

**CHIEF RISK OFFICERS AND FIRM VALUE: EMPIRICAL EVIDENCE FROM
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We study the relationship between enterprise risk management and firm value. We analyze how the influence, reporting and compensation incentives of the chief risk officer (CRO) contribute to firm value. We use U.S. publicly traded insurers data between 2009 and 2017 and find that the participation of a CRO is insufficient for value creation in insurers. Our results present a negative relationship between a CRO and firm value. However, we find empirical evidence of a positive relationship between firm value and the incentives related to the compensation of the CRO, specifically including the CRO in the compensation committee of the board and providing the CRO with an equity-based compensation plan. Moreover, we propose two scores to isolate the participation of the CRO from other ERM proxies on value creation. We confirm a negative relationship between CRO and firm value and a positive relationship between firm value and the incentives related to the compensation of the CRO.

Palavras-chave: Enterprise risk management; Chief risk officer; Compensation; Firm value; Insurance industry

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ABSTRACT

We study the relationship between enterprise risk management and firm value. We analyze how the influence, reporting and compensation incentives of the chief risk officer (CRO) contribute to firm value. We use U.S. publicly traded insurers data between 2009 and 2017 and find that the participation of a CRO is insufficient for value creation in insurers. Our results present a negative relationship between a CRO and firm value. However, we find empirical evidence of a positive relationship between firm value and the incentives related to the compensation of the CRO, specifically including the CRO in the compensation committee of the board and providing the CRO with an equity-based compensation plan. Moreover, we propose two scores to isolate the participation of the CRO from other ERM proxies on value creation. We confirm a negative relationship between CRO and firm value and a positive relationship between firm value and the incentives related to the compensation of the CRO.

Keywords: Enterprise risk management; Chief risk officer; Compensation; Firm value; Insurance industry.

1 INTRODUCTION

The literature on risk management provides extensive empirical analysis of enterprise risk management (ERM). The relationship between ERM and firm value has been documented by several studies (e.g., Meulbroek, 2002; Beasley, Clune & Hermanson, 2005; Nocco & Stulz, 2006; Pagach & Warr, 2010; Hoyt & Liebenberg, 2011; Aebi, Sabato & Schmid, 2012; Paape & Speklé, 2012; Ellul & Yerramilli, 2013; Eckles, Hoyt & Miller, 2014; Florio & Leoni, 2017). These findings are of interest to companies and regulators supporting the view that enterprise risk management is pivotal to reduce losses and improve firms' performance by enabling them to manage risk in a holistic manner.

While several studies have focused on the determinants, adoption, and maturity of an ERM system and the relationship with firm value, the process by which chief risk officers (CROs) influence firm value is less clear. In particular, empirical evidence on the association between firm value creation and the compensation of CROs is lacking. Hence, this study explores the CROs' compensation incentives and evaluates their relationship with firm value.

Unlike previous studies, we focus on the role played by the CRO in value creation. We identify how the influence, reporting and CROs' compensation incentives contribute to firm value. We use data from publicly traded U.S. insurers (i.e., disclosure and corporate governance characteristics) from 2009 to 2017. We collect additional information about CROs such as name, function, and individual characteristics (i.e., age and sex) for all firm-years where available.

We follow Hoyt and Liebenberg (2011) and use a maximum-likelihood treatment effects model to capture the decision to employ a CRO and the effect of having a CRO on firm value. The model estimates the treatment effects allowing for self-selection problems. Further, we run an ordinary least squares (OLS) regression model to evaluate how the CRO's characteristics relate to firm value.

We show that the participation of a CRO (solely) is insufficient for value creation in insurers. In fact, our results reveal a negative association between the presence of a CRO and firm value, in line with the findings of Aebi et al. (2012), Grace, Leverty, Phillips and Shimpi (2015), and Florio and Leoni (2017). However, we find empirical evidence of a positive relationship

between firm value and to compensation incentives of the CRO (i.e., including the CRO in the compensation committee of the board and providing the CRO with an equity-based compensation plan). To the best of our knowledge, this is the first study to present such an outcome.

As a robustness check, we analyze the average treatment effect on the treated (ATET) for value creation by matching firms with the same covariates (size, leverage, and sales growth). We also find that the CRO (solely) is insufficient to create value and that the compensation incentives of the CRO are pivotal to value creation.

Further, we consider that our measure of the participation of the CRO (a dummy variable) in value creation can hide relevant ERM information that confuses the interpretation of our results. Considering that the presence of a CRO can also be considered a proxy for ERM adoption, it would be difficult to gauge whether our results capture the isolated relationship between CRO and firm value or simply the relationship between ERM and firm value. To tackle this concern, we propose two scores focusing on ERM practices.

Our scores aim to isolate the relationship between the CRO and value creation by controlling for other ERM proxies. Our two scores include a total of seven components related to risk management and four components representing risk governance characteristics in our sample period as proxies of the ERM practice. Our tests are consistent with negative association between the presence of a CRO and firm value. In addition, we confirm a positive relationship between firm value and compensation incentives of the CRO.

Our study sheds light on the findings of Grace et al. (2015) and Pernell, Jung and Dobbin (2017) and our results are in line with those of Baker, Jensen and Murphy (1988) and Kuo, Li and Yu (2013) in the area of corporate governance. Moreover, we add to Hoyt and Liebenberg (2011), Florio and Leoni (2017), and Pernell et al. (2017) by breaking down the disclosure and oversight of risk management and compensation policies for proxy statements.

From a practical perspective, our study provides a meaningful analysis of an important risk management issue. According to the rules specified in Items 402, 403, 405, and 407 of Regulation S-K (U.S. Securities and Exchange Commission, 2009, 2017a) and Section 16 of the Securities Exchange Act of 1934 (U.S. Securities and Exchange Commission, 2017b), we exploit the compensation plans of executives such as CROs and verify that their compensation incentives help enhance firm value.

The remainder of the paper is organized as follows. Section 2 provides the related literature and the hypotheses of our study. Section 3 defines our variables, shows the descriptive statistics, and detail our empirical strategy. Section 4 reports our results and explains our robustness tests. The final section presents our conclusions.

2 PRIOR RESEARCH AND HYPOTHESES DEVELOPMENT

Our study is connected to several strands of the literature. The first is the literature documenting the value creation of ERM. In imperfect capital markets, ERM can create value by improving risk management, capital allocation, and capital structure decisions (Mayers & Smith, 1982; Cummins, Phillips & Smith, 2001; Myers & Read Jr., 2001; Nocco & Stulz, 2006). Moreover, the development of ERM systems attenuates the direct and indirect costs of financial distress and earnings dispersion (Beasley et al., 2005; Beasley, Pagach & Warr, 2008; Hoyt & Liebenberg, 2011).

A second stream of research aims to provide the consequences of ERM on firms' financial and market performance (McShane, Nair & Rustambekov, 2011; Baxter, Bedard, Hoitash & Yezegel, 2013; Farrell & Gallagher, 2015). More closely related to our work is research studying the relationship between ERM systems and risk governance characteristics to evaluate performance

and identify value creation (Caldarelli, Fiondella, Maffei & Zagaria, 2016; Florio & Leoni, 2017). Moreover, previous studies associate ERM implementation to the appointment of CROs and risk committees (Liebenberg & Hoyt, 2003; Subramaniam, McManus & Zhang, 2009; Yatim, 2010).

Although the participation of CROs in risk management duties has received considerable attention in recent empirical work (Florio & Leoni, 2017; Pernell et al., 2017), little attention has been devoted to the compensation plans arising from CROs' management strategies that aim to enhance value. In fact, the results on the appointment of CROs are ambiguous. Beasley et al. (2008) specify that the appointment of a CRO relates to positive equity market reactions for non-financial firms but not for financial firms. Hoyt and Liebenberg (2011) find a positive and significant relationship between value and a CRO's appointment in U.S. insurance companies. Florio and Leoni (2017) study the appointment of a CRO, the presence of a risk committee, and the board of directors (as proxies for ERM sophistication) to evaluate performance. They find that ERM sophistication is important to improve performance.

Our research focuses on the relationship between CROs' compensation incentives and value creation. The Committee of Sponsoring Organizations of the Treadway Commission (COSO, 2004) recommends appointing a CRO to drive the ERM systems in a company. Notably, the CRO oversees the disseminating and monitoring of the integrated risk management strategy to all parts of the company. The Dodd–Frank Act of 2010 requires that banking holdings and other types of holding companies with more than \$10 billion of total assets have a separate risk committee with at least one experienced risk professional. Pagach and Warr (2011) point out that CROs are hired by large companies facing a greater predisposition to risk.

2.1 Presence of a CRO and firm value

The employment of a CRO as an executive in charge of ERM in the United States has consolidated since the release of Sections 302 and 404 of the Sarbanes–Oxley Act of 2002 (Sarbanes-Oxley Act, 2002). This has partly occurred in response to market pressure for better risk management practices (CAS, 2003; COSO, 2004; New York Stock Exchange 2004; Standard & Poor's, 2005). On the contrary, the importance of regulatory forces after the 2008 global financial crisis is directly related to the presence of a CRO in companies (U.S. Securities and Exchange Commission, 2009; Dodd–Frank Act, 2010; Federal Reserve Regulation YY, 2012; NAIC, 2012, 2014). According to Whitman (2015), the requirements and rules provided by these forces have become a new rulebook for risk management procedures, and these strengthen arguments in favor of the appointment of a CRO as a key part of companies' risk management. COSO (2004, 2017) recommends hiring a CRO because he or she has the resources to drive ERM to benefit the entire company by overseeing the monitoring of each step of the process. CROs are also responsible for disseminating the risk management duties and strategic philosophy of the company to managers. Their message must thus be clear to avoid inconsistencies and management conflicts.

CROs benefit firms in several ways such as reducing stock price volatility (Liebenberg & Hoyt, 2003; Pagach & Warr, 2011), attenuating information asymmetry (Liebenberg & Hoyt, 2003; Beasley et al., 2008), and decreasing the cost of capital (Berry-Stölzle & Xu, 2018). These benefits are linked to the adoption of a strategic risk management approach, where the presence of a CRO has been used as a proxy for the adoption of ERM (Hoyt & Liebenberg, 2011; Florio & Leoni, 2017). In this study, we follow Aebi et al. (2012), Grace et al. (2015), and Florio and Leoni (2017) to evaluate the correlation between firm value and the presence of a CRO. Hence, the first hypothesis of our study can be presented as follows:

H1: *There is a negative relation between firm value and the presence of a CRO.*

2.2 Influence and reporting of the CRO and firm value

According to Aebi et al. (2012), a CRO has more influence and power when he or she is an executive director. However, the increase in influence and power is not necessarily associated with value creation. Grace et al. (2015) state that a risk manager that has access to the board of directors may have more credibility than one that does not. Within the context of risk governance, Aebi et al. (2012), Grace et al. (2015), and Florio and Leoni (2017) assess the association between the firm's value metrics and risk manager's strategy for reporting to the CEO, CFO, a risk committee, or the board of directors. The results are contradictory or not statistically significant. Our study also investigates the association between the attributes and reporting of the CRO and firm value. According to the empirical findings mentioned above, we evaluate the following hypotheses:

H2: *Having a CRO who is an executive director is negatively associated with firm value.*

H3: *Having a CRO who reports to the CEO or CFO is negatively associated with firm value.*

H4: *Having a CRO who reports to a risk committee or the board is positively associated with firm value.*

2.3 CRO compensation incentives and firm value

According to Jensen and Meckling (1976), executive compensation plays an important role in the firm's ability to incentivize managers. A thorough understanding of internal incentive structures is critical to developing a viable theory of the firm, since these incentives largely determine how the individuals within an organization behave (Baker et al., 1988). Compensation policy can provide value-increasing incentives through several mechanisms including performance-based bonuses, stock options, and performance-based dismissal decisions. Stock ownership or equity-based plans are another way through which an executive's welfare varies directly with firm performance, independent of any link between compensation and performance. Although the process through which CEOs select their equilibrium stockholdings is not well understood, the incentives generated by these shareholdings clearly add to the incentives generated by the compensation package. Although such holdings are small and declining, the most powerful CEO performance incentives come from ownership of their firms' stock (Jensen & Murphy, 1990). Kuo et al. (2013) show that the positive impact of CEO equity incentives on firm performance is more pronounced not only for companies with lower and moderate levels of CEO stock-based incentive pay, but also for less profitable firms.

In the context of risk management, Grace et al. (2015) were the first to provide evidence of a link between incentives and executive compensation/risk management. The authors use the survey of ERM by Tillinghast Towers Perrin¹ to insurance companies in 2004 and 2006 and create an indicator to describe whether firms use the output from ERM to influence executive compensation. The results show no association between this indicator and the value metrics adopted (cost and revenue efficiency). In another approach, Pernell et al. (2017) suggest that CROs in the banking industry encourage increased risk-taking by contracting new derivatives. The authors also suggest that CEOs' performance-related pay (ratio of bonus to salary compensation) favors new derivatives, whereas the effect of bonus pay does not change with the presence of a CRO.

Demand for the disclosure and oversight of risk management and compensation policies for proxy statements is increasing (Whitman, 2015). Items 402, 403, and 405 of Regulation S-K require

¹ According Grace et al. (2015), the survey conducted by Tillinghast Towers Perrin asked participants whether ERM measures are incorporated into incentive compensation at their company. The survey gave participants examples of risk performance metrics. The respondents, however, were not required to provide details.

that companies specify the role of the board of directors and committees in overseeing risk management in their proxy statements, their compensation policies and practices for executives and other employees, and if those policies and practices create risks that are reasonably likely to have a material adverse effect on the company (U.S. Securities and Exchange Commission, 2009, 2017a). In 2012, the Federal Reserve created, for large financial institutions, a set of guidelines under which the board of directors should provide effective corporate governance with the support of senior management, ensuring that compensation arrangements and other incentives are consistent with the corporate culture and institutional risk appetite (Federal Reserve Regulation YY, 2012). The literature and associated regulation above suggest a link between incentives for executive compensation and strategic risk management when the CRO is at the center of this process. Thus, we postulate the following hypotheses:

H5: *Having a CRO on the compensation committee of the board (i.e., involved in the annual review, oversight, and assessment of the compensation plans of senior executives) is positively associated with firm value.*

H6: *Having a CRO with an equity-based compensation plan is positively associated with firm value.*

3 SAMPLE SELECTION, VARIABLES, AND DESCRIPTIVE STATISTICS

3.1 Sample selection

We test our hypotheses on all U.S. publicly traded insurers following Hoyt and Liebenberg (2011). The initial sample was drawn from the universe of insurance companies (SIC codes between 6311 and 6399) available in the S&P Capital IQ database for 2009–2017. The sample was composed of 243 companies that operated in any year during the nine-year period. We hand-collected our variables on CROs and corporate governance from insurers using the 10-k (annual report), DEF 14A (proxy statement), Forms 3 and 4 in the SEC's EDGAR database, LexisNexis Academic database, and LinkedIn. We excluded 136 insurance companies without 10-k and DEF 14A filings in the SEC's EDGAR database from our sample as well as five subsidiaries that already had their respective headquarters in the database, thus avoiding the duplication of companies in the sample. Finally, we excluded 11 companies with missing financial and accounting data (total assets, shares outstanding, market value of equity, leverage, sales growth). Our final sample contained 91 insurance companies (762 firm-year observations).

3.2 Variable definitions

We use *Tobin's Q* (i.e., the market value of equity plus the book value of liabilities divided by the book value of assets) as a proxy for firm value following previous empirical ERM studies (Hoyt & Liebenberg, 2011; Baxter et al., 2013; Eckles et al., 2014; Florio & Leoni, 2017). In addition, we collect insurer-specific data (i.e., overall disclosure and corporate governance characteristics). Similar to Hoyt and Liebenberg (2011), we control for the determinants of firm value and include firms' characteristics and corporate governance variables.

We are interested in studying the presence, influence, reporting and CROs' compensation incentives. We use the DEF 14A, 10-k, Forms 3 and 4 available in the SEC's EDGAR database, LexisNexis Academic database, and LinkedIn to collect the information disclosures by firm for 2009–2017. In these forms, we identify firms that disclose the presence of a chief risk officer, searching for the keyword "chief risk officer" or its synonyms such as "director of risk," "risk manager," "chief of risk," "executive vice president of risk," and "chief enterprise risk officer." Thus, we create a CRO dummy variable (1 for firm-years that have a CRO and 0 otherwise) as an

indicator to evaluate the hypothesis H1. Previous research investigates the participation of an executive dedicated to risk management duties and often associates the presence of a risk manager with ERM implementation (Hoyt & Liebenberg, 2011; Grace et al., 2015; Florio & Leoni, 2017). In this study, we highlight the presence of a CRO as a key factor in the company's ERM structure. Hence, we identify the presence of a CRO in the reports of each company in our sample. Further, we collect the officer's name, function, and individual characteristics (i.e., age and sex) for all firm-years with available information in our sample.

In contrast to Aebi et al. (2012), we identify whether the chief risk officer is an executive director (i.e., senior director, vice president, senior vice president, executive vice president, or senior executive vice president) for all firm-years, allowing us to create two indicators for hypothesis H2 (*CRO_ISEXECDIRECTOR* and *CRO_OFFICER*). We also create dummy variables for hypotheses H3 and H4, identifying, respectively, all the firm-years that disclose whether the CRO reports directly to the CEO or CFO (*CRO_REPORTtoCEOorCFO*) or directly to the board of directors (*CRO_REPORTtoBOARD*) (Aebi et al., 2012; Grace et al., 2015; Florio and Leoni, 2017).

Following the context described in Section 2.3, we create indicators (dummy variables) to test hypotheses H5 and H6. The first indicator (*CRO_COMPENSATIONPLANS*) identifies the participation of the CRO in reviewing and assisting the activities of the compensation committee of the board (hypothesis H5) generally responsible for reviewing the company's compensation practices and overseeing risk management with respect to its compensation arrangements. The information on the participation of the CRO in risk management and the activities of the compensation committee comes from the firm's disclosure in the "Corporate Governance – Board's Role in the Oversight Risk" and "Compensation Discussion and Analysis" sections of the DEF 14A Proxy Statement (SEC's EDGAR database). Thus, we identify all firm-years that disclose whether the CRO is involved in the review, oversight, and assessment of the compensation plans of executive directors at least annually. Hence, we create a second indicator (*CRO_EQUITYBASEDPLAN*) that provides information on the equity-based compensation of the CRO (hypothesis H6). We identify all the firm-years in which the CRO has an equity-based compensation plan (stock awards and/or options awards) and code this indicator 1 and 0 otherwise. We hand-collect this information from the DEF 14A Proxy Statement and Forms 3 and 4 in the SEC's EDGAR database. We also use the LexisNexis Academic database and LinkedIn to enhance the cross between the firm-year and name of the CRO. Finally, according to Section 16 of the Securities Exchange Act of 1934 (U.S. Securities and Exchange Commission, 2017b), every individual directly or indirectly who is a beneficial owner of over 10% of a company, or who is a director or an officer of the issuer of such a security, must file Forms 3 and 4. Thus, in Forms 3 and 4, we find all the firm-years in which the CRO was the owner of equity granted by stock awards and/or options awards.

Finally, we separate the *CRO_EQUITYBASEDPLAN* in two proxy's: *CRO_COMPENSATIONSTOCK*, a dummy variable equal to 1 for firm-years in which the CRO has only stock-based compensation (equity compensation), and 0 otherwise, and *CRO_COMPENSATIONOPTIONS*, a dummy variable equal to 1 for firm-years in which the CRO has only options-based compensation (options awards), and 0 otherwise. The objective was to describe which type of compensation is most relevant within the CROs compensation plan.

3.3 Descriptive statistics

Table 1 describes the attributes of the CROs of our sample. We only consider nominally identified CROs with available data. On average, 32.4% of the firm-years in our sample period have a CRO. The typical CRO is 52 years, male (76.2%), and has about 5.5 years of professional experience. The dominant undergraduate degree majors are Business (Accounting, Business Administration, Economics, and Actuarial), Mathematics, and Others (Philosophy and Law, Political Science, Liberal Arts, Oceanography, and Computer Science). 75.7% of the CROs have executive functions and 60.7% are an officer (regardless of being named Chief Risk Officer). 38.3% of the CROs report to the CEO or CFO and 82.9% report to the board of directors.

Table 1. Frequency distribution of the variables of influence, reporting and CROs' compensation incentives.

Variable	Equal to	2009 (%)	2010 (%)	2011 (%)	2012 (%)	2013 (%)	2014 (%)	2015 (%)	2016 (%)	2017 (%)	2009–2017 (%)	2009–2017 Frequency
<i>CRO</i>	0	76.3	75.3	73.2	72.6	69.3	65.6	62.5	60.2	55.8	67.8	511
	1	23.7	24.7	26.8	27.4	30.7	34.4	37.5	39.8	44.2	32.2	243
<i>CRO_EXECDIRECTOR</i>	0	27.8	25.0	22.7	26.1	25.9	25.8	24.2	25.7	20.6	24.7	60
	1	72.2	75.0	77.3	73.9	74.1	74.2	75.8	74.3	79.4	75.3	183
<i>CRO_OFFICER</i>	0	50.0	45.0	40.9	43.5	40.7	41.9	36.4	37.1	35.3	40.3	98
	1	50.0	55.0	59.1	56.5	59.3	58.1	63.6	62.9	64.7	59.7	145
<i>CRO_REPORTtoCEOorCFO</i>	0	64.7	63.2	61.9	59.1	53.9	53.3	59.4	58.8	54.6	58.1	136
	1	35.3	36.8	38.1	40.9	46.2	46.7	40.6	41.2	45.5	41.9	98
<i>CRO_REPORTtoRCorBOARD</i>	0	17.7	15.8	14.3	13.6	15.4	13.3	9.4	8.8	12.1	12.3	30
	1	82.4	84.2	85.7	86.4	84.6	86.7	90.6	91.2	87.9	87.2	234
<i>CRO_COMPENSATIONPLANS</i>	0	52.9	57.9	57.1	54.6	61.5	63.3	65.6	64.7	57.6	60.3	141
	1	47.1	42.1	42.9	45.5	38.5	36.7	34.4	35.3	42.4	39.7	93
<i>CRO_EQUITYBASEDPLAN</i>	0	66.7	60.0	50.0	56.5	55.6	51.6	48.5	42.9	44.1	51.4	125
	1	33.3	40.0	50.0	43.5	44.4	48.4	51.5	57.1	55.9	48.6	118
<i>CRO_COMPENSATIONSTOCK</i>	0	66.7	60.0	50.0	56.5	59.3	54.8	51.5	42.9	44.1	52.7	128
	1	33.3	40.0	50.0	43.5	40.7	45.2	48.5	57.1	55.9	47.3	115
<i>CRO_COMPENSATIONOPTIONS</i>	0	77.8	85.0	63.6	69.6	66.7	58.1	57.6	54.3	55.9	63.4	154
	1	22.2	15.0	36.4	30.4	33.3	41.9	42.4	45.7	44.1	36.6	89

Notes: *CRO* is a dummy variable equal to 1, for firm-years that has a Chief Risk Officer, and 0 otherwise (*CRO* classification is based on a search of SEC filings 10-k, DEF 14A, Forms 3 and 4 (EDGAR database), LexisNexis Academic database and LinkedIn). *CRO_EXECDIRECTOR* is a dummy variable equal to 1, for firm-years that Chief Risk Officer is an executive director (Senior Director; Vice President; Senior Vice President; Executive Vice President or Senior Executive Vice President), and 0 otherwise. *CRO_OFFICER* is a dummy variable equal to 1, for firm-years that Chief Risk Officer is an executive Chief Officer (regardless of being named Chief Risk Officer), and 0 otherwise. *CRO_REPORTtoCEOorCFO* is a dummy variable equal to 1, for firm-years that Chief Risk Officer report to CEO or CFO, and 0 otherwise. *CRO_REPORTtoRCorBOARD* is a dummy variable equal to 1, firm-years that Chief Risk Officer report to Risk Committee (at the board level) or Board of Directors, and 0 otherwise. *CRO_COMPENSATIONPLANS* is a dummy variable equal to 1, for firm-years that Chief Risk Officer is involved in the review, oversight and assessment compensation plans to senior executives (executive directors), and 0 otherwise. *CRO_EQUITYBASEDPLAN* is a dummy variable equal to 1, for firm-years that CRO has equity-based plan (stock awards and/or options awards), and 0 otherwise. *CRO_COMPENSATIONSTOCK* is a dummy variable equal to 1 for firm-years in which the CRO has stock-based compensation (equity compensation), and 0 otherwise. *CRO_COMPENSATIONOPTIONS* is a dummy variable equal to 1 for firm-years in which the CRO has options-based compensation (options awards), and 0 otherwise.

Focusing on the CROs' compensation incentives, 39.3% are involved in the review, oversight, and assessment of the compensation plans of senior executive directors (including the

CRO in the compensation committee of the board) and 48.6% have equity-based compensation plans (stock awards and/or option awards). Finally, Table 1 indicates the evolution of the attributes and incentives of CROs in our sample period. The presence of CROs in insurers has risen markedly from 23.1% in 2009 to 46.2% in 2017 and the decision-making power of these managers (*CRO_OFFICER*) has also increased from 50% in 2009 to 69.4% in 2017. In addition, there is a greater proportion of equity-based compensation plans (from 33.3% in 2009 to 61.1% in 2017).

3.4 Empirical strategy

Our empirical approach focuses on evaluating the relationship between the participation of CROs in risk management duties and value creation. We first carry out a basic mean test for the differences in value creation in companies with and without a CRO in our sample period. We then estimate an OLS regression to examine the relationship between value creation and a CRO. We control for both the firm and the corporate governance characteristics following Hoyt and Liebenberg (2011), Aebi et al. (2012), Baxter et al. (2013), and Florio and Leoni (2017). Our first equation is specified as follows and follows Hoyt and Liebenberg (2011):

$$\begin{aligned} \text{Value}_{it} = & \beta_0 + \beta_1 \text{SIZE}_{it} + \beta_2 \text{LEVERAGE}_{it} + \beta_3 \text{ROA}_{it} + \beta_4 \text{BETA}_{it} + \beta_5 \text{SALESGROWTH}_{it} \\ & + \beta_6 \text{DIVIDENDS}_{it} + \beta_7 \text{DIV_INT}_{it} + \beta_8 \text{DIV_IND}_{it} + \beta_9 \text{BIG4}_{it} \\ & + \beta_{10} \text{BOARDSIZE}_{it} + \beta_{11} \text{BOARDIND}_{it} + \beta_{12} \text{CEO_DUALITY}_{it} \\ & + \beta_{13} \text{INST_OWNER}_{it} + \beta_{14} \text{INSIDERS}_{it} + \beta_{15} \text{CEO_COMPENSATION}_{it} \\ & + \beta_{16} \text{CRO}_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

where

$\text{Value}_{it} = \text{Tobin's } Q_{it}$,

$\text{CRO}_{it} = \begin{cases} 1, & \text{if there is a CRO for firm}_i \text{ in time}_t \\ 0, & \text{otherwise} \end{cases}$,

and the β s are the parameters to be estimated.

Further, we follow Hoyt and Liebenberg (2011) and measure *Tobin's Q* as a function of the CRO and other control variables. We use a maximum-likelihood treatment effects model that simultaneously estimates the decision to employ a CRO and the effect of having a CRO on *Tobin's Q*. The model estimates the treatment effects considering self-selection problems (i.e., the decision to hire a CRO does not yield valid estimates of the causal effect because the selection mechanism is not random). Hence, the OLS model provides a biased estimation if the error terms of the equations are correlated. Equations (2) and (3) are simultaneously estimated using the likelihood function presented in Maddala (1983). We also control for the firm and corporate governance characteristics. The simultaneously estimated equations are specified as follows:

$$\begin{aligned} \text{CRO}_{it} = & \alpha_0 + \alpha_1 \text{SIZE}_{it} + \alpha_2 \text{LEVERAGE}_{it} + \alpha_3 \text{BETA}_{it} + \alpha_4 \text{DIVIDENDS}_{it} + \alpha_5 \text{DIV_INT}_{it} \\ & + \alpha_6 \text{DIV_IND}_{it} + \alpha_7 \text{INST_OWNER}_{it} + \alpha_8 \text{CEO_COMPENSATION}_{it} + u_{it} \end{aligned} \quad (2)$$

$$\begin{aligned} \text{Value}_{it} = & \gamma_0 + \gamma_1 \text{SIZE}_{it} + \gamma_2 \text{LEVERAGE}_{it} + \gamma_3 \text{ROA}_{it} + \gamma_4 \text{BETA}_{it} + \gamma_5 \text{SALESGROWTH}_{it} \\ & + \gamma_6 \text{DIVIDENDS}_{it} + \gamma_7 \text{DIV_INT}_{it} + \gamma_8 \text{DIV_IND}_{it} + \gamma_9 \text{BIG4}_{it} \\ & + \gamma_{10} \text{BOARDSIZE}_{it} + \gamma_{11} \text{BOARDIND}_{it} + \gamma_{12} \text{CEO_DUALITY}_{it} \\ & + \gamma_{13} \text{INST_OWNER}_{it} + \gamma_{14} \text{INSIDERS}_{it} + \gamma_{15} \text{CEO_COMPENSATION}_{it} \\ & + \gamma_{16} \text{CRO}_{it} + \varepsilon_{it} \end{aligned} \quad (3)$$

where α and γ are the parameters to be estimated.

We further exploit the CRO's variables related to value to evaluate the determinants of value creation for firms with a CRO in each point of our sample period. We consider in our final sample only firms with a CRO that undertakes risk management duties. In all the regressions, standard errors are clustered at the firm level and robust to heteroscedasticity. We also present the mean variance inflation factor (VIF) in our OLS regressions to show that our data do not have multicollinearity problems.

We also run an OLS regression to obtain the relationship between value creation and the CROs' compensation incentives (*CRO_COMPENSATIONPLANS* and *CRO_EQUITYBASEDPLAN*). We use the following specification:

$$\begin{aligned} \text{Value}_{it} = & \delta_0 + \delta_1 \text{SIZE}_{it} + \delta_2 \text{LEVERAGE}_{it} + \delta_3 \text{ROA}_{it} + \delta_4 \text{BETA}_{it} + \delta_5 \text{SALESGROWTH}_{it} \\ & + \delta_6 \text{DIVIDENDS}_{it} + \delta_7 \text{DIV_INT}_{it} + \delta_8 \text{DIV_IND}_{it} + \delta_9 \text{BIG4}_{it} \\ & + \delta_{10} \text{BOARDSIZE}_{it} + \delta_{11} \text{BOARDIND}_{it} + \delta_{12} \text{CEO_DUALITY}_{it} \\ & + \delta_{13} \text{INST_OWNER}_{it} + \delta_{14} \text{INSIDERS}_{it} + \delta_{15} \text{CEO_COMPENSATION}_{it} \\ & + \delta_{16} \text{CRO_EXECDIRECTOR}_{it} + \delta_{17} \text{CRO_REPORTtoCEOorCFO}_{it} \\ & + \delta_{18} \text{CRO_REPORT_RCorBOARD}_{it} + \delta_{19} \text{CRO_COMPENSATIONPLANS}_{it} \\ & + \delta_{20} \text{CRO_EQUITYBASEDPLAN}_{it} + \vartheta_{it} \end{aligned} \quad (4)$$

where the δ s are the parameters to be estimated. We also run three more OLS regression models considering alternative scenarios, *but due to space limitations, we exclude the results presented.*

4 RESULTS

4.1 Pooled OLS regression analysis

Table 2 shows the results of the pooled OLS model for firm value (*Tobin's Q*) and the maximum-likelihood treatment effects model in which the CRO and *Tobin's Q* equations are estimated jointly. The Wald test for independent equations does not reject the null hypothesis that the residuals from Equations (1) and (2) are uncorrelated and supports their joint estimation at the 1% significance level. The results for the firm value estimation using a pooled OLS model are consistent with those obtained using the maximum-likelihood treatment effects model. The coefficient of CRO is negative in both models, but only significant in the maximum-likelihood treatment effects model, after controlling for other value determinants and potential endogeneity bias. This result indicates that the presence (solely) of a CRO as a risk manager seems to diminish value for insurers in line with the findings of previous research (Aebi et al., 2012; Grace et al., 2015; Florio & Leoni, 2017).

A pooled OLS regression for firm value and the influence, reporting and compensation incentives of the CRO also was developed. We only consider firms who appointed a CRO as a risk manager in our sample period (232 firm-year observations for 34 insurers).

4.2 Robustness checks

A potential concern in our empirical strategy is the connection between the CRO and all other ERM proxies. Considering that the CRO is also a proxy for a variety of ERM studies that we previously mentioned, it is possible that the CRO (defined as a dummy variable) is hiding the ERM effect on firm value. The other ERM proxies can act as confounding factors in our empirical analysis and disturb our evaluation of the relationship between the participation of CROs in risk management duties and value creation. Hence, it is necessary to disentangle the CRO role from the other ERM proxies. We tackle this issue by creating two score groups that isolate ERM proxies

from the CRO role. Therefore, we develop two score groups that capture seven components related to risk management and four to risk governance in our sample period as proxies of the ERM practice.

Our first score group is based on a proxy of firm risk scope (in accordance to CAS, 2003; Segal, 2011; Pagach & Warr, 2011; NAIC, 2014; COSO, 2017; Florio & Leoni, 2017), we hand-collected descriptive characteristics from each firm-statement that comprises: (1) a risk management strategic process, a fullness risk management concerning every area of the company, and an addressed integrated risk management procedure to all business units and all products segments; (2) a descriptive scope of an integrated framework across risk types; and (3) a descriptive risk assessment conducted by the board to its businesses (at least annually). For each one of the three characteristics above, we adopt a group of keywords to capture the scope of an enterprise-wide risk management, that is addressed in the section of risk oversight (DEF 14A form), which: *holistic, strategic, enterprise-wide, types of risks*, and *risk assessment* represents a company risk management practice that could be conclusive as a holistic scope.

Table 2. Regression results for firm value (*Tobin's Q*).

Variable	Pooled OLS model	Full maximum-likelihood treatment effects model	
		<i>CRO</i> (Equation 1)	<i>Tobin's Q</i> (Equation 2)
<i>Constant</i>	0.5115 (0.2162) **	-11.2748 (2.5328) ***	0.2655 (0.2284)
<i>SIZE</i>	-0.0201 (0.0199)	0.3615 (0.1137) ***	-0.0102 (0.0218)
<i>LEVERAGE</i>	-0.0016 (0.0024)	-0.0136 (0.0158)	-0.0017 (0.0023)
<i>ROA</i>	0.0072 (0.0026) ***	-	0.0074 (0.0026) ***
<i>BETA</i>	0.0271 (0.0101) ***	0.1564 (0.1911)	0.0301 (0.0127) **
<i>SALESGROWTH</i>	0.0203 (0.0164)	-	0.0176 (0.0148)
<i>DIVIDENDS</i>	0.0221 (0.0211)	0.0503 (0.3287)	0.0225 (0.0233)
<i>DIV_INT</i>	0.0233 (0.0421)	0.0024 (0.3625)	0.0324 (0.0419)
<i>DIV_IND</i>	0.0117 (0.0343)	-0.5575 (0.4575)	-0.0025 (0.0362)
<i>BIG4</i>	-0.0611 (0.0495)	-	-0.0721 (0.0486)
<i>BOARDSIZE</i>	0.0859 (0.0842)	-	0.0956 (0.0850)
<i>BOARDIND</i>	-0.0386 (0.0706)	-	-0.0360 (0.0693)
<i>CEO_DUALITY</i>	0.0102 (0.0192)	-	0.0123 (0.0182)
<i>INST_OWNER</i>	0.0014 (0.0007) *	0.0069 (0.0097)	0.0015 (0.0008) **
<i>INSIDERS</i>	-0.0013 (0.0014)	-	-0.0012 (0.0014)
<i>CEO_COMPENSATION</i>	0.0390 (0.0173) **	0.4577 (0.1826) **	0.0502 (0.0191) ***
<i>CRO (Reference = No)</i>	-0.0374 (0.0287)	-	-0.1647 (0.0566) ***
<i>Years control (Dummies of YEAR)</i>	Yes***	Yes	Yes***
<i>Sector control (Dummies of SECTOR)</i>	Yes***	Yes	Yes***
No. of observations (firm-years)	742		742
No. of clusters (insurers)	91		91
<i>R</i> ²	0.4423		-
Mean VIF	2.17		-
Log pseudolikelihood	-		131.1290
Wald test of independent equations (p-value)	-		7.7900 (0.0053)***

Levels of significance: * - 10%; ** - 5%; and *** - 1%.

In the sequence, according to CAS (2003), Segal (2011), Gatzert and Martin (2015), and COSO (2017), we proceed to capture characteristics that include: (4) all comprehensive risk

categories and; (5) a description that risk management is focused on key risks. This part aggregates the keywords that enhance the scope of different risks categories than traditional ones, such as credit, liquidity, reputational, and operational risk. Based on this part, we search for four keywords in the section of risk management of each form: *credit*, *liquidity*, *reputational*, and *operational* in conjunction with the word *risk*, and *key risks*.

Table 3. Description of attributes and ERM and Risk Governance Scores.

SCORE 1	DESCRIPTION	KEYWORDS
<i>AttributeERM_01</i>	Has the company declared that the risk management (RM) framework an enterprise-wide scope? Yes =1; No = 0	holistic, strategic, enterprise-wide
<i>AttributeERM_02</i>	Is there a description that RM framework is integrated across risk types (aggregate risk profile; measured in all business units and all products segments)? Yes =1; No = 0	types of risks
<i>AttributeERM_03</i>	Does the company annually conduct a risk assessment (oversight) of its businesses? Yes =1; No = 0	risk assessment
<i>AttributeERM_04</i>	Is there a description that all risk categories are included in the RM framework? Yes =1; No = 0	credit, liquidity, reputational, and operational risk
<i>AttributeERM_05</i>	Is there a description that RM framework is focused on key risks? Yes =1; No = 0	key risks
<i>AttributeERM_06</i>	Is there a description that RM framework is focused on increasing value to shareholder? Yes =1; No = 0	shareholder, value to shareholder
<i>AttributeERM_07</i>	Is there a description that RM framework includes the definition of risk appetite and tolerances? Yes =1; No = 0	risk appetite, risk tolerance
<i>ERM_score</i>	Sum of the following attributes: <i>AttributeERM_01</i> , <i>AttributeERM_02</i> , <i>AttributeERM_03</i> , <i>AttributeERM_04</i> , <i>AttributeERM_05</i> , <i>AttributeERM_06</i> , <i>AttributeERM_07</i>	
<i>ERM_advanced</i>	Dummy variable equal to 1 if <i>ERM_score</i> is equal to or higher than 5, and 0 otherwise	
SCORE 2	DESCRIPTION	KEYWORDS
<i>AttributeRG_01</i>	Is the Board of Directors responsible for oversight risk management practices and/or the ERM? Yes =1; No = 0	risk oversight
<i>AttributeRG_02</i>	Does the audit committee monitor the oversight and assessment of risk (not only in financial reporting and internal controls)? Yes =1; No = 0	risk assessment, audit committee
<i>AttributeRG_03</i>	Is there a description that compensation plans to senior executives (review and assessment) is integrated with RM framework? Yes =1; No = 0	compensation plan, chief risk officer
<i>RISK_COMMITTEE</i>	Does the company have a specific risk committee? Yes =1; No = 0	risk committee, audit and risk committee, and internal control and risk committee
<i>RISKGVERNANCE_score</i>	Sum of the following attributes: <i>AttributeRG_01</i> , <i>AttributeRG_02</i> , <i>AttributeRG_03</i> , <i>RISK_COMMITTEE</i>	
<i>RISKGVERNANCE</i>	Dummy variable equal to 1 if <i>RISKGVERNANCE_score</i> is equal to or higher than 2, and 0 otherwise	

For the last two attributes in the first group, according to CAS (2003), Segal (2011), Pagach and Warr (2011), Baxter et al. (2013), Lundqvist (2014), COSO (2017), and S&P (2005, 2017), we assumed that the company risk management framework addresses: (6) a description that the risk management scope focus on increasing value to the shareholder; and (7) a description of risk

appetite and level of tolerance. For this part, we take on four keywords that hold an assumption that a firm provides a risk management framework and shows an awareness of risk appetite, and tolerance, although still focus on shareholder wealth. The keywords are *shareholder value*, *value to shareholder*, *risk appetite*, and *risk tolerance*.

In the second score group, we extract information on firm-risk, approaching to the governance process of managing risk in each firm-year as the main target in our empirical study. In accordance to NYSE (2004), Gordon, Loeb and Tseng (2009), Aebi et al. (2012), Federal Reserve Regulation YY (2012), Baxter et al. (2013), Lundqvist (2014), Whitman (2015), U.S. Securities and Exchange Commission (2009, 2017a), Florio and Leoni (2017), and S&P (2005, 2017), we hand-collected data from both DEF 14A and 10-k filings and create four dummies that include the board of directors' responsibilities, the board committees, the internal control, and the compensation plan guidelines and process. For this assumption, we procedure to: (1) capture the addressed responsibility in risk oversight, and the ERM framework itself in the section of the board of directors; (2) analyze if the board addresses the assessment of risk to the audit committee as sponsor of the procedure of risk oversight; (3) identify whether the board addresses the responsibility of reviewing and assessing all senior executive compensation plans to the department of risk management (i.e. ERM) or to the CRO, in order to evaluate excessive risk-taking by them from the section of compensation plan guideline; and (4) we monitor whether the company has a specific risk committee inside an executive board structure, or addresses the committee of risk to another, not only to the audit but also to the internal control. Based on these four assumptions of risk governance, we structure eight keywords: *risk oversight*, *risk assessment*, *audit committee*, *compensation plan*, *chief risk officer*, *risk committee*, *audit and risk committee*, and *internal control and risk committee*.

For the two score groups, every keyword matching in each firm-year disclosure, we read the entirely paragraph to get a better sense of whether or not the firm risk management scope enhances the group of characteristics that shall be understood as an ERM attributes, and so is actually being used by each firm-year. Finally, we summarize the score for each firm-year, wherein it ranges from zero to seven for *ERM_score*, and from zero to four for *RISKGOVERNANCE_score*. Table 3 provides a description of each component considered for our score groups.

As before, we adopt a maximum-likelihood treatment effects model that simultaneously estimates the decision to employ a CRO and the effect of having a CRO on *Tobin's Q*. However, our new specification considers our two scores as control variables. Hence, we point out that our control for the ERM proxies (*ERM_advanced* and *RISKGOVERNANCE*) in our two scores allow us to estimate the relationship between the CRO and value creation in a cleaner way. Our results remain qualitatively the same as those presented in Table 2.

Table 4. Pooled OLS regression results for firm value (*Tobin's Q*) and the influence, reporting and compensation incentives of the CRO.

Variable	(1)	(2)	(3)	(4)
<i>Constant</i>	0.8277 (0.2837) ***	0.9561 (0.2559) ***	0.8793 (0.2798) ***	1.0158 (0.2478) ***
<i>SIZE</i>	-0.0579 (0.0126) ***	-0.0598 (0.0110) ***	-0.0597 (0.0126) ***	-0.0619 (0.0107) ***
<i>LEVERAGE</i>	0.0018 (0.0022)	0.0018 (0.0019)	0.0016 (0.0023)	0.0016 (0.0018)
<i>ROA</i>	0.0061 (0.0034) *	0.0063 (0.0029) **	0.0066 (0.0032) **	0.0067 (0.0027) **
<i>BETA</i>	0.0122 (0.0125)	0.0201 (0.0107) *	0.0101 (0.0126)	0.0198 (0.0103) **
<i>SALESGROWTH</i>	-0.0492 (0.0148) ***	-0.0510 (0.0129) ***	-0.0528 (0.0159) ***	-0.0556 (0.0144) ***
<i>DIVIDENDS</i>	0.0278 (0.0323)	0.0159 (0.0326)	0.0273 (0.0329)	0.0132 (0.0332)
<i>DIV_INT</i>	0.0554 (0.0299) *	0.0793 (0.0274) ***	0.0629 (0.0294) **	0.0873 (0.0262) ***
<i>DIV_IND</i>	0.0654 (0.0358) *	0.0521 (0.0344)	0.0466 (0.0362)	0.0328 (0.0352)
<i>BIG4</i>	-0.0782 (0.0403) *	-0.0554 (0.0352)	-0.0697 (0.0396) *	-0.0426 (0.0341) *
<i>BOARDSIZE</i>	0.3171 (0.1100) ***	0.2776 (0.1017) ***	0.2787 (0.1060) ***	0.2466 (0.0965) **
<i>BOARDIND</i>	-0.2021 (0.0794) **	-0.1930 (0.0669) ***	-0.1713 (0.0743) **	-0.1721 (0.0595) ***
<i>CEO_DUALITY</i>	0.0391 (0.0193) **	0.0384 (0.0179) **	0.0362 (0.0188) *	0.0374 (0.0172) **
<i>INST_OWNER</i>	0.0009 (0.0009)	0.0017 (0.0008) **	0.0004 (0.0010)	0.0013 (0.0009)
<i>INSIDERS</i>	-0.0017 (0.0011)	-0.0013 (0.0009)	-0.0015 (0.0010)	-0.0011 (0.0009) *
<i>CEO_COMPENSATION</i>	0.0358 (0.0193) *	0.0255 (0.0166)	0.0357 (0.0184) *	0.0248 (0.0153) *
<i>ERM_advanced</i>	-0.0153 (0.0121)	-0.0174 (0.0121)	-0.0152 (0.0126)	-0.0179 (0.0124)
<i>RISKGVERNANCE</i>	0.0192 (0.0139)	0.0261 (0.0124) **	0.0149 (0.0137)	0.0234 (0.0122)
<i>CRO_EXECDIRECTOR</i>	-0.0609 (0.0262) **	-0.0502 (0.0251) **	-	-
<i>CRO_OFFICER</i>	-	-	-0.0719 (0.0297) **	-0.0706 (0.0308) *
<i>CRO_REPORTtoCEOorCFO</i>	0.0016 (0.0214)	0.0042 (0.0215)	-0.0151 (0.0180)	-0.0100 (0.0175)
<i>CRO_REPORTtoRCorBOARD</i>	-0.0565 (0.0412)	-0.0405 (0.0373)	-0.0282 (0.0400)	-0.0138 (0.0363)
<i>CRO_COMPENSATIONPLANS</i>	0.0404 (0.0241) *	0.0265 (0.0216)	0.0502 (0.0244) **	0.0346 (0.0196) *
<i>CRO_EQUITYBASEDPLAN</i>	0.0519 (0.0174) ***	-	0.0783 (0.0252) ***	-
<i>CRO_COMPENSATIONSTOCK</i>	-	-0.0287 (0.0271)	-	-0.0098 (0.0300)
<i>CRO_COMPENSATIONOPTIONS</i>	-	0.0948 (0.0287) ***	-	0.1073 (0.0303) ***
<i>Years control (Dummies of YEAR)</i>	Yes***	Yes***	Yes***	Yes***
<i>Sector control (Dummies of SECTOR)</i>	Yes***	Yes***	Yes***	Yes***
No. of observations (firm-years)	233	233	233	233
No. of clusters (insurers)	37	37	37	37
<i>R²</i>	0.7142	0.7335	0.7073	0.7384
Mean VIF	3.08	3.25	3.17	3.28

Levels of significance: * - 10%; ** - 5%; and *** - 1%.

We then run a Pooled OLS regression to capture the relationship between firm value (*Tobin's Q*) and the CRO compensation plans. We consider the participation, influence, reporting and compensation incentives of the CRO in our regression model. We also control for the ERM proxies (*ERM_advanced* and *RISKGOVERNANCE*). Table 4 shows our results.

We find a negative and significant association between firm value and CRO influence (*CRO_EXECDIRECTOR* and *CRO_OFFICER*). In terms of their relationship with firm value, both variables predict *Tobin's Q* negatively. The results are consistent with those of Aebi et al. (2012), who find a negative but insignificant association. Our results are also robust to the two indicators of CRO influence. Unlike Aebi et al. (2012) and Grace et al. (2015), we find no significant relationship between firm value and the CRO reporting variables (*CRO_REPORTtoCEOorCFO* and *CRO_REPORTtoRCorBOARD*). Most importantly, we present evidence of a positive association between firm value and the incentives to compensate the CRO (including the CRO in the compensation committee of the board, *CRO_COMPENSATIONPLANS*, and providing the CRO with an equity-based compensation plan, *CRO_EQUITYBASEDPLAN*), supporting hypotheses H5 and H6. *CRO_COMPENSATIONPLANS* presents a positive relationship with firm value, statistically significant at the 1% and 5% levels for the hypothesis H5. We find a similar result for *CRO_EQUITYBASEDPLAN*, which is significant at the 1% level for the hypothesis H6. The different scenarios show that option-based compensation to the CRO (*CRO_COMPENSATIONOPTIONS*) is positive and statistically significant. Considering the CRO payment incentives used to enhance firm value, our study thus sheds light on the findings of Grace et al. (2015) and Pernell et al. (2017). From the perspective of corporate governance, our results are in line with those of Baker et al. (1988) and Kuo et al. (2013).

5 CONCLUSIONS

This study investigates the relationship between CROs' compensation incentives and firm value. The focus on U.S. publicly traded insurers allows us to gauge the CRO's role in adding value for a firm. Hence, our research focuses on the participation of the CRO in the risk management process. We follow the literature by controlling for the determinants of firm value. In particular, we include the firm's characteristics and corporate governance variables in our analysis. Our study thus builds on previous studies by exploring the characteristics of the CRO. We provide information on the influence and reporting of the CRO as well as their compensation incentives.

Our empirical approach evaluates the relationship between the participation of CROs in risk management duties and value creation. Based on a maximum-likelihood treatment effects model, our regressions simultaneously estimate the decision of adopting a CRO and the influence of compensation incentives on firm value. Our research goes further and evaluates the relationship between CRO compensation plans and firm value considering solely firms with a CRO in our sample period. We rely on OLS and propensity score matching models to tackle our research questions.

Collectively, we add to the literature by providing evidence that CRO compensation plans present relationship with firm value. Our results show that simply having a CRO does not add value to the company. In fact, the presence of a CRO can lower value when incentives based on compensation plans for risk management duties are lacking. We also provide robust results for different specifications.

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