMSTRAT*	*ERMRPT*	*ERMCOMP*	ERM1–ERM5	$ERMOVR^2$
ERMOVR	0.022***						
	[0.000]						
ERMOPS		0.023***					
		[0.000]					
ERMSTRAT			0.022***				
			[0.000]				
ERMRPT				0.018***			
				[0.000]			
ERMCOMP					0.018***		
					[0.003]		
ERM1						0.007	
						[0.677]	
ERM2						0.023	
						[0.170]	
ERM3						0.045**	
						[0.022]	
ERM4						0.119***	
						[0.000]	
ERM5						−0.018	
						[0.314]	
$ERMOVR^2$							0.006***
							[0.000]
ROE_{t-1}	0.036***	0.038***	0.036***	0.036***	0.036***	0.040***	0.038***

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Table 5 (*continued*)

Panel B: Constrained ROA model-industry adjustment by GIC group sample restricted to firm-year observations where abs(ROE) < 0.30 Dependent Variable = *IndAdjROE*.

Variable	*ERMOVR*	*ERMOPS*	*ERMSTRAT*	*ERMRPT*	*ERMCOMP*	ERM1–ERM5	*ERMOVR*^{2}
	[0.002]	[0.004]	[0.002]	[0.002]	[0.003]	[0.000]	[0.000]
lnBKMKT	0.026	0.028	0.030	0.032	0.035	0.037	0.032
	[0.389]	[0.352]	[0.326]	[0.291]	[0.270]	[0.241]	[0.268]
lnMVE	0.097***	0.099***	0.104***	0.100***	0.101***	0.109***	0.102***
	[0.003]	[0.003]	[0.002]	[0.003]	[0.003]	[0.002]	[0.002]
SALE_GROWTH	0.083**	0.079**	0.084**	0.081**	0.078**	0.071**	0.076**
	[0.020]	[0.026]	[0.022]	[0.029]	[0.032]	[0.039]	[0.024]
EQRATIO	0.235**	0.235**	0.213*	0.205*	0.212*	0.245**	0.237**
	[0.036]	[0.039]	[0.055]	[0.063]	[0.063]	[0.028]	[0.031]
HHI_GIC	−3.415**	−3.451**	−3.360**	−3.230**	−3.291**	−3.473**	−3.316**
	[0.027]	[0.029]	[0.029]	[0.043]	[0.034]	[0.027]	[0.033]
BOD_MTG	−0.000	−0.000	0.000	−0.000	0.000	0.000	−0.000
	[0.898]	[0.793]	[0.959]	[0.773]	[0.997]	[0.869]	[0.907]
BOD_INDP	0.084	0.066	0.078	0.082	0.090	0.077	0.079
	[0.329]	[0.418]	[0.353]	[0.337]	[0.296]	[0.363]	[0.349]
Constant	−0.777***	−0.777***	−0.815***	−0.782***	−0.803***	−0.854***	−0.807***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.000]	[0.001]
R-squared	0.332	0.337	0.334	0.323	0.318	0.368	0.345
f	6.955	7.099	6.685	7.164	7.137		6.958
Observations	360	360	360	360	360	360	360

Results in Panel B of Table 5 are from OLS Panel estimate of Eq. (1). The dependent variable for all models is the median industry (using GIC Groups) adjusted ROE. Variables of interest are *ERMOVR* the overall assessed maturity of ERM processes, *ERMOPS*, *ERMSTRAT*, *ERMRPT*, and *ERMCOMP* the assessed maturity of ERM processes related to Operations, Strategy, Compliance, and Reporting respectively; ERM1–5 are coded as 1 if *ERMOVR* maturity was assessed at the corresponding maturity level and 0 otherwise, and ERM-SQ is a non-linear transformation of the *ERMOVR* assessed maturity. To minimize the influence of outliers, the reduced sample is restricted to firms with an absolute value of ROE that is <0.30 containing 360 firm-year observations based on 152 unique firms. Robust two-tailed p-values are presented in brackets, where ***p < 0.01, **p < 0.05, *p < 0.1.

Although not identical to the results of the full-sample, in general, the results of the constrained sample provide support of a positive association between ERM maturity and operating performance as measured as industry-adjusted ROE in support of H1. Due to the difference in significance in the control variables between the two models and the level of variability in the measures of ROE, and consistent with the results of ROA, the constrained model appears to better reflect the relationship between ERM maturity and operating performance when ROE is used as the proxy.

5.1.3. Robustness test

In addition to restricting the sample to observations with an absolute value of ROE <0.3, we also stratify the sample into two separate groupings of three (1/3rd groupings and a 25%/50%/25% groupings) to evaluate the sensitivity of the center of the sample to reduce implications of outliers. We also perform additional testing (untabulated) by ranking the dependent variable ($IndAdjROE_{i,t}$) into deciles and use a an ordered rank logit model to regress it on the variables of interest and controls. Our results of this analysis using the unconstrained sample are qualitatively similar with the results of the constrained sample reported with the exception of the coefficient on $ERMOVR_{i,t}$ which is positive but insignificant.

We determine whether our results would differ if we used SEC filing data as opposed to our survey data. Using the WRDS SEC Analytics Suite, we performed a keyword search to find firms within our sample that mentioned ERM-related terminology (Enterprise Risk Management, Strategic Risk Management, Corporate Risk Management, Risk Management Committee, Risk Committee, and Chief Risk Officer) based on the Gordon et al. (2009) study. Consistent with prior literature, we coded these firms as having implemented ERM. Next we created binary variables based on *ERMOVR* maturity levels to compare with the public SEC disclosure. The correlation between the public disclosure and our binary measure of ERM maturity was 0.123, which could indicate the potential for underreporting of ERM in public filings. An alternative explanation is that survey respondents overstate ERM adoption and maturity. We consider both explanations by evaluating the measures of the public SEC filing disclosure with a binary measure of adoption form survey responses. The results of a regression analysis indicate that the binary measure of public SEC disclosure is not significant in any model of our models. Alternatively, we find that whether we code adoption at any of our three lowest levels of maturity, (where *ERMOVR* is greater than "non-existent") to identify ERM adoption, the variable is significant in each model except for the unconstrained *IndAdjROE* model. We believe this result supports the explanation of underreporting of ERM adoption within public SEC filings. One rational for this result is the potential for increased liability over the public disclosure of the use of ERM in public financial disclosure. The difference in results also provides support for the use of survey-based data to contrast with alternative measures.[28]

Finally, to ensure that we test model assumptions and resolve all statistical issues that could potentially change or account for the inference drawn in this study that relates to ERM maturity and operating performance, we consider multicollinearity as well as other potential statistical issues (such as correlated omitted variables and violation of error term structure).[29,30] Our results are qualitatively the same or robust to all corrections or specifications indicated.

[28] We thank an anonymous reviewer for suggesting this additional test.

[29] We conduct several sensitivity tests including dropping the governance variables (BOD_MTG and BOD_IND) from the model, using only the Brown and Caylor (2009) model, as well as basing Industry-adjusted performance on two-digit SIC. In short our results were qualitatively similar across these design choices.

[30] Although multicollinearity presents a potential statistical concern in linear regression, we test variance inflation factors (VIF) using the 'collin' function in STATA and find that the highest VIF is <2 in our model. In addition, we note that existence of multicollinearity would be a concern if the ERM multi-stage variables were highly collinear with board governance or other control variables. However, this would bias against finding a significant coefficient on ERM multi-stage variables as the variance of the estimated coefficients would increase with a resultant decrease in t-scores while the overall fit of the model would be largely unaffected.

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6. Conclusions and contributions

Using a unique survey-based dataset linked to archival firm data, we find a positive association between ERM process maturity and industry-adjusted operating performance (ROA and ROE) in a broad industry sample. In the wake of recent economic events that have raised significant concerns related to managing risk within firms, the results of this study provide limited empirical evidence of the benefits of ERM processes related to operating performance. Although all risk is not predictable, failing to attempt to identify and manage response to risk throughout a firm can have a detrimental impact.

The current study builds on the literature to contribute empirical evidence on operational performance benefits associated with ERM. Our study extends Gordon et al. (2009) that demonstrate that using *excess market returns* as an ERM performance metric and focusing on ERM implementation in 2005, a subset of their 112 firm sample (high performing firms) is associated with contextual factors such as industry competition, firm complexity, firm size and board monitoring and have a significant effect on the effectiveness of ERM. Our study builds upon this work and makes four contributions to existing ERM literature. First, we use survey responses of self-assessed ERM process maturity over a three year period to operationalize our measure of ERM. That is, we use a unique data set obtained from survey responses provided by U.S. based Chief Audit Executives to empirically evaluate the value of mature ERM processes. Secondly, we consider the role of ERM across a broad set of industries beyond financial service and insurance firms examined in the previous literature. Third, we consider the association between maturity of ERM processes and operational performance, in contrast to previous literature relying on the adoption of ERM or the appointment of a CRO. Lastly, to validate the research methodology (survey based study linked to archival firm operational data), we compare our sample with publicly disclosed terms used in Gordon et al. (2009) and find that public disclosures (at least for our sample respondents) likely underreport ERM activities.

One limitation of the survey method is the potential for response biased that would likely limit our ability to find results consistent with the hypotheses. We compare survey responses with key ERM related terms in SEC filings and note that in many cases, ERM adoption may not be disclosed within SEC filings indicating an alternative bias potentially due to liability concerns.

Our results provide support of a significant positive association between ERM Maturity and operating performance that extends the literature on the benefits of ERM process maturity to firms in non-financial industries. While not the only stakeholder to have an interest in the potential benefits associated with ERM adoption and maturity, executive management and the board of directors (and their committees) have the greatest control in adopting and implementing ERM processes and the quality of ERM activities. The results of these findings may provide additional management insights that have the potential to assist in the assessment of ERM investment decisions as well as contribute to future research studies on the value enhancing potential of ERM processes. Given that prior studies focus on short-term benefits, future studies should consider the long-term benefits that may be associated with ERM adoption and maturity of processes related to specific ERM objectives.

Appendix A. Variable definitions

Variable Name	Variable Description
$IndAdjROA_{i,t}$	Defined as the difference between $ROA_{i,t}$ of firm i and the industry j median $ROA_{j,t}$ in year t.
$IndAdjROE_{i,t}$	Defined as the difference between $ROE_{i,t}$ of firm i and the industry j median $ROE_{j,t}$ in year t.
$ROA_{i,t}$	Computed as Income Before Extraordinary Items Available for Common (IBCOM) scaled by Total Assets ($AT_{i,t}$) at year t ($IBCOM_{i,t}/(AT_{i,t})$
$ROE_{i,t}$	Computed as Income Before Extraordinary Items Available for Common (IBCOM) scaled by the sum of common ordinary equity total ($CEQ_{i,t}$) and deferred taxes ($TXDB_{i,t}$) at year t ($IBCOM_{i,t}/(CEQ_{i,t} + TXDB_{i,t})$).
$lnBKMKT_{i,t}$	Natural log of the book value of equity (sum of common ordinary equity total ($CEQ_{i,t}$) and deferred taxes ($TXDB_{i,t}$) at year t) to market value of equity (product of common shares outstanding ($CSHO_{i,t}$) and stock price ($PRCC\_F_{i,t}$)) at end of fiscal year t).
$lnMVE_{i,t}$	Natural log of the market value of common stock at end of year t (product of common shares outstanding ($CSHO_{i,t}$) and stock price ($PRCC\_F_{i,t}$)) at end of fiscal year t).
$SALE\_GROWTH_{i,t}$	1 year change in sales (Compustat Annual Data Item 117($SALE_{i,t}$)) computed as $((SALE_{i,t} - SALE_{i,t-1}) / SALE_{i,t-1})$.
$EQRATIO_{i,t}$	is the ratio of book value of equity Compustat Annual Data Item 60 ($CEQ_{i,t}$) to total assets (Compustat Annual Data Item 6 (AT)).
$HHI\_GIC_{i,t}$	Herfendahl Index for Industry Concentration based on 2-digit GIC Group computed as the sum of the Square of Market Share for all firms within an industry where market share equals company sales ((Compustat Annual Data Item 117($SALE_{i,t}$)) scaled by the total sales of all firms within the industry.
$BOD\_MTG_{i,t}$	The number of board meetings held for a given fiscal year (obtained from the Bloomberg database and hand collection from the SEC Edgar website at sec.gov).
$BOD\_IND_{i,t}$	The percentage of the board membership that are considered independent board members for a given fiscal year (obtained from the Bloomberg database).
$ERMOVR_{i,t}$	survey participant assessed level of ERM process maturity based on a six-point ordinal scale by survey respondents taking on one of the following maturity values defined by COBIT 4.0 (2005, p 18): 0, for "Non-Existent" ERM processes 1, for "Initial/Adhoc"; 2, for "Repeatable but Intuitive"; 3, for "Defined Process"; 4, for "Managed and Measurable"; 5, for "Optimized"; only three usable firm year observations were identified at the Optimized level (5). Due to the limited number of *ERMOVR* optimized responses, these observations were excluded from the analysis.
The assessed maturity level for the following specific objectives identified by the COSO-Enterprise Risk Management Framework captured by year (2006, 2007, and 2008) from survey respondents to assess the association with operating performance.	
$ERMOPS_{i,t}$	Survey participant assessed level of ERM maturity related to Operational objectives.
$ERMSTRAT_{i,t}$	Survey participant assessed level of ERM maturity related to Strategy objectives.
$ERMCOMP_{i,t}$	Survey participant assessed level of ERM maturity related to Compliance objectives.
$ERMRPT_{i,t}$	Survey participant assessed level of ERM maturity related to Reporting objectives.
$ERM0_{i,t}$	Binary variables taking on a value of 1 if respondents assessed *ERMOVR* as "Non-Existent"; Otherwise coded as 0.
$ERM1_{i,t}$	Binary variables taking on a value of 1 if respondents assessed *ERMOVR* as "Initial/Adhoc"; Otherwise coded as 0.
$ERM2_{i,t}$	Binary variables taking on a value of 1 if respondents assessed *ERMOVR* as "Repeatable but Intuitive"; Otherwise coded as 0.
$ERM3_{i,t}$	Binary variables taking on a value of 1 if respondents assessed *ERMOVR* as "Defined Process"; Otherwise coded as 0.
$ERM4_{i,t}$	Binary variables taking on a value of 1 if respondents assessed *ERMOVR* as "Managed and Measurable"; Otherwise coded as 0.
$ERM5_{i,t}$	Binary variables taking on a value of 1 if respondents assessed *ERMOVR* as "Optimized"; Otherwise coded as 0.

This variable is not included in the regression model as it provides the base to measure maturity variables (ERM1-ERM5) against.

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Appendix B. Survey instrument

I. Introduction - Internal Audit Function Management Questionnaire

Enterprise Risk Management (ERM) is a very broad process which organizations for various different reasons may or may not choose to implement with no two implementations being identical. While Internal Audit Functions (IAFs) may or may not be directly involved in the implementation of ERM, it is likely that IAF management would be knowledgeable of ERM implementation, the structure of ERM reporting function, and ERM risk considerations. Therefore I am hopeful that you will assist me in my dissertation study of factors contributing to ERM adoption and potential organizational benefits which may potentially result from ERM adoption. While identification of your organization is necessary to match your responses to financial reporting and market data, your responses will be kept in strict confidence and will only be presented and discussed in aggregate. Your time in completing the following survey is greatly appreciated.

1. Organization Name: _____

2. How would you classify your organization?
___Publicly Traded ___Privately Held ___Not-for-profit ___Government Agency
Other (please specify)_____

II. Internal Audit Function Characteristics:

1. How many full-time equivalents (FTEs) does your Internal Audit Function (IAF) employ? ____

2. Approximately what percentage of IAF staff members hold the following certifications (please do not enter a "%"):
%CIA ___ %CPA ___ %CISA % ___ %Other ___%
staff with at least one certification (CPA, CIA, CISA, Other) ___

3. Please indicate your level of agreement with the following statements regarding your organizations Internal Audit Function (IAF):

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Internal Audit Reports to the CEO					
Internal Audit Reports to the CFO					
Internal Audit Reports to the Audit Committee					
The CFO has authority to terminate the Chief Audit Executive(CAE)					
The CEO has authority to terminate the CAE					
The Audit Committee has authority to terminate the CAE					
The Audit Committee authorizes/approves the IAF Budget					
The CFO authorizes/approves the IAF Budget					
The CEO authorizes/approves the IAF Budget					
The Audit Committee reviews and approves the IAF's annual risk assessment plan					
The CEO reviews and approves the IAF's annual risk assessment plan					
The CFO reviews and approves the IAF's annual risk assessment plan					

4. How frequently do the following attend audit committee meetings?

Title	Never	Infrequently	Frequently	Always
Chief Executive Officer (CEO)				
Chief Financial Officer (CFO)				
Chief Audit Executive (CAE)				
Chairman of the Board				

5. How much is the annual budget of the internal audit function? (please enter a whole number without any formatting decimals or commas) $_____

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III. Organizational Risk & Risk Assessment Characteristics

1. How would you rate the overall level of inherent risk at your organization?
___ High ___Moderate ___Low ___Unknown

2. How would you rate the overall level of residual risk at your organization?
___ High ___Moderate ___Low ___Unknown

3. How frequently does Internal Audit conduct a Risk Assessment of the Audit Universe at your organization?
___Monthly __Quarterly ___Semi-Annually ___Annually
___Do Not Conduct Risk Assessment ___Other (please specify) _____

4. What type of Risk Assessment do you conduct at your organization?
___Qualitative ___Quantitative ___Hybrid (combined Qualitative and Qualitative)
___Other (please specify) _____

5. What are the key components (classification categories) of your organizations Internal Audit risk assessment and weighting of each (High, Medium, Low)?

Classification	Not Considered	Low	Medium	High
Management Change				
Technology Change				
Process Change				
Competition				
Market Growth/Decline				
Geographical Characteristics				
Unit Revenue				
Unit Costs				
Budget Variances				
Prior Audit Opinion				
Time Since Last Audit				
Other				

6. What is the basis of your organizations Audit Plan? (please check one)
___Risk Based Coverage ___Rotational Audit Coverage
___Hybrid (combination of risk and rotational coverage)___Other (please specify)_____

7. Approximately what percentage of the audit time budget is spent conducting the following project types (total should equal 100):
Financial ____% Operational ___% Systems ___% Consulting___% Financial Audit Support
ERM Assessment ___% Other ___%

8. Has a Quality Assurance Review (QAR) of the Internal Audit Function (IAF) been conducted? If so, please indicate the year of the last review, frequency of reviews, and the party who conducted the review?

Type	Yes/No	Year Last Conducted	Frequency	Conducted by
Internal				
External				

Other (please specify) _____

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IV. ERM Characteristics

1. Has your organization implemented ERM?
___No ___Informally ___Formally ___Other (please specify) _____

2. Using the following rating scale, please rate the maturity your organizations ERM Processes strategic, operational, reporting, compliance, overall) for the given year (2008, 2007, 2006):
0 - Non-existent – Management processes are not applied at all
1 - Initial/Adhoc – Processes are ad hoc and disorganized
2 - Repeatable but Intuitive – Processes follow a regular pattern
3 - Defined Process – Processes are documented and communicated
4 - Managed and Measureable – Processes are monitored and measured
5 - Optimized – Good processes are followed and automated

Objective	2008	2007	2006
Strategic			
Operational			
Reporting			
Compliance			
Overall			

3. Who is the sponsor of your organizations ERM process? (Check all that apply)
___Chief Executive Officer (CEO) ___Chief Financial Officer (CFO)
___Chief Audit Executive (CAE) ___Board of Directors Audit Committee
Other (please specify) _____

4. Who is the leader of the ERM function/process at your organization? (check only one)
___Chief Risk Officer (CRO) ___Chief Financial Officer (CFO) ___ERM Committee
___Chief Audit Executive (CAE) ___Chief Executive Officer (CEO) ___Legal Counsel
___Other (please specify) _____

5. If responsibility lies within an ERM committee; Indicate each business function represented on the committee? Please specify any additional business function members not listed.
___Finance
___Internal Audit Operations
___Information Technology
___Legal
___Other (please specify) _____

6. If responsibility lies within an ERM committee, please identify the business function of those who chair the committee.
_____

7. How much is the annual budget (in $'s) for organization-wide ERM activities? $_____

8. Approximately how many full-time equivalents (FTE's) are designated to the ERM function? ____FTE's

V. Chief Risk Officer (CRO) Characteristics

1. Does your organization have a Chief Risk Officer (CRO)?
___No CRO ___Informal CRO ___Formally Appointed CRO ___Other (please specify) _____

2. Please specify any additional role (title) the CRO (formal or informal) fulfills at the organization: _____

3. If your organization has a formal or informal CRO, approximately when (MM/YYYY) was this role filled?
_____

4. Who (title) appointed the CRO? Functionally (title) _____
Administratively (title) _____

5. Who (title) does the CRO report to? _____

6. Who (title) is responsible for reviewing the CRO's performance? _____

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