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內部控制缺失對經理人權益薪酬誘因與公司風險性投資之影響*

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摘要

美國沙賓法案 404 款要求上市公司每年需自我評估財務報導之內部控制是否有缺失，並要求會計師針對客戶之內部控制評估結果出具意見。本研究旨在探討內部控制缺失對經理人權益薪酬誘因與公司風險性投資之影響。權益薪酬誘因可能導致經理人過度投資進而掩飾財務報表，一旦公司之內部控制出現重大缺失，董事會可能為了降低財務報表誤述之風險，而減少經理人之權益薪酬誘因，進而減少風險性投資。研究結果發現，有內部控制重大缺失（違反 404 款）之公司，其經理人之權益薪酬誘因較低；此外，在控制權益薪酬誘因後，內部控制有重大缺失之公司，有較低之風險性投資。最後，若公司改善內部控制之缺失，董事會也會再度調升經理人權益薪酬誘因。本研究提供證據顯示董事會在設計經理人權益薪酬結構與決定公司投資水準時，會將內部控制品質納為考慮因素。

關鍵詞：內部控制、總經理薪酬、權益薪酬誘因、公司風險性投資

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The Effect of Internal Control Material Weaknesses on Executive Equity Incentives and Corporate Risk-Taking*

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Abstract

In this study we examine how CEO equity incentives and firms' risk-taking behavior are influenced by material weaknesses in internal controls. We find that the disclosure of such material weaknesses is negatively associated with the vega and delta of CEO compensation, suggesting that firms with adverse SOX 404 opinions reduce equity incentives to discourage the CEO from taking excessive risks. Moreover, this association seems to be stronger for more severe company-level internal control weaknesses. In addition, we find that after controlling for the effect of equity incentives on risk-taking, firms receiving adverse SOX 404 opinions have less R&D and capital expenditure investment. Further remediation analysis shows that the boards not only make downward adjustments for CEO equity incentives and risky investments when internal controls are found to be ineffective, but also make upward adjustments when material weaknesses are remediated. Our study contributes to both the compensation and internal control literature by providing evidence that internal control quality plays a role in a board's decision to design CEO equity incentives as well as the level of a firm's risk-taking.

Keywords: *Internal control, CEO compensation, Equity incentives, Corporate risk-taking.*

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1. INTRODUCTION

In an attempt to improve corporate transparency and investor confidence, the Sarbanes–Oxley Act (SOX) introduced a host of reforms, including certification requirements and criminal penalties for executive officers, more stringent internal controls, independent audit committees, disclosure regulation, and a variety of rules impacting the audit and analyst industries. Many studies provide evidence that SOX has led to unintended firm behaviors such as going private, going dark, delisting, and staying small (Engel, Hayes, and Wang 2007; Leuz, Triantis, and Wang 2008; Piotroski and Srinivasan 2008; Hochberg, Sapienza, and Vissing-Jorgensen 2009). Such economic consequences are attributed to the large compliance costs of the regulation, among which the internal control requirement is a highly controversial section.

SOX Section 404 requires CEOs and CFOs to assess their firm's internal control structure and procedures for financial reporting and provide a certification report annually[1]. A separate report is required from the firm's external auditor providing an attestation opinion on management's assessment of internal control effectiveness. Auditors are required to indicate in their reports any material weaknesses found in a company's internal controls[2]. When one or more material weaknesses exist, auditors should issue an adverse SOX 404 opinion. A clean (unqualified) SOX 404 opinion indicates that internal controls are effective[3].

Researchers have assessed the costs and benefits of SOX Section 404 from different aspects. Some studies find that the implementation of Section 404 creates significant additional work for auditors, leading to higher audit fees and more audit delays (Ettredge, Li, and Sun 2006; Raghunandan and Rama 2006). Other studies show that the internal control requirement improves the quality of financial reporting (Altamuro and Beatty 2010) and reduces firms' cost of capital (Ashbaugh-Skaife, Collins, Kinney, and LaFond 2009; Dhaliwal, Hogan, Trezevant, and Wilkins 2011). In this paper, we examine how the

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[1] Although the Treadway Commission's Committee of Sponsoring Organizations (COSO) framework broadly defines internal control in terms of achieving (1) the effectiveness and efficiency of operations, (2) the reliability of financial reporting, and (3) compliance with applicable laws and regulations, SOX Section 404 only pertains to internal control related to the reliability of financial reporting.

[2] Material weakness is the key concept in evaluating the effectiveness of internal controls under SOX 404. The Public Company Accounting Oversight Board (PCAOB) defines a material weakness as a significant deficiency, or a combination of significant deficiencies, that results in a more than remote likelihood that a material misstatement of the annual or interim financial statements will not be prevented or detected (PCAOB Auditing Standards No. 2 2004). On May 24, 2007, the PCAOB adopted Auditing Standard No. 5, which replaces the term "more than a remote likelihood" with "reasonably possible" when defining internal control material weaknesses.

[3] While Section 302 of SOX also requires CEOs and CFOs to disclose the effectiveness of, and significant changes in, internal control procedures, we believe auditors' opinions issued under SOX 404 are more objective. Auditors' SOX 404 opinions are mandatory and independent assessments of firms' internal control effectiveness. In contrast, management disclosures under SOX 302 are subject to considerable discretion (e.g., Doyle, Ge, and McVay 2007a; Ashbaugh-Skaife, Collins, Kinney, and LaFond 2008).

provision of SOX 404 opinions affects executive equity incentives and corporate risk-taking.

We first examine whether firms receiving adverse SOX 404 opinions (MW firms) have lower CEO equity incentives than firms with clean SOX 404 opinions (non-MW firms). According to agency theory, shareholders can align the interests of an underdiversified and risk-averse manager with their wealth by offering incentives in the manager's compensation scheme. However, equity incentives motivate managers to increase stock return volatility and stock prices by undertaking risky projects. If those projects cannot create positive returns in the end, managers may manipulate financial reporting to disguise the bad performance (Cheng and Farber, 2008). Many studies provide evidence that equity-based compensation contributes to subsequent earnings management and accounting irregularities (e.g., Cheng and Warfield 2005; Bergstresser and Philippon 2006; Burns and Kedia 2006; Feng, Ge, Luo, and Shevlin 2011; Armstrong, Larcker, Ormazabal, and Taylor 2013). If a firm reports material weaknesses in internal controls, we expect that the board of directors will reduce equity incentives to prevent the CEO from engaging in excessive risk-taking which may lead to future financial misreporting.

Although the above arguments predict a negative association between internal control effectiveness and CEO equity incentives, it is also possible that we might observe a positive association. Since material weaknesses in internal controls reduce the credibility of accounting-based performance measures (Indjejikian and Matějka 2009; Costello and Wittenberg-Moerman 2011; Hsu and Liao 2012), the board might consider increasing the weight placed on equity-based performance measures. As a result, CEO equity incentives could increase after the firm's disclosure of internal control material weaknesses. The relation between internal control effectiveness and equity incentives is thus an empirical question.

Our test of the association between internal control quality and equity incentives corroborates the research by Balsam, Jiang, and Lu (2014). Balsam et al. (2014) document that firms providing higher levels of CEO equity incentives are less likely to report material weaknesses in internal controls, suggesting that equity-based compensation increases management's incentives to maintain higher internal control quality. We consider another direction of causation by testing whether firms adjust the level of equity incentives based on the quality of internal controls.

We next examine how changes in internal control material weaknesses are associated with firms' risk-taking behavior. This test extends recent papers that investigate the effect of SOX on corporate risk-taking. While Bargeron, Lehn, and Zutter (2010) and Cohen, Dey, and Lys (2013) find that firms reduce their risky investments after the passage of SOX, these studies do not examine the cross-sectional variation between internal control quality and corporate investment behavior. Lambert, Leuz, and Verrecchia (2007) show

that the quality of the accounting information system, including internal controls, can affect a firm's real decisions. The disclosure of internal control material weaknesses affects investors' risk assessments; thus, firms with ineffective internal controls bear higher costs of capital (Ashbaugh-Skaife et al. 2009). Given the higher idiosyncratic risk and increased cost of raising funds, we expect that the board of a firm with internal control material weaknesses will induce the CEO to take on less risky projects.

To investigate our research questions, we use the CEO's portfolio delta and vega to measure equity incentives because these two measures directly reflect the sensitivity of the CEO's wealth to the firm's share performance (including stock price and stock risk). We adopt a change specification as a change analysis allows us to draw stronger causal inferences by controlling for unobservable characteristics. The empirical results show that the disclosure of the material weaknesses is negatively associated with vega and delta, supporting the argument that firms with adverse SOX 404 opinions reduce equity incentives to discourage the CEO from taking excessive risks. We also find that firms receiving adverse SOX 404 opinions have less R&D and capital expenditure investment[4]. These results complement the findings on equity incentives and suggest that firms with ineffective internal controls will make less risky investments for the fear that operation complexity further increases the compliance costs as well as the exposure to litigation risk. Further remediation analysis suggests that once the material weaknesses are remediated, the board will adjust upward the CEO's equity incentives and the firm's risky investments will also increase relative to those of firms whose internal controls remain ineffecitve. We also find some evidence that the changes in CEO equity incentives and risky investments are more significant for firms having more severe company-level material weaknesses compared to those having account-specific material weaknesses.

This paper contributes to the extant literature in the following ways. First, we extend the literature on internal control over financial reporting by showing additional managerial consequences resulting from internal control weaknesses. Prior research has found that firms having internal control problems experience higher executive turnover as well as reductions in executive compensation (e.g., Li, Sun, and Ettredge 2010; Wang 2010; Hoitash, Hoitash, and Johnstone 2012; Hsu and Liao 2012). Nevertheless, these studies tend to focus on the level of compensation. Our study differs from this literature in that we focus specifically on risk-taking incentives arising from equity compensation[5]. We find

[4] Cheng, Dhaliwal, and Zhang (2013) find that firms improve their investment efficiency after the disclosure of material weaknesses in internal controls. Our paper differs from their study in that we do not examine the deviation from a normal level of investment (either overinvestment or underinvestment). More specifically, we test whether a firm's choice of risky investments is affected by the internal control quality.

[5] Prior studies (i.e., Core and Guay 2002; Hayes, Lemmon, and Qiu 2012) suggest that the risk incentives provided by stocks and options are better reflected in the sensitivity of the executive's wealth to changes in stock price (i.e., delta) and stock price volatility (i.e., vega). However, the effect of internal control quality on equity risk incentives has not been explored in the literature.

that firms also adjust executives' equity-based risk incentives as well as risk-taking behavior based on the quality of internal controls. When the internal control becomes ineffective, the board lowers managerial equity incentives and the level of risk-taking. On the other hand, equity incentives and risky investments are adjusted upward after internal control weaknesses are remediated.

Second, we contribute to the compensation literature regarding equity incentives. A considerable literature finds that excessive equity incentives are associated with increased financial misreporting such as earnings management or restatements (e.g., Burns and Kedia 2006; Efendi, Srivastava, and Swanson 2007; Feng et al. 2011; Armstrong et al. 2013). Besides, many accounting irregularities as well as SEC sanctions are preceded by internal control weaknesses (Hogan, Lambert, and Schmidt 2013; Rice, Weber, and Wu 2015)[6]. Nevertheless none of the prior literature tests whether firms reduce managerial equity incentives upon their discovery of internal control material weaknesses. Our study provides implications that reducing managerial equity incentives in accordance with internal control weaknesses might be a mechanism to prevent possible future misstatements. These results complement Cheng and Farber (2008), who find that firms reduce CEOs' option-based compensation following earnings restatements and that these reductions decrease CEOs' incentives to make excessively risky investments. While Cheng and Farber (2008) focus on accounting irregularities, our study augments the setting to internal control weaknesses which are less severe and more recurring. We also extend the work of Cheng and Farber (2008) by using more comprehensive equity incentive measures which represent total wealth changes beyond option grants and better capture risk-taking incentives[7].

The rest of this paper proceeds as follows: Section 2 reviews related literature and develops the research hypotheses. Section 3 discusses our research design. Section 4 describes the sample, data, and summary statistics. Section 5 presents the main empirical results. Section 6 contains additional analyses, and Section 7 concludes the paper.

2. LITERATURE AND RESEARCH HYPOTHESES

2.1 Sox Internal Control Literature

SOX has prompted many researchers to investigate the determinants as well as consequences of internal control weaknesses. Studies find that firms with internal control problems tend to be younger, more complex, financially constrained, and have significant organizational changes (e.g., Ge and McVay 2005; Ashbaugh-Skaife, Collins, and Kinney

[6] A univariate test of our sample shows that 39.2% of MW firms incurred restatements while 6.9% of non-MW firms had restatements during 2004-2014, results consistent with the prior literature.

[7] Our measures of investments (i.e., R&D and capital expenditures) are also different from those of Cheng and Farber (2008), who examine stock return volatility. Besides, Cheng and Farber (2008) conduct only univariate tests of changes in risk-taking, whereas we perform multivariate regressions that control for other confounding factors.

2007; Doyle et al. 2007a). Research also shows that weak internal controls are related to poor accruals quality (e.g., Ashbaugh-Skaife et al. 2008; Chan, Farrell, and Lee 2008; Doyle, Ge, and McVay 2007b). Moreover, Feng, Li, and McVay (2009) document that firms with ineffective internal controls rely on erroneous internal management reports to generate forecasts and, thus, provide less accurate earnings guidance.

Other studies investigate the market reactions to internal control problems (Hammersley, Myers, and Shakespeare 2008), whether investors find disclosures of material weaknesses informative (Ogneva, Subramanyam, and Raghunandan 2007), and whether these disclosures are associated with a firm's cost of equity (Beneish, Billings, and Hodder 2008; Ashbaugh-Skaife et al. 2009) as well as cost of debt (Dhaliwal et al. 2011; Kim, Song, and Zhang 2011). Generally, this stream of research finds that firms experience negative capital market consequences once internal control material weaknesses are revealed.

Another stream of literature examines the managerial consequences when firms are found to have weak internal controls. Li et al. (2010) and Wang (2010) find a higher likelihood of CFO turnover when companies receive adverse SOX 404 opinions. Other studies find that firms with internal control material weaknesses have lower CFO compensation (Hoitash et al. 2012; Hsu and Liao 2012). Despite the job and pay penalties, however, Balsam et al. (2014) suggest that equity-based compensation can motivate executives to develop and maintain effective internal controls over financial reporting. Cheng et al. (2013) also document that the disclosure of internal control material weaknesses induces firms to increase real investment efficiency.

2.2 Compensation Incentives and Risk-Taking

The literature suggests that managerial incentives are significantly influenced by the compensation structure (e.g., Guay 1999). Jensen and Murphy (1990) also argue that the sensitivity of executive wealth to stock price, namely, delta, is seen as aligning the incentives of managers with the interests of shareholders. Many researchers suggest that option-based compensation provides convex payoffs that can encourage managerial risk-taking as increases in stock return volatility increase the value of the options (Haugen and Senbet 1981; Smith and Stulz 1985).

Many empirical studies provide evidence that equity incentives are positively associated with managers' risk-taking behavior. For example, Rajgopal and Shevlin (2002) find a positive association between exploration risk and employee stock options, as well as other risk-related incentives. Coles, Daniel, and Naveen (2006) document that higher sensitivity to stock volatility in CEO compensation induces riskier policy choices such as more investment in R&D and higher leverage. That is, equity incentives can induce managers to invest in high-risk, high-return projects on behalf of risk-neutral shareholders.

Some studies specifically examine how executive compensation and corporate investments change after SOX. For example, Carter, Lynch, and Zechman (2009) document that firms place more weight on earnings in executive bonus contracts following the enactment of SOX. However, Chang, Choy, and Wan (2012) and Cohen et al. (2013) show that SOX leads to a decrease in the sensitivity of CEOs' wealth to changes in shareholder wealth. The decline of incentive compensation is linked to a reduction in risk-taking in the post-SOX period (Cohen et al. 2013). Overall speaking, the literature indicates that SOX reduces managers' risk-taking incentives and induces a weaker incentive alignment between managers and shareholders.

2.3 Hypothesis Development

The conventional wisdom of agency theory suggests that compensation and performance should be closely related to provide managers with sufficient incentives to act in the shareholders' interests (Holmstrom 1979, Jensen and Murphy 1990). Research has shown a substantial increase in the sensitivity of CEO wealth to stock price (or delta) due to the widespread use of equity-based compensation (Hall and Liebman 1998). Also, the increase in option grants and holdings is accompanied by an increase in the sensitivity of CEO wealth to stock price volatility (or vega), which can potentially decrease the possibility of underdiversified and risk-averse managers passing up risky but positive net present value projects (Core and Guay 2002).

However, a body of evidence suggests that the use of equity incentives also increases the likelihood of financial misreporting including accruals management and accounting restatements (e.g., Cheng and Warfield 2005; Bergstresser and Philippon 2006; Burns and Kedia 2006; Jiang, Petroni, and Wang 2010; Feng et al. 2011; Armstrong et al. 2013). One critical reason is that equity compensation induces managers to engage in excessively risky projects. When these risky investments do not produce net positive returns in the end, managers may attempt to mask the resulting underperformance with earnings manipulation (Burns and Kedia 2006) or income smoothing (Shu and Thomas 2017). We expect that a board of directors will be more concerned about the likelihood of financial misstatements when there are internal control material weaknesses. Nagy (2010) documents a positive relation between SOX Section 404 noncompliance and the issuance of materially misstated financial statements. Plumlee and Yohn (2010) also show that the majority of restatements are attributed to internal company errors. Cheng and Farber (2008) find that firms experiencing earnings restatements significantly reduce the CEO's compensation in the form of options following restatements and that such a reduction is accompanied by a decrease in the riskiness of investments and an improvement of subsequent operating performance. Therefore, adjusting compensation schemes seems to be an effective mechanism in reducing a CEO's incentives to make excessively risky investments. If a board of directors is concerned that the use of equity-based compensation exacerbates

financial misstatements, we expect that the reporting of material weaknesses in internal controls will induce the firm to reduce managers' equity incentives.

Notwithstanding the above arguments, it is possible to observe an opposite relation between internal control quality and equity incentives. Prior research suggests that internal control material weaknesses reduce the credibility of reported financial measures on which compensation contracts are often based (Indjejikian and Matějka 2009). Costello and Wittenberg-Moerman (2011) find that lenders decrease the use of financial covenants and financial-ratio-based performance pricing provisions in debt contracts for firms that disclose material weaknesses in internal controls. Hsu and Liao (2012) also document that the accounting-based pay-performance sensitivity of CEO/CFO compensation is lower for firms that receive adverse SOX 404 auditor opinions, suggesting that the compensation committees reduce the performance weight placed on accounting measures[8]. If ineffective internal controls lead to less use of accounting-based performance measures, we might observe more reliance on equity-based performance contracts leading to a positive association between internal control material weaknesses and CEO equity incentives. Based on the above competing arguments, we consider it an empirical question and develop the first set of hypothesis as follows:

H1a: Firms with internal control material weaknesses have lower CEO equity incentives than those with effective internal controls.

H1b: Firms with internal control material weaknesses have higher CEO equity incentives than those with effective internal controls.

Prior research has documented that firms face not only higher audit and accounting costs but also higher legal fees since SOX was enacted (Hartman 2007; Asthana, Balsam, and Kim 2009). Bargeron et al. (2010) show that the costs of complying with SOX lead to a decline in corporate risk-taking in the post-SOX period. Cohen et al. (2013) also find a reduction of CEO incentive-based compensation after SOX that is accompanied by a reduction of investments in risky projects. Although the findings of a decline in risky investments are attributable in part to the internal control provision of SOX, these prior studies have not tested how corporate investment behavior varies cross-sectionally with firms' internal control quality.

Many studies show that ineffective internal control can have a negative effect on firms' operating activities as it results in erroneous internal management reports used for operational decisions. Feng, Li, McVay, and Skaife (2015) find that firms with inventory-

[8] However, Hsu and Liao (2012) do not test whether the relative weight placed on market-based measures (i.e., the stock return) increases after internal control material weaknesses are discovered. Rather than testing the pay-performance sensitivity of accounting versus stock-based performance measures, our study examines how internal control weaknesses affect executives' risk-related equity incentives (namely, delta and vega).

related material weaknesses in internal controls have poor inventory management characteristics, such as lower inventory turnover and more inventory impairments. Cheng et al. (2013) conclude that managers of firms with ineffective internal controls make poor investments. Effective internal controls also enchance tax planning so that firms with material weaknesses have higher tax rates (Gallemore and Labro 2015; Bauer 2016). In summary, these studies indicate that management relies on internal information environments when making operational decisions. Since investment decisions such as capital budgeting and R&D expeditures also require internal reports generated from the internal control system, we expect the effectiveness of internal controls to affect investment decicions as well.

We argue that companies with ineffective internal controls will reduce their risky investments after the discovery of internal control material weaknesses. The reasons for this are two-fold. First, the disclosure of internal control material weaknesses triggers negative stock price reactions, and firms with adverse SOX 404 audit opinions encounter an increase in both the cost of equity and cost of debt (Hammersley et al. 2008; Ashbaugh-Skaife et al. 2009; Dhaliwal et al. 2011). Several studies in the finance literature have provided a theoretical foundation indicating that the cost of capital has a negative effect on corporate investment and is an important force in firms' capital budgeting decisions (Abel and Blanchard 1986; Pástor, Sinha, and Swaminathan 2008; Frank and Shen 2016). Economists also suggest that higher costs of financing tend to prevent firms from spending on R&D, which has more uncertain returns than ordinary investments (Hall 1992). As the dislcosure of internal control weaknesses could increase capital providers' risk premium as well as the scruity on managers' decisions to invest, these effects suggest a smaller amount of capital that a firm can raise, leading to lower investment (Sun 2016). Consequently, we expect firms having material weaknesses in internal controls to take on less risky investment projects due to higher costs of capital.

Second, the board of directors likely takes actions to ensure that the CEO's efforts are devoted to fixing internal control problems. For example, Hsu and Liao (2012) document that compensation committees will reduce CEO compensation when their firms receive adverse SOX 404 opinions. As the remediation of internal control weaknesses takes time, such remediation may divert managers' attention and firm resources from investments (Eisenberg 2007). Besides, engaging in risky activities increases the complexity of transactions and makes it more difficult to maintain effective internal controls or to remediate existing control problems (Ashbaugh-Skaife et al. 2007; Doyle et al. 2007a). If in the test of H1 we find evidence that boards reduces equity incentives for firms with internal control weaknesses, we should also find these firms to have less risky investments given that equity incentives and risk-taking are positively related. Moreover, weak internal controls allow executives to manipulate performance when the benefits of risky

investments are not realized (Nagy 2010). If boards are concerned about equity incentives leading to excessively risky investments which in turn increase the chance of financial misreporting, we expect that relative to non-MW firms, the boards of MW firms are less likely to approve high-risk investments unless the material weakness of internal controls have been remediated. Our second hypothesis is stated as follows:

H2: Firms with internal control material weaknesses have lower risk-taking than those with effective internal controls.

3. RESEARCH DESIGN

3.1 Internal Control Quality and Equity Incentives

Our first empirical model tests whether firms adjust the CEO's portfolio delta and vega in reference to material weaknesses in internal controls. To mitigate concern about the omitted variables problem and provide stronger causal inferences, we perform a change analysis. A change model allows us to control for unobservable company characteristics that might potentially drive the results. The model specification is as follows:

$$\begin{aligned}\Delta EQUITY_{i,t} = {} & \alpha_0 + \alpha_1 \Delta ICW_{i,t} + \alpha_2 \Delta SIZE_{i,t} + \alpha_3 \Delta RET_{i,t} + \alpha_4 \Delta MB_{i,t} + \alpha_5 \Delta LEVERAGE_{i,t} \\ & + \alpha_6 \Delta CASHCOMP_{i,t} + \alpha_7 \Delta RETSTD_{i,t} + \varepsilon_{i,t}. \end{aligned} \quad (1)$$

In the above equation, all variables are calculated as the change from year *t*-1 to year *t*. To test the first hypothesis, we use two equity incentive measures: the sensitivity of the CEO's wealth to changes in equity price (*DELTA*) and the sensitivity of the CEO's wealth to changes in equity risk (*VEGA*). Following the existing literature (Core and Guay 2002; Coles et al. 2006), we calculate a CEO's portfolio *DELTA* as the partial derivative of stock and option value with respect to stock prices, and this represents a dollar change in the executive's wealth for a 1% change in stock price. Similarly, *VEGA* is the partial derivative of stock and option value with respect to a firm's stock price volatility, and this represents the CEO's wealth change in value with respect to a 1% change in stock price volatility[9].

Our main independent variable of interest is the existence of material internal control weaknesses, based on auditors' SOX 404 opinions (*ICW*). Relative to managers' self-assessments under SOX Section 302, Section 404 opinions represent a more objective measure of the quality of internal controls. We define *ICW* as 1 if the firm in question receives an adverse SOX 404 opinion (indicating internal control ineffectiveness), and 0 if the firm in question receives an unqualified SOX 404 opinion (indicating internal controls effectiveness).

[9] As a robustness check, we also take the natural logarithm of *DELTA* and *VEGA* as in Armstrong et al. (2013). The empirical results are qualitatively the same.

The control variables are consistent with those used in prior research (Guay 1999; Coles et al. 2006). CEOs of larger firms are likely to have higher equity incentives (Core and Guay 1999). We use logarithm of sales (*SIZE*) as a proxy for firm size, and expect *SIZE* to be positively related to both of our equity incentive variables. The variable *RET* is the cumulative 12-month returns and is expected to be positive as executives in better-performing firms are likely to be awarded greater incentive compensation. We include the market-to-book ratio (*MB*) to control for the presence of investment opportunities on incentive compensation (Smith and Watts 1992), and expect *MB* to have a positive coefficient. As in prior studies, we control for *LEVERAGE* defined as the total debt divided by total assets. The boards of firms with high leverage are likely to structure managerial compensation to have low delta and vega, so that managers choose low-risk projects and shareholders bear lower costs of financial distress (John and John 1993). Therefore, we expect a negative relation between *EQUITY* and *LEVERAGE*. Consistent with the existing literature, we also include the cash compensation of the CEO (*CASHCOMP*), which is measured by the sum of salary and bonus. On one hand, CEOs with higher cash compensation are likely to be better diversified and therefore less risk averse (Guay 1999). On the other hand, Berger, Ofek, and Yermack (1997) argue that CEOs with higher cash compensation are more likely to be entrenched and will seek to avoid risk. Therefore, there is no expected sign for *CASHCOMP*. Following Cohen et al. (2013), we include the standard deviation of stock returns for the prior 60 months (*RETSTD*) and expect a positive coefficient for this variable.

Since our sample period lasts for nine years, all t-statistics are adjusted for firm and time clusters to address the potential serial correlation in the panel issue (Petersen 2009). If the board reduces CEO equity incentives when the firm receives adverse SOX 404 opinions, we should observe a negative coefficient on *ICW*. On the other hand, the coefficient on *ICW* could be positive if the board increases the weight placed on equity-based measures due to lower reliability of accounting measures after the discovery of internal control material weaknesses.

3.2 Internal Control Quality and Risky Investment

Our second hypothesis predicts that firms with internal control material weaknesses have less risky investments. Similar to model (1), we employ a change specification as the following model:

$$\begin{aligned}\Delta RISKINVEST_{i,t} = {} & \beta_0 + \beta_1 \Delta ICW_{i,t} + \beta_2 \Delta VEGA_{i,t} + \beta_3 \Delta DELTA_{i,t} + \beta_4 \Delta SIZE_{i,t} + \beta_5 \Delta RET_{i,t} \\ & + \beta_6 \Delta MB_{i,t} + \beta_7 \Delta LEVERAGE_{i,t} + \beta_8 \Delta CASHCOMP_{i,t} + \beta_9 \Delta GROWTH_{i,t} \\ & + \beta_{10} \Delta CASH_{i,t} + \varepsilon_{i,t}. \end{aligned} \quad (2)$$

To test whether internal control material weaknesses are related to investment decisions, we use three risky investment measures: research and development expenditures

(*RD*)[10], net capital expenditures (*CAPEX*, defined as capital expenditure less cash receipts from sale of property, plant and equipment), and the total investments (*INVEST*, defined as the sum of research and development expenditure, capital expenditure, and acquisition expenditure less cash receipts from sale of property, plant and equipment). All three investment measures are scaled by total assets. These measures are consistent with prior studies that investigate the relation between the passage of SOX and corporate risk-taking (Bargeron et al. 2010; Cohen et al. 2013). If firms reduce their risk-taking after receiving adverse SOX 404 opinions, we expect coefficient β_1 to be negative.

In addition to the main variable of interest *ICW*, we include control variables that are likely to be associated with investments as evidenced in the prior literature (e.g., Coles et al. 2006). Since equity incentives are expected to be positively associated with risk-taking, we control for *VEGA* and *DELTA* in model (2). We include *SIZE* (defined as the logarithm of sales) and expect a negative relation between investment variables and firm size. Bhagat and Welch (1995) show that a firm's stock returns can affect its investment decisions; therefore, we include the cumulative 12-month returns (*RET*) and expect a positive relation between returns and risky investments. Guay (1999) shows that firms with greater growth opportunities provide more risk-taking incentives so that firm risk is greater. Thus, we include the market-to-book ratio (*MB*) as the measure of growth opportunities and expect a positive coefficient on this variable. We include *LEVERAGE* to control for the association between financing policy and investments and expect a positive relation (Coles et al. 2006). As in model (1), we include *CASHCOMP* (the sum of salary and bonus) to control for the level of risk aversion of the CEO. We also include *GROWTH*, defined as the percentage change in sales from the prior year, and *CASH*, defined as the cash divided by total assets, and expect positive coefficients for these variables (Coles et al. 2006). Appendix 1 summarizes all the variable definitions.

4. DATA AND SUMMARY STATISTICS

4.1 Data and Sample Selection

This study obtains data from several sources. Internal control effectiveness data (i.e., auditor SOX 404 opinions) are obtained from Audit Analytics. CEO compensation data come from ExecuComp. Other financial and market data are obtained from COMPUSTAT and CRSP. Since SOX Section 404 became effective in 2004, our sample period spans from 2004 to 2014.

[10] We follow prior studies (Coles et al. 2006; Bargeron et al. 2010) and replace R&D expenditure with zero when it is missing from COMPUSTAT. A test of missing R&D frequency shows that 40% of MW firms have missing R&D data, which is significantly lower than the 47% of non-MW firms. Thus, replacing missing R&D with zero should not bias us toward finding the results.

We initially get a sample of 6,537 firms with 44,238 firm-year observations from Audit Analytics. After merging with Compustat, we lose 2,758 observations. A further merge with ExecuComp subtracts another 24,361 observations since ExecuComp covers only firms in the S&P 1500 index[11]. We also require all observations to have necessary data for all variables used in the two empirical models, and this procedure yields a final sample of 2,214 distinct firms and 13,832 firm-year observations. Table 1, Panel A, illustrates the sample selection process, and Panel B summarizes the sample distribution by year. We can see that the majority of internal control weaknesses are observed in the first two years after SOX Section 404 became effective, and there is generally a downward trend until 2011.

Table 1 Sample Selection and Distribution by Year

Panel A: Sample Selection Process		Observations
Firm-year observations covered by Audit Analytics from 2004-2014		44,238
Less: firm-year observations not available in Compustat		(2,758)
Less: firm-year observations not available in ExecuComp		(24,361)
Less: firm-year observations with missing values in any of the empirical variables used in model (1) and (2)		(3,287)
Final sample		13,832
Panel B: Sample Distribution by Year	MW firms	Full sample
2004	67	674
2005	69	943
2006	51	1,057
2007	51	1,264
2008	31	1,300
2009	19	1,343
2010	14	1,373
2011	18	1,417
2012	33	1,450
2013	33	1,491
2014	40	1,520
Total	426	13,832

4.2 Descriptive Statistics

To mitigate the influence of outliers, we winsorize all continuous dependent and independent variables at the top and bottom one percentile of their distributions. Panel A of

[11] The different data sources probably explain why our MW firms are 3.08% of the final sample, whereas in Balsam et al. (2014), their MW firms are 13.03% of the final sample. Another reason for the percentage difference could be that Balsam et al. (2014) focus on the first two years of the SOX Section 404 regime, when the occurrences of internal control material weaknesses are the highest.

Table 2 provides summary statistics of all the variables used in the empirical tests for the full sample. The primary observations for the key variables are similar to those reported in related studies. Regarding CEO compensation, the average cash compensation of the sample is $1.01 million, and the average delta and vega are $0.66 million and $0.10 million, respectively.

We then compare firm-year observations receiving adverse SOX 404 opinions with those that receive unqualified SOX 404 opinions. Table 2, Panel B, shows that there are significant differences between MW firms and non-MW firms. The mean (median) value of *DELTA* for the MW firms is $0.467 million ($0.098 million), while the mean (median) value of *DELTA* for the control firms is $0.669 million ($0.162 million). The mean differences are significant at the 10% level, and the median differences are significant at the 1% level. The MW firms have an average (median) *VEGA* of $0.073 million ($0.022 million), and the non-MW firms have an average (median) *VEGA* of $0.102 million ($0.033 million). Both the mean and median differences are statistically significant. These results suggest that MW firms' CEOs have lower levels of equity incentives than CEOs in non-MW firms. As for the three risky investment measures, we find that firms with internal control material weaknesses have significantly lower R&D, capital expenditures, and total investments than firms with effective internal controls. In addition, consistent with the prior literature, we find that firms with internal control weaknesses are smaller and less profitable, face fewer growth opportunities, have more volatile stock returns, and hold more cash.

In summary, our univariate analysis provides some evidence that firms with material weaknesses in internal controls have lower CEO equity incentives as well as less risky investments. However, the univariate comparison cannot indicate causal relationships. The change specification in the multivariate tests will provide more valid evidence regarding differences in equity incentives changes and risk-taking changes between MW firms and non-MW firms.

4.3 Correlation Matrix

Table 3 provides the correlation coefficients among all the empirical variables. Both Pearson and Spearman correlations between *ICW* and *DELTA* and *VEGA* are negative (significant mostly at the 0.01 level). In addition, we also find significantly negative correlations between *ICW* and *RD* (significant at the 0.01 level), *CAPEX* (Pearson correlations significant at the 0.01 level), and *INVEST* (Pearson correlations significant at the 0.01 level and Spearman correlations significant at the 0.10 level). The correlation results provide preliminary evidence that internal control quality is negatively associated with managerial equity incentives as well as risk-taking behavior. However, the univariate tests do not control for other covariates. We discuss the results of the multivariate regression analyses in the next section.

Table 2　Summary Statistics

Panel A: Full Sample (N=13,832)

	Mean	Std. Dev.	Minimum	P1	Q1	Median	Q3	P99	Maximum
DELTA ($000s)	662.830	5,711.500	0.000	2.480	57.130	160.600	456.280	7,684.260	442,105.400
VEGA ($000s)	101.020	211.660	0.000	0.000	6.330	32.430	104.540	992.250	5,001.620
RD	0.025	0.055	0.000	0.000	0.000	0.000	0.025	0.233	0.887
CAPEX	0.039	0.050	-0.280	0.000	0.009	0.025	0.051	0.248	0.568
INVEST	0.089	0.096	-0.424	-0.008	0.022	0.064	0.123	0.439	1.375
SIZE	7.359	1.623	0.000	3.948	6.227	7.271	8.418	11.453	13.070
RET	0.026	0.103	-0.800	-0.227	-0.024	0.021	0.068	0.345	1.538
MB	3.583	18.566	0.055	0.424	1.342	2.052	3.296	19.209	1,076.043
LEVERAGE	0.548	0.221	0.014	0.094	0.390	0.552	0.711	0.954	1.000
CASHCOMP ($000s)	1,015.100	1,324.060	0.000	102.160	540.000	775.000	1,060.160	5,528.680	32,013.460
RETSTD	0.116	0.056	0.008	0.041	0.077	0.106	0.139	0.319	0.538
GROWTH	0.139	3.387	-1.000	-0.411	-0.008	0.069	0.162	0.943	378.913
CASH	0.105	0.117	0.000	0.001	0.021	0.064	0.149	0.528	0.960

Table 2 Summary Statistics (continued)

Panel B: Sub-sample Partitioned by Internal Control Material Weaknesses

	Observations with *ICW*=1 (N=426)			Observations with *ICW*=0 (N=13,406)			Difference	
	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median	t-test	Wilcoxon Z-test
DELTA ($000s)	466.940	2,294.646	98.687	669.057	5,787.027	162.601	1.66*	6.49***
VEGA ($000s)	73.170	240.742	22.072	101.905	210.621	33.004	2.43**	3.40***
RD	0.025	0.054	0.000	0.037	0.068	0.000	3.81***	4.55***
CAPEX	0.034	0.042	0.021	0.040	0.050	0.025	2.58**	1.47
INVEST	0.088	0.096	0.064	0.099	0.104	0.075	2.13**	2.38**
SIZE	6.621	1.642	6.579	7.382	1.617	7.294	9.60***	9.70***
RET	0.023	0.134	0.015	0.026	0.102	0.021	0.36	1.83*
MB	2.556	2.690	1.890	3.615	18.852	2.059	5.08***	3.13***
LEVERAGE	0.536	0.234	0.544	0.548	0.221	0.552	1.10	1.01
CASHCOMP ($000s)	969.705	1,592.710	650.900	1,016.544	1,314.668	779.199	0.60	4.87***
RETSTD	0.141	0.064	0.129	0.115	0.056	0.105	-8.11***	-9.26***
GROWTH	0.111	0.570	0.063	0.140	3.439	0.070	0.70	0.64
CASH	0.119	0.129	0.079	0.104	0.116	0.064	-2.26**	-2.20**

Notes: *ICW*=1 if the firm receives an adverse SOX 404 opinion, and 0 if the firm receives a clean SOX 404 opinion. *DELTA*=a dollar change in the executive's wealth for 1% change in the firm's stock price. *VEGA*=a dollar change in the executive's wealth for 1% change in the firm's stock return volatility. *RD*=research and development expenditures scaled by total assets. *CAPEX*=net capital expenditures divided by total assets. *INVEST*=sum of research and development expenditure, capital expenditure, and acquisition expenditure less cash receipts from sale of property, plant and equipment, divided by total assets. *SIZE*=natural logarithm of sales. *RET*=cumulative 12-month stock returns. *MB*=market-to-book ratio of equity. *LEVERAGE*=total debt divided by total assets. *CASHCOMP*=sum of salary and bonus for the CEO. *RETSTD*=standard deviation of monthly stock returns for the past 60 months. *GROWTH*=percentage change in sales from the prior year. *CASH*=cash divided by total assets. *, **, *** denote significance at p=0.10, 0.05, and 0.01 levels, respectively, based on two-tailed tests.

Table 3 Variable Correlation Matrix

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14
V1. *ICW*	1.000	**-0.055**	**-0.029**	**-0.038**	-0.013	*-0.020*	**-0.076**	*-0.015*	**-0.027**	-0.008	**-0.041**	**0.078**	-0.005	*0.018*
V2. *DELTA*	*-0.015*	1.000	**0.580**	**0.028**	0.005	**0.035**	**0.337**	-0.004	**0.349**	*-0.015*	**0.455**	-0.194	**0.161**	**0.049**
V3. *VEGA*	**-0.024**	**0.105**	1.000	**0.154**	0.007	**0.069**	**0.382**	**-0.027**	**0.184**	**0.039**	**0.366**	-0.135	0.004	**0.073**
V4. *RD*	**-0.040**	-0.009	**0.029**	1.000	**0.058**	**0.530**	**-0.185**	0.000	**0.287**	**-0.362**	**-0.134**	**0.199**	**0.071**	**0.460**
V5. *CAPEX*	**-0.018**	0.002	**0.043**	**-0.073**	1.000	**0.624**	**0.161**	**-0.059**	**0.216**	**-0.226**	**-0.026**	**0.053**	**0.083**	**0.081**
V6. *INVEST*	**-0.020**	-0.008	-0.013	**0.570**	**0.446**	1.000	**-0.078**	**-0.050**	**0.304**	**-0.405**	**-0.128**	**0.183**	**0.220**	**0.270**
V7. *SIZE*	**-0.081**	**0.090**	**0.375**	**-0.275**	**0.037**	**-0.167**	1.000	**0.054**	**0.030**	**0.343**	**0.530**	**-0.341**	**-0.067**	**-0.154**
V8. *RET*	-0.001	-0.002	**-0.021**	0.013	**-0.028**	-0.014	**0.027**	1.000	0.005	0.007	**-0.032**	**0.107**	**-0.066**	0.012
V9. *MB*	-0.010	0.006	0.013	**0.038**	*0.015*	**0.035**	*0.016*	-0.004	1.000	**-0.072**	**0.029**	**-0.101**	**0.266**	**0.283**
V10. *LEVERAGE*	-0.009	0.001	**-0.065**	**0.305**	**0.147**	**0.299**	**0.350**	0.007	**0.091**	1.000	**0.245**	**-0.217**	**-0.151**	**-0.447**
V11. *CASHCOMP*	-0.006	**0.046**	**0.308**	**-0.086**	**-0.030**	**-0.083**	**0.293**	-0.002	0.004	**0.126**	1.000	**-0.178**	**-0.026**	**-0.104**
V12. *RETSTD*	**0.079**	-0.042	-0.135	**0.215**	**0.027**	**0.146**	**-0.313**	**0.062**	0.006	**-0.139**	**-0.053**	1.000	**0.039**	**0.313**
V13. *GROWTH*	-0.002	0.000	-0.006	0.006	0.004	0.011	**-0.034**	0.002	0.001	**-0.021**	0.004	-0.002	1.000	**0.052**
V14. *CASH*	**0.021**	*0.016*	**-0.017**	**0.397**	**-0.066**	**0.169**	**-0.265**	0.011	**0.038**	**-0.421**	**-0.080**	**0.242**	0.011	1.000

Notes: The coefficients below (above) the diagonal are the Pearson (Spearman) correlation coefficients. The coefficients in bold are significant at the 0.01 level based on two-tailed tests. The coefficients in italic are significant at the 0.10 level based on two-tailed tests. The other coefficients are not significant at the 0.10 level. See Table 2 for variable definitions.

5. MAIN EMPIRICAL RESULTS

Table 4 reports the estimation results of model (1). Because of the change computation, we lose one year of data, resulting in a lower number of observations used in the regression model. Column (1) shows that *ICW* is negatively associated with *DELTA*, and the coefficient is significant at the 10% level. In column (2), where equity incentives are measured by *VEGA*, the coefficient on *ICW* is also negative and significant (at the 5% level). Although the net incentive effect of delta is theoretically ambiguous, this consistent result with *VEGA* indicates that *DELTA* still captures the risk incentives of equity compensation. Taken together, these results support the conjecture that firms with internal control material weaknesses reduce the CEO's sensitivity of wealth to stock performance. The findings suggest that, after the disclosures of internal control problems, the board attempts to curtail the CEO's incentives to take excessive risks that may lead to subsequent financial misreporting. The change analysis also indicates that the managerial equity incentives and risky investments are adjusted upward if the internal controls change from ineffective to effective[12]. The control variables are generally consistent with the predicted signs. The positive coefficient on *CASHCOMP* is consistent with Cohen et al. (2013), who find that after SOX, firms reward more cash compensation while reducing equity-based compensation.

The results of model (2) are presented in Table 5. Consistent with our second hypothesis, we observe a significant decrease in risky investments for MW firms compared to non-MW firms. After controlling for the effect of equity incentives on risk-taking, the estimated coefficients on *ICW* are negative and significant at the 1% level when risky investments are measured by R&D expenditures and significant at the 10% level for capital expenditures and total investment[13]. We also find some evidence that the coefficient on *VEGA* is positive and significant, consistent with vega having a positive effect on risk taking[14]. Overall, relative to non-MW firms, MW firms will invest less in risky projects following the receipt of an adverse SOX 404 opinion. These results support our hypothesis

[12] As an additional analysis, we further conduct a sub-sample test on only the sample of MW firms and examine the difference between remediating firms and non-remediating firms.

[13] Although some studies (e.g., Coles et al. 2006) argue that capital expenditures are not as risky as R&D expenditures, our findings are consistent with Bargeron et al. (2010) and Cohen et al. (2013), who treat both investments identically.

[14] While the coefficient on *VEGA* is significantly positive in the *CAPEX* regression, it is not significant in the *RD* regression. This finding is not consistent with Coles et al. (2006), who document that vega is positively related to R&D expenditures but negatively related to capital expenditures. Our results are different from those of Coles et al. (2006) for two possible reasons: First, the sample period in Coles et al. (2006) covers 1992~2002, which is the pre-SOX period, while our sample includes the post-SOX period. Given that firms tend to reduce risk-taking after the passage of SOX (Bargeron et al. 2010; Cohen et al. 2013), this could cause a difference in the relation between vega and different forms of risky investments. Second, our model includes internal control weaknesses as an additional explanatory variable, while Coles et al. (2006) do not have this variable in their regression model. The inclusion of an additional independent variable can also alter the existing relation of another variable if the added variable has a stronger effect.

2. As for the control variables, most of them are significant and consistent with the predicted signs, with the exception of *CASH*. Our finding of a negative coefficient on *CASH* is consistent with the finding of Bargeron et al. (2010) that firms hold more cash and reduce other risky investments after SOX[15].

Table 4 Internal Control Material Weaknesses and Equity Incentives

	Pred. sign	(1) $\Delta DELTA$	(2) $\Delta VEGA$
Intercept	?	0.077**	1.470**
		(1.97)	(2.00)
ΔICW	?	-0.019*	-0.506**
		(-1.76)	(-2.51)
$\Delta SIZE$	+	0.062***	0.373***
		(7.70)	(2.45)
ΔRET	+	0.090***	0.222
		(8.60)	(1.14)
ΔMB	+	0.032***	0.005
		(28.92)	(0.26)
$\Delta LEVERAGE$	-	-0.264***	-1.207***
		(-12.60)	(-3.09)
$\Delta CASHCOMP$	?	0.029***	0.336***
		(8.64)	(5.24)
$\Delta RETSTD$	+	-0.124	5.421***
		(-1.56)	(3.63)
N		12,349	12,349
Adjusted R^2		0.189	0.041

Notes: t statistics in parentheses. *, **, *** denote significance at p=0.10, 0.05, and 0.01 levels, respectively, based on two-tailed tests for variables with no predicted signs and one-tailed tests otherwise. All variables are calculated as the change from year t-1 to year t. *DELTA*=a dollar change in the executive's wealth for 1% change in the firm's stock price. *VEGA*=a dollar change in the executive's wealth for 1% change in the firm's stock return volatility. *ICW*=1 if the firm receives an adverse SOX 404 opinion, and 0 if the firm receives a clean SOX 404 opinion. *SIZE*=natural logarithm of sales. *RET*=cumulative 12-month stock returns. *MB*=market-to-book ratio of equity. *LEVERAGE*=total debt divided by total assets. *CASHCOMP*=sum of salary and bonus for the CEO. *RETSTD*=standard deviation of monthly stock returns for the past 60 months.

[15] Since we find a significant association between *ICW* and *DELTA*/*VEGA*, we also perform a test by adding the interaction terms *ICW*×*DELTA* and *ICW*×*VEGA* into equation (2). However, a change regression model makes it difficult to interpret the coefficient of interaction terms. Consequently, we use a level regression when interaction terms are added. Untabulated results show that the coefficients on *ICW* are significantly negative, consistent with the main results. Moreover, *ICW*×*DELTA* and *ICW*×*VEGA* are both significantly negatively associated with R&D investment, suggesting that the existence of material weaknesses in internal controls weakens the positive association between equity incentives and risky investments. These findings corroborate hypothesis 1 that in the presence of internal control material weaknesses, the board attempts to lower the CEO's risk incentives so as to avoid excessively risky investments.

Table 5 Internal Control Material Weaknesses and Risky Investments

	Pred. sign	(1) ΔRD	(2) $\Delta CAPEX$	(3) $\Delta INVEST$
Intercept	?	1.250	1.684	0.003
		(0.51)	(0.29)	(0.23)
ΔICW	-	-1.397***	-2.119*	-0.008*
		(-3.04)	(-1.94)	(-1.93)
$\Delta DELTA$	+	0.459***	-0.197	0.004***
		(3.52)	(-0.30)	(2.99)
$\Delta VEGA$	+	0.179	7.979**	0.014*
		(0.23)	(2.10)	(1.66)
$\Delta SIZE$	+	-0.256	9.647***	0.028***
		(-0.80)	(6.31)	(5.70)
ΔRET	+	0.096	7.179***	0.016***
		(0.29)	(4.37)	(4.21)
ΔMB	+	0.127***	0.515***	0.004***
		(3.52)	(3.00)	(9.15)
$\Delta LEVERAGE$	+	1.060	9.048***	0.217***
		(0.79)	(2.72)	(27.29)
$\Delta CASHCOMP$	?	-0.442**	-0.439	-0.002*
		(-2.10)	(-0.88)	(-1.75)
$\Delta GROWTH$	+	0.506**	-1.021	0.017***
		(2.30)	(-0.97)	(6.91)
$\Delta CASH$	+	-5.194***	-42.700***	-0.237***
		(-7.08)	(-12.43)	(-29.39)
N		12,349	12,349	12,349
Adjusted R^2		0.016	0.042	0.165

Notes: t statistics in parentheses. *, **, *** denote significance at p=0.10, 0.05, and 0.01 levels, respectively, based on two-tailed tests for variables with no predicted signs and one-tailed tests otherwise. All variables are calculated as the change from year t-1 to year t. *RD*=research and development expenditures scaled by total assets. *CAPEX*=net capital expenditures divided by total assets. *INVEST*=sum of research and development expenditure, capital expenditure, and acquisition expenditure less cash receipts from sale of property, plant and equipment, divided by total assets. *ICW*=1 if the firm receives an adverse SOX 404 opinion, and 0 if the firm receives a clean SOX 404 opinion. *DELTA*=a dollar change in the executive's wealth for 1% change in the firm's stock price. *VEGA*=a dollar change in the executive's wealth for 1% change in the firm's stock return volatility. *SIZE*=natural logarithm of sales. *RET*=cumulative 12-month stock returns. *MB*=market-to-book ratio of equity. *LEVERAGE*=total debt divided by total assets. *CASHCOMP*=sum of salary and bonus for the CEO. *RETSTD*=standard deviation of monthly stock returns for the past 60 months. *GROWTH*=percentage change in sales from the prior year. *CASH*=cash divided by total assets.

6. ADDITIONAL ANALYSES

6.1 Propensity Score Matching

Our main analysis is based on a pooled sample, with a control sample based on all firms that have no material weaknesses in internal controls. To more effectively control for differences in relevant dimensions between MW firms and non-MW firms, we attempt to match each MW firm with a control firm that is similar across all observable relevant variables. In selecting the matched firms, we adopt the propensity score matching

approach, which can eliminate the selection bias arising from observed covariates (Rosenbaum and Rubin, 1983). Following prior research (Ge and McVay 2005; Ashbaugh-Skaife et al. 2007; Doyle et al. 2007a; Balsam et al. 2014;), we identify relevant characteristics that are determinants of internal control material weaknesses. More specifically, we estimate the following logistic regression model:

$$\begin{aligned} ICW_{i,t} = {} & \gamma_0 + \gamma_1 SALARY_{i,t} + \gamma_2 BONUS_{i,t} + \gamma_3 SIZE_{i,t} + \gamma_4 LOSS_{i,t} + \gamma_5 SEGMENT_{i,t} + \gamma_6 GROWTH_{i,t} \\ & + \gamma_7 RESTRUCTURE_{i,t} + \gamma_8 FOREIGN_{i,t} + \gamma_9 BIG4_{i,t} + \gamma_{10} FEERATIO_{i,t} + \gamma_{11} AUDITORCHG_{i,t} \\ & + \gamma_{12} SALESVOL_{i,t} + \gamma_{13} RETSTD_{i,t} + \varepsilon_{i,t}. \end{aligned} \quad (3)$$

In model (3), we include CEO salary and bonus (both measured as a percentage of total compensation) as they provide incentives pertaining to internal controls (Balsam et al. 2014). Prior research finds that smaller (measured by *SIZE*) and poorly performing firms (measured by *LOSS*) are associated with a higher incidence of material weaknesses in internal controls because these firms tend to underinvest in internal controls (Ge and McVay 2005; Doyle et al. 2007a). Firms having more complex operations, such as those operating multiple business segments, those engaging in foreign transactions, and those undergoing restructuring, are more likely to experience internal control problems (Ashbaugh-Skaife et al. 2007; Doyle et al. 2007a). We thus include *SEGMENT*, *FOREIGN*, and *RESTRUCTURE* to proxy for operating complexities. Following Doyle et al. (2007a), we also control for sales growth (*GROWTH*) because rapidly growing firms are more likely to report internal control material weaknesses. We control for auditor quality by incorporating *BIG4* and *FEERATIO* because auditor choice and the ratio of audit to total fees both affect the likelihood of material weakness disclosures (Ge and McVay 2005; Zhang, Zhou, and Zhou 2007). We also include *AUDITORCHG* following Ashbaugh-Skaife et al. (2007) and Zhang et al. (2007), who find auditor changes to be associated with increased probabilities of internal control weaknesses. Finally, we include stock return volatility (*RETSTD*) and sales volatility (*SALESVOL*) to proxy for monitoring difficulty arising from less predictable operating environments (Balsam et al. 2014). Using the propensity scores estimated from the first-stage logistic regression, we then create matched pairs with the nearest neighbor having the closest propensity score. The complete first-stage model is summarized in Appendix 2.

The results of the matched sample analysis are presented in Table 6[16]. Columns (1) and (2) pertain to the tests of equity incentives. We find that, after propensity score matching, the coefficient of *ICW* is significantly negative, supporting the first hypothesis that firms with material weaknesses have lower CEO equity incentives. Columns (3) through (5) show the results regarding risky investments. Similar to our main tests, in the

[16] Since the segment data is not available for years prior to 2008, we perform the propensity score matching for years 2008-2014. As a result, we obtain matched pairs of 188 MW firms and 188 non-MW firms after the first-stage matching process. A change regression in the second-stage reduces the observations to 318.

matched sample we also find significantly negative associations between *ICW* and all three risk-taking measures. In general, the results in Table 6 provide even stronger evidence (in terms of the *t*-value of *ICW*) that firms reduce CEO equity incentives as well as the level of risky investments upon discovery of internal control material weaknesses. The change analysis also indicates that the managerial equity incentives and risky investments are adjusted upward if the internal controls change from ineffective to effective.

Table 6 Propensity Score Matched Sample

	(1) $\Delta DELTA$	(2) $\Delta VEGA$	(3) ΔRD	(4) $\Delta CAPEX$	(5) $\Delta INVEST$
Intercept	0.077***	0.010***	0.072***	0.070***	0.188***
	(14.65)	(11.18)	(6.23)	(6.69)	(7.87)
ΔICW	-1.440***	-0.162***	-0.298***	-0.065**	-0.220***
	(-6.82)	(-4.72)	(-10.74)	(-2.57)	(-3.84)
$\Delta DELTA$			-2.793	0.001	0.006***
			(-1.27)	(0.50)	(3.05)
$\Delta VEGA$			6.978	0.040***	-0.007
			(0.50)	(2.99)	(-0.60)
$\Delta SIZE$	0.068***	0.001	0.005***	0.001*	0.012***
	(41.43)	(0.05)	(12.20)	(1.76)	(13.76)
ΔRET	0.088***	0.002	0.005	-0.005	-0.012
	(3.41)	(0.43)	(1.24)	(-1.28)	(-1.29)
ΔMB	0.061***	0.002	0.002***	0.001***	0.003***
	(23.80)	(0.95)	(12.49)	(8.85)	(8.55)
$\Delta LEVERAGE$	-0.454***	-0.030***	0.017***	0.025***	0.026***
	(-8.54)	(-3.49)	(6.31)	(10.16)	(4.75)
$\Delta CASHCOMP$	0.053***	0.005***	0.001	-0.001*	0.001
	(5.06)	(3.07)	(0.07)	(-1.80)	(1.24)
$\Delta RETSTD$	0.380**	0.280***			
	(2.20)	(9.95)			
$\Delta GROWTH$			0.005**	0.009***	0.077***
			(2.53)	(4.44)	(17.50)
$\Delta CASH$			-0.065***	-0.028***	-0.036***
			(-15.29)	(-7.28)	(-4.19)
N	318	318	318	318	318
Adjusted R^2	0.248	0.018	0.466	0.497	0.325

Notes: The sample period covers years 2008-2014 due to limited data availability of the segment variable used to perform propensity score matching. *t* statistics in parentheses. Except for the intercept, *, **, *** denote significance at *p*=0.10, 0.05, and 0.01 levels, respectively, based on one-tailed tests. All variables are calculated as the change from year *t*-1 to year *t*. *ICW*=1 if the firm receives an adverse SOX 404 opinion, and 0 if the firm receives a clean SOX 404 opinion. *DELTA*=a dollar change in the executive's wealth for 1% change in the firm's stock price. *VEGA*=a dollar change in the executive's wealth for 1% change in the firm's stock return volatility. *RD*=research and development expenditures scaled by total assets. *CAPEX*=net capital expenditures divided by total assets. *INVEST*=sum of research and development expenditure, capital expenditure, and acquisition expenditure less cash receipts from sale of property, plant and equipment, divided by total assets. *SIZE*=natural logarithm of sales. *RET*=cumulative 12-month stock returns. *MB*=market-to-book ratio of equity. *LEVERAGE*=total debt divided by total assets. *CASHCOMP*=sum of salary and bonus for the CEO. *RETSTD*=standard deviation of monthly stock returns for the past 60 months. *GROWTH*=percentage change in sales from the prior year. *CASH*=cash divided by total assets.

6.2 Severity of Internal Control Material Weaknesses

Research suggests that company-level weaknesses such as the control environment or the overall financial reporting process represent a more serious concern than account-specific weaknesses related to specific account balances or transaction-level processes (Doss and Jonas 2004). Many studies also provide evidence showing that company-level weaknesses are associated with significantly lower accruals quality (Doyle et al. 2007b) and more negative stock returns (Hammersley et al. 2008). Therefore, we examine whether changes in equity incentives and risk-taking behavior vary with the severity of internal control weaknesses.

Following prior literature (e.g., Doyle et al. 2007b), we classify a material weakness as company-level if the firm discloses keywords that indicate "ineffective control environment" or "override by senior management" in its internal control attestation report. If a firm has both types of material weaknesses or has at least three account-specific weaknesses, we classify the firm as having a company-level material weakness. We create an indicator *MWCOM* which equals one if the MW firm has company-level material weaknesses and zero otherwise. We conduct model (1) and (2) based on the sample of MW firms, among which 47% (53%) of the observations have company-level (account-specific) material weaknesses. The coefficient on *MWCOM* represents the difference between an MW firm having company-level material weaknesses and an MW firm having account-specific material weaknesses. We expect the reductions in equity incentives as well as risky investments are greater for companies who have company-level material weaknesses. The regression results are presented in Table 7.

Columns (1) and (2) in Table 7 pertain to the results for equity incentives. We find that the coefficient on *MWCOM* is negatively associated with *DELTA* and *VEGA* (both are significant at the p=10% level), indicating that the negative association between internal control material weaknesses and CEO equity incentives is stronger for MW firms with company-level weaknesses. These findings provide evidence that the severity of the internal control weaknesses influences the board's decision to reduce CEO equity incentives. Columns (3) through (5) in Table 7 show the results for risk-taking. When the risky investments are measured by R&D expenditures, we find that the coefficient on *MWCOM* is significantly negative (t=-2.18, significant at the p=0.05 level). These results suggest that MW firms who have company-level material weaknesses reduce their R&D investments to a greater extent than MW firms whose internal controls have less severe account-specific material weaknesses. However, we do not find evidence of such stronger reductions in capital expenditures and total investments. Perhaps R&D is a riskier investment and, thus, considered to have a more profound effect on financial reporting. Overall, although the results for risk-taking are not very consistent, we still find some evidence that the reductions in risky investments are related to the severity of internal

control weaknesses. When company-wide problems are disclosed, managers need to pay more attention and expend greater efforts to fix these problems before continuing to engage in risky projects.

Table 7 Distinguishing Company-level and Account-level Material Weaknesses

	(1)	(2)	(3)	(4)	(5)
	Δ*DELTA*	Δ*VEGA*	Δ*RD*	Δ*CAPEX*	Δ*INVEST*
Intercept	-0.182	0.130***	2.267**	0.018*	0.001
	(-0.45)	(6.16)	(2.34)	(1.84)	(1.04)
MWCOM	-0.060*	-0.004*	-3.048**	-0.004	-0.003
	(-1.54)	(-1.45)	(-2.18)	(-1.14)	(-0.47)
Δ*DELTA*			-2.793	0.001	0.006***
			(-1.27)	(0.50)	(3.05)
Δ*VEGA*			6.978	0.040***	-0.007
			(0.50)	(2.99)	(-0.60)
Δ*SIZE*	0.072***	0.020	9.517**	0.006***	0.020***
	(4.26)	(1.30)	(2.25)	(5.90)	(4.32)
Δ*RET*	-0.061	-0.008	3.232	0.010	0.026***
	(-0.32)	(-0.88)	(0.67)	(0.81)	(4.95)
Δ*MB*	0.025***	0.002	1.428**	0.002***	0.005***
	(2.75)	(1.39)	(2.24)	(3.84)	(8.52)
Δ*LEVERAGE*	-0.281**	-0.010	14.414*	0.041***	0.320***
	(-2.46)	(-0.63)	(1.59)	(6.59)	(30.53)
Δ*CASHCOMP*	0.003***	0.001	-2.179*	-0.001	0.005
	(8.10)	(0.35)	(-1.41)	(-0.51)	(0.31)
Δ*RETSTD*	-0.445	-0.057			
	(-1.27)	(-0.85)			
Δ*GROWTH*			2.317	-0.005	0.035***
			(0.78)	(-0.80)	(10.98)
Δ*CASH*			0.131	-0.036***	-0.311***
			(0.01)	(-3.01)	(-28.23)
N	351	351	351	351	351
Adjusted R^2	0.315	0.181	0.037	0.129	0.154

Notes: t statistics in parentheses. Except for the intercept, *, **, *** denote significance at p=0.10, 0.05, and 0.01 levels, respectively, based on one-tailed tests. Except *MWCOM* which is an indicator, all other variables are calculated as the change from year t-1 to year t. *MWCOM*=1 if a MW firm has company-level material weaknesses, and zero if the material weaknesses are account-specific. *DELTA*=a dollar change in the executive's wealth for 1% change in the firm's stock price. *VEGA*=a dollar change in the executive's wealth for 1% change in the firm's stock return volatility. *RD*=research and development expenditures scaled by total assets. *CAPEX*=net capital expenditures divided by total assets. *INVEST*=sum of research and development expenditure, capital expenditure, and acquisition expenditure less cash receipts from sale of property, plant and equipment, divided by total assets. *SIZE*=natural logarithm of sales. *RET*=cumulative 12-month stock returns. *MB*=market-to-book ratio of equity. *LEVERAGE*=total debt divided by total assets. *CASHCOMP*=sum of salary and bonus for the CEO. *RETSTD*=standard deviation of monthly stock returns for the past 60 months. *GROWTH*=percentage change in sales from the prior year. *CASH*=cash divided by total assets.

6.3 Remediation Analysis

While our main results suggest that compensation committees adjust (both upwards and downwards) CEO equity incentives and risky investments based on the firm's internal control quality, the change specification treats all firms with no *ICW* changes as equal. However, $\Delta ICW = 0$ includes both firms with values of one and those with values of zero in two consecutive periods. To provide more direct evidence regarding the causal effect and in order to consider the possibility of asymmetric changes, we further focus only on the sample of firms with internal control material weaknesses (i.e., *ICW*=1). We create an indicator variable, *REMED*, which equals one if a firm having internal control material weaknesses receives a clean SOX 404 opinion in the following year (i.e., *ICW* equals one in year *t*-1 and zero in year *t*), and zero otherwise[17]. If internal control quality plays a role in the design of CEO equity incentives, the remediating firms should have higher equity incentives relative to firms whose internal controls remain ineffective. Similarly, remediating firms should have higher levels of risky investments after their internal control weaknesses are remediated.

Table 8 shows the results for the remediation analysis[18]. In the first two columns, we find that *REMED* is negatively associated with *DELTA* (*t*=-2.18, significant at the *p*=0.05 level) and *VEGA* (*t*=-1.53, significant at the p=0.1 level). These findings suggest that, relative to firms that do not immediately remediate internal control weaknesses, the boards of remediating firms increase the CEO's equity incentives upon the receipt of clean SOX 404 opinions. In the last three columns pertaining to risky investments, we only find a negative and significant coefficient on *REMED* for total investments (*t*=-2.24, significant at the *p*=0.05 level). When investments are separated into R&D and capital expenditures, we do not find evidence that either type of investment is higher in remediating firms relative to non-remediating firms. These weaker results could be due to the lower cross-sectional variations in only one category of investment: some firms might adjust R&D investment whereas others are adjusting capital expenditures. Thus, we might not observe changes in a single type of investment even as the total investments are higher. Overall, the evidence in the remediation analysis supplements our main findings: the boards not only make downward adjustments for CEO equity incentives and risky investments when internal controls are found to be ineffective, but also make upward adjustments when the material weaknesses are remediated.

[17] Since all other variables are calculated in the form of changes from year *t*-1 to year *t*, we measure *REMED* in the same way to make it a consistent specification. As a result, we lose one sample year in the regression model.

[18] Among the 351 observations used in the regression, 244 observations (69.5%) have remediation and 107 observations (30.5%) do not have remediation.

Table 8 Remediation of Internal Control Material Weaknesses

	(1) ΔDELTA	(2) ΔVEGA	(3) ΔRD	(4) ΔCAPEX	(5) ΔINVEST
Intercept	-2.090**	0.028	0.086***	-0.020**	0.108
	(-2.05)	(0.22)	(5.77)	(-2.27)	(1.18)
REMED	-0.243**	-0.021*	-0.001	-0.002	-0.023**
	(-2.18)	(-1.53)	(-0.63)	(-0.93)	(-2.24)
Δ*DELTA*			-0.003	0.002	-0.006
			(-1.34)	(1.36)	(-1.13)
Δ*VEGA*			0.037**	-0.014	0.027
			(2.14)	(-1.31)	(0.57)
Δ*SIZE*	0.184***	0.027***	-0.003	0.003***	0.002
	(4.66)	(5.67)	(-0.91)	(3.38)	(0.07)
Δ*RET*	-0.447	-0.032	-0.006	0.012	0.003
	(-0.97)	(-0.58)	(-0.41)	(1.23)	(0.08)
Δ*MB*	0.081***	0.006**	0.003***	0.001	0.004**
	(3.95)	(2.52)	(3.44)	(1.17)	(1.98)
Δ*LEVERAGE*	-0.435	-0.037	0.006	0.008	-0.026
	(-1.58)	(-1.11)	(0.68)	(0.47)	(-0.99)
Δ*CASHCOMP*	0.180***	0.030***	0.002	-0.001	0.014***
	(3.31)	(4.56)	(1.40)	(-1.06)	(2.63)
Δ*RETSTD*	-0.634	-0.059			
	(-0.75)	(-0.57)			
Δ*GROWTH*			0.005	0.004	0.118***
			(0.67)	(0.88)	(5.99)
Δ*CASH*			-0.014	-0.001	-0.234**
			(-1.05)	(-0.19)	(-2.61)
N	351	351	351	351	351
Adjusted R^2	0.100	0.283	0.565	0.711	0.341

Notes: t statistics in parentheses. Except for the intercept, *, **, *** denote significance at p=0.10, 0.05, and 0.01 levels, respectively, based on one-tailed tests. Except *REMED* which is an indicator, all other variables are calculated as the change from year t-1 to year t. *REMED*=1 if a MW firm receives an adverse SOX 404 opinion in year t-1 and a clean SOX 404 opinion in year t, and 0 if a MW firm receives an adverse SOX 404 opinion in both year t-1 and year t. *DELTA*=a dollar change in the executive's wealth for 1% change in the firm's stock price. *VEGA*=a dollar change in the executive's wealth for 1% change in the firm's stock return volatility. *RD*=research and development expenditures scaled by total assets. *CAPEX*=net capital expenditures divided by total assets. *INVEST*=sum of research and development expenditure, capital expenditure, and acquisition expenditure less cash receipts from sale of property, plant and equipment, divided by total assets. *SIZE*=natural logarithm of sales. *RET*=cumulative 12-month stock returns. *MB*=market-to-book ratio of equity. *LEVERAGE*=total debt divided by total assets. *CASHCOMP*=sum of salary and bonus for the CEO. *RETSTD*=standard deviation of monthly stock returns for the past 60 months. *GROWTH*=percentage change in sales from the prior year. *CASH*=cash divided by total assets.

6.4 CFO Equity Incentives

Most prior research focuses on CEO compensation and incentives mainly because the amounts are larger and CEOs are considered more influential than CFOs. However, recent

research shows that CFOs have a greater influence on financial reporting (e.g., Jiang et al. 2010; Li et al. 2010). Therefore, we perform our previous analysis on CFOs to test whether the board also adjusts CFO equity incentives conditional on the firm's disclosures of material weaknesses in internal controls. The sample becomes smaller (10,397 observations) because not all firms in the ExecuComp database disclose the CFO title.

Consistent with our CEO findings, the (untabluated) results show that *ICW* is negatively associated with *DELTA* (coefficient=-0.006, *t*=-2.64, significant at the 1% level) and *VEGA* (coefficient=-0.173, *t*=-2.17, significant at the 5% level). We also find that *ICW* is negatively related to *RD* (coefficient=-2.31, *t*=-2.06, significant at the 5% level) and *CAPEX* (coefficient=-2.84, *t*=-1.90, significant at the 5% level), although the results for total investments are not significant. Overall, the evidence suggests that the board also adjusts CFO equity incentives based on internal control quality and that such adjustments are associated with changes in the firm's risk-taking. When equity incentives become lower, the executives engage in less R&D and capital expenditure investment.

6.5 Alternative Measure of Equity Incentives

Although our study uses delta and vega to measure equity incentives, prior research also suggests that firms can adjust the amount of annual option grants to manage the optimal level of equity incentives (Core and Guay 1999). Given that the convexity of the manager's wealth-performance relation mainly comes from option-based compensation, we also use changes in option grants as an alternative measure of equity incentives. More specifically, we follow Cheng and Farber (2008) and measure option-based compensation in two ways: (1) the ratio of the dollar value of option grants to total compensation (*$OPGRANT*) and (2) the ratio of the number of option grants in shares scaled by total shares outstanding (*#OPGRANT*). Both measures are expressed in percentage. In the test of H1, we use *$OPGRANT* and *#OPGRANT* as the dependent variable and re-estimate model (1). In the test of H2, we replace *DELTA* and *VEGA* with *$OPGRANT* and re-estimate model (2). The regression results are presented in Table 9.

Table 9, columns (1) and (2), show that the coefficients on *ICW* are both negative and significant at the 5% level. These results suggest that firms with internal control weaknesses have lower option grants (both in dollars and in number of shares), consistent with the main findings of H1. Columns (3) through (5) indicate that the coefficients on *ICW* are consistently negative and significant across different risk-taking measures. These results also support H2 that, after controlling for equity incentives, MW firms have significantly less risky investments compared to non-MW firms. In summary, using annual option grants as the measure of equity incentives does not alter our main inferences.

Table 9 Using Option Grants to Measure Equity Incentives

	(1)	(2)	(3)	(4)	(5)
	Δ*$OPGRANT*	Δ*#OPGRANT*	Δ*RD*	Δ*CAPEX*	Δ*INVEST*
Intercept	-0.013***	-0.017***	0.110	-1.163***	0.002***
	(-6.52)	(-9.55)	(1.10)	(-4.88)	(3.40)
Δ*ICW*	-0.029**	-0.035**	-1.436***	-2.085*	-0.007*
	(-2.02)	(-2.53)	(-3.11)	(-1.90)	(-1.69)
Δ*$OPGRANT*			0.486	0.627	-0.001
			(0.97)	(0.53)	(-0.22)
Δ*SIZE*	0.026**	0.005	1.681***	13.847***	0.008**
	(2.42)	(0.52)	(2.66)	(9.21)	(2.23)
Δ*RET*	0.045***	0.026*	0.246	9.858***	0.017***
	(3.26)	(1.91)	(0.35)	(5.93)	(4.39)
Δ*MB*	0.003**	0.004	0.219***	0.217	0.004***
	(2.12)	(0.35)	(3.07)	(1.28)	(9.09)
Δ*LEVERAGE*	0.038	-0.038	3.084**	-0.730	0.236***
	(1.34)	(-1.42)	(2.16)	(-0.21)	(28.42)
Δ*CASHCOMP*	0.006	0.023***	-0.490**	-0.511	-0.002*
	(1.55)	(5.84)	(-2.33)	(-1.02)	(-1.74)
Δ*RETSTD*	0.241***	0.312***			
	(2.64)	(3.60)			
Δ*GROWTH*			1.196***	-1.553	0.020***
			(2.71)	(-1.48)	(7.65)
Δ*CASH*			-12.774***	-48.273***	-0.288***
			(-8.30)	(-13.18)	(-32.84)
N	12,349	12,349	12,349	12,349	12,349
Adjusted R^2	0.189	0.176	0.013	0.049	0.188

Notes: t statistics in parentheses. Except for the intercept, *, **, *** denote significance at p=0.10, 0.05, and 0.01 levels, respectively, based on one-tailed tests. All variables are calculated as the change from year t-1 to year t. *ICW*=1 if the firm receives an adverse SOX 404 opinion, and 0 if the firm receives a clean SOX 404 opinion. *$OPGRANT*=the ratio of the dollar value of option grants to total compensation. *#OPGRANT*=the ratio of the number of option grants in shares scaled by total shares outstanding. *RD*=research and development expenditures scaled by total assets. *CAPEX*=net capital expenditures divided by total assets. *INVEST*=sum of research and development expenditure, capital expenditure, and acquisition expenditure less cash receipts from sale of property, plant and equipment, divided by total assets. *SIZE*=natural logarithm of sales. *RET*=cumulative 12-month stock returns. *MB*=market-to-book ratio of equity. *LEVERAGE*=total debt divided by total assets. *CASHCOMP*=sum of salary and bonus for the CEO. *RETSTD*=standard deviation of monthly stock returns for the past 60 months. *GROWTH*=percentage change in sales from the prior year. *CASH*=cash divided by total assets.

6.6 Controlling Industry and Year Fixed Effects

Since our main analyses are based on change regressions, we do not control for industry and year fixed effects. However, to ensure the robustness of our results, we also perform a robustness check by including industry and year fixed effects into models (1) and (2). The results remain qualitatively the same. In the regression results of model (1),

the coefficients on *ICW* are -0.019 (*t*=-1.74, significant at *p*=10%) and -0.080 (*t*=-2.53, significant at *p*=1%) when the dependent variables are *DELTA* and *VEGA*, respectively. In the regression results of model (2), the coefficient on *ICW* is -1.307 (*t*=-2.84, significant at *p*=1%) when the dependent variable is *RD*, -2.245 (*t*=-2.07, significant at *p*=5%) when the dependent variable is *CAPEX*, and -0.008 (*t*=-1.99, significant at *p*=5%) when the dependent variable is *INVEST*.

7. CONCLUSION

In this study, we examine how CEO equity incentives and firms' risk-taking behaviors are influenced by material weaknesses in internal controls. We first test whether firms reduce CEO equity incentives after receiving adverse SOX 404 opinions. Since considerable evidence suggests that higher equity incentives can exacerbate financial misreporting and that internal control effectiveness is closely associated with financial reporting quality, we expect firms with internal control material weaknesses to reduce equity incentives. Consistent with our expectation, we find that MW firms have significantly lower delta and vega of CEO compensation relative to non-MW firms. Further remediation analysis shows that among the MW firms, those who remediate their material weaknesses experience an upward adjustment in equity incentives, providing strong evidence that the board refers to internal control quality in the design of CEO incentives.

We next examine whether firms receiving adverse SOX 404 opinions have less risky investments than firms with clean SOX 404 opinions. Owing to the legal liabilities imposed by SOX, directors and executives have a tendency to favor lower-risk investments (Bargeron et al. 2010; Cohen et al. 2013). For firms that have material weaknesses in internal controls, both the increase in litigation risk and cost of raising capital may discourage firms from taking risky projects. Our empirical results support our expectation that MW firms have significantly less risky investments compared to non-MW firms.

Taken together, our findings suggest that the boards of MW firms attempt to induce the CEO to focus more on the remediation of internal control problems by lowering the CEO's risk incentives as well as the firm's risky investments. Moreover, this association seems to be stronger for more severe company-level internal control weaknesses.

In considering the results of our study, one should note the following caveats. First, our sample is comprised of relatively large firms (i.e., those in the S&P 1500 index) due to the limitation of compensation data. As prior studies document that larger firms are less likely to exhibit material weaknesses in internal controls (Ge and McVay 2005; Ashbaugh-Skaife et al. 2007; Doyle et al. 2007a), our findings and inferences should be generalized to smaller firms with caution. Second, measuring risk-taking behavior is inherently difficult. While we follow the majority of the literature, measures such as R&D and capital

expenditures can still contain measurement errors and do not capture all aspects of risky investments. Despite the above limitations, however, our study contributes to the internal control literature by documenting an additional consequence of reporting internal control material weaknesses that is related to managerial incentives and corporate investment behavior.

References

Abel, B. A., and O. J. Blanchard. 1986. The present value of profits and cyclical movements in investment. *Econometrica* 54 (March): 249-273. (DOI: 10.2307/1913150)

Altamuro, J., and A. Beatty. 2010. How does internal control regulation affect financial reporting? *Journal of Accounting and Economics* 49 (February): 58-74. (DOI: 10.1016/j.jacceco.2009.07.002)

Armstrong, C. S., D. F. Larcker, G. Ormazabal, and D. J. Taylor. 2013. The relation between equity incentives and misreporting: The role of risk-taking incentives. *Journal of Financial Economics* 109 (August): 327-350. (DOI: 10.1016/j.jfineco.2013.02.019)

Ashbaugh-Skaife, H., D. W. Collins, and W. R. Kinney Jr. 2007. The discovery and reporting of internal control deficiencies prior to SOX-mandated audits. *Journal of Accounting and Economics* 44 (September): 166-192. (DOI: 10.1016/j.jacceco.2006.10.001)

Ashbaugh-Skaife, H., D. Collins, Jr. W. Kinney, and R. LaFond. 2008. The effect of SOX internal control deficiencies and their remediation on accrual quality. *The Accounting Review* 83 (January): 217-250. (DOI:10.2308/accr.2008.83.1.217)

Ashbaugh-Skaife, H., D. W. Collins, W. R. Kinney Jr., and R. LaFond. 2009. The effect of SOX internal control deficiencies on firm risk and cost of equity. *Journal of Accounting Research* 47 (January): 1-43. (DOI: 10.1111/j.1475-679X.2008.00315.x)

Asthana, S., S. Balsam, and S. Kim. 2009. The effect of Enron, Andersen, and Sarbanes-Oxley on the US market for audit services. *Accounting Research Journal* 22 (November): 4-26. (DOI: 10.1108/10309610910975306)

Balsam, S., W. Jiang, and B. Lu. 2014. Equity incentives and internal control weakness. *Contemporary Accounting Research* 31 (November): 178-201. (DOI: 10.1111/1911-3846.12018)

Bargeron, L. L., K. M. Lehn, and C. J. Zutter. 2010. Sarbanes–Oxley and corporate risk-taking. *Journal of Accounting and Economics* 49 (February): 34-52. (DOI: 10.1016/j.jacceco.2009.05.001)

Bauer, A. M. 2016. Tax avoidance and the implications of weak internal controls. *Contemporary Accounting Research* 33 (2): 449-486. (DOI: 10.1111/1911-3846.12151)

Beneish, M. D., M. B. Billings, and L. D. Hodder. 2008. Internal control weaknesses and information uncertainty. *The Accounting Review* 83 (May): 665-703. (DOI: 10.2308/accr.2008.83.3.665)

Berger, P. G., E. Ofek, and D. L. Yermack. 1997. Managerial entrenchment and capital structure decisions. *The Journal of Finance* 52 (4): 1411-1438. (DOI: 10.2307/2329441)

Bergstresser, D., and T. Philippon. 2006. CEO incentives and earnings management. *Journal of Financial Economics* 80 (June): 511-529. (DOI: 10.1016/j.jfineco.2004.10.011)

Bhagat, S., and I. Welch. 1995. Corporate research and development investments International comparisons. *Journal of Accounting and Economics* 19 (March–May): 443-470. (DOI: 10.1016/0165-4101(94)00391-H)

Burns, N., and S. Kedia. 2006. The impact of performance-based compensation on misreporting. *Journal of Financial Economics* 79 (January): 35-67. (DOI: 10.1016/j.jfineco.2004.12.003)

Carter, M. E., L. J. Lynch, and S. L. C. Zechman. 2009. Changes in bonus contracts in the post-Sarbanes-Oxley era. *Review of Accounting Studies* 14 (December): 480-506. (DOI: 10.1007/s11142-007-9062-z)

Chan, K. C., B. Farrell, and P. Lee. 2008. Earnings management of firms reporting material internal control weaknesses under Section 404 of the Sarbanes-Oxley Act. *Auditing*: *A Journal of Practice and Theory* 27 (November): 161-179. (DOI: 10.2308/aud.2008.27.2.161)

Chang, H., H. L. Choy, and K. M. Wan. 2012. Effect of the Sarbanes-Oxley Act on CEOs' stock ownership and pay-performance sensitivity. *Review of Quantitative Finance and Accounting* 38 (February): 177-207. (DOI: 10.1007/s11156-011-0226-3)

Cheng, Q., and T. D. Warfield. 2005. Equity incentives and earnings management. *The Accounting Review* 80 (April): 441-476. (DOI: 10.2308/accr.2005.80.2.441)

Cheng, Q., and D. B. Farber. 2008. Earnings restatements, changes in CEO compensation, and firm performance. *The Accounting Review* 83 (September): 1217-1250. (DOI: 10.2308/accr.2008.83.5.1217)

Cheng, M., D. Dhaliwal, and Y. Zhang. 2013. Does investment efficiency improve after the disclosure of material weaknesses in internal control over financial reporting? *Journal of Accounting and Economics* 56 (July): 1-18. (DOI: 10.1016/j.jacceco.2013.03.001)

Cohen, D. A., A. Dey, and T. Z. Lys. 2013. Corporate governance reform and executive incentives: Implications for investments and risk-taking. *Contemporary Accounting Research* 30 (August): 1296-1332. (DOI: 10.1111/j.1911-3846.2012.01189.x)

Coles, J. L., N. Daniel, and L. Naveen. 2006. Managerial incentives and risk-taking. *Journal of Financial Economics* 79 (February): 431-468. (DOI: 10.1016/j.jfineco.2004.09.004)

Costello, A. M., and R. Wittenberg-Moerman. 2011. The impact of financial reporting quality on debt contracting: Evidence from internal control weakness reports. *Journal of Accounting Research* 49 (March): 97-136. (DOI: 10.1111/j.1475-679X.2010.00388.x)

Core, J., and W. Guay. 1999. The use of equity grants to manage optimal equity incentive levels. *Journal of Accounting Economics* 28 (December): 151-184. (DOI: 10.1016/S0165-4101(99)00019-1)

Core, J., and W. Guay. 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. *Journal of Accounting Research* 40 (June): 613-630. (DOI: 10.1111/1475-679X.00064)

Dhaliwal, D., C. Hogan, R. Trezevant, and M. Wilkins. 2011. Internal control disclosures, monitoring, and the cost of debt. *The Accounting Review* 86 (July): 1131-1156. (DOI: 10.2308/accr-10043)

Doss, M., and G. Jonas. 2004. Section 404 reports on internal control: Impact on ratings will depend on nature of material weaknesses reported. *Moody's Investors Service, Global Credit Research*.

Doyle, J. T., W. Ge, and S. McVay. (2007a). Determinants of weaknesses in internal control over financial reporting. *Journal of Accounting and Economics* 44 (September): 193-223. (DOI: 10.1016/j.jacceco.2006.10.003)

Doyle, J. T., W. Ge, and S. McVay. (2007b). Accruals quality and internal control over financial reporting. *The Accounting Review* 82 (October): 1141-1170. (DOI: 10.2308/accr.2007.82.5.1141)

Efendi, J., A. Srivastava, and E. P. Swanson. 2007. Why do corporate managers misstate financial statements? The role of option compensation and other factors. *Journal of Financial Economics* 85 (September): 667-708. (DOI: 10.1016/j.jfineco.2006.05.009)

Eisenberg, A. 2007. Comment letter to the SEC, July 12, 2007. Available at: https://www.sec.gov/comments/pcaob-2007-02/pcaob200702-27.pdf. Accessed: June 15, 2018.

Engel, E., R. M. Hayes, and X. Wang. 2007. The Sarbanes Oxley Act and firms' going private decisions. *Journal of Accounting and Economics* 44 (September): 116-145. (DOI: 10.1016/j.jacceco.2006.07.002)

Ettredge, M. L., C. Li, and L. Sun. 2006. The impact of SOX Section 404 internal control quality assessment on audit delay in the SOX era. *Auditing: A Journal of Practice and Theory* 25 (November): 1-23. (DOI: 10.2308/aud.2006.25.2.1)

Feng, M., C. Li, and S. McVay. 2009. Internal control and management guidance. *Journal of Accounting and Economics* 48 (December): 190-209. (DOI: 10.1016/j.jacceco.2009.09.004)

Feng, M., W. Ge, S. Luo, and T. Shevlin. 2011. Why do CFOs become involved in material accounting manipulations? *Journal of Accounting and Economics* 51 (February): 21-36. (DOI:10.1016/j.jacceco.2010.09.005)

Feng, M., C. Li, S. E. McVay, and H. Skaife. 2015. Does ineffective internal control over financial reporting affect a firm's operations? Evidence from firms' inventory management. *The Accounting Review* 90 (March): 529-557. (DOI: 10.2308/accr-50909)

Frank, M. Z., and T. Shen. 2016. Investment and the weighted average cost of capital. *Journal of Financial Economics* 119 (February): 300-315. (DOI: 10.1016/j.jfineco.2015.09.001)

Gallemore, J., and E. Labro. 2015. The importance of the internal information environment for tax avoidance. *Journal of Accounting and Economics* 60 (August): 149-167. (DOI: 10.1016/j.jacceco.2014.09.005)

Ge, W., and S. McVay. 2005. The disclosure of material weaknesses in internal control after the Sarbanes-Oxley Act. *Accounting Horizons* 19 (September): 137-158. (DOI: 10.2308/acch.2005.19.3.137)

Guay, W. R. 1999. The sensitivity of CEO wealth to equity risk: an analysis of the magnitude and determinants. *Journal of Accounting and Economics* 53 (July): 43-71. (DOI: 10.1016/S0304-405X(99)00016-1)

Hall, B. H. 1992. Investment and research and development at the firm level: Does the source of financing matter? Working paper, National Bureau of Economic Research.

Hall, B. J., and J. B. Liebman. 1998. Are CEOs really paid like bureaucrats? *The Quarterly Journal of Economics* 113 (August): 653-691. (DOI: 10.1162/003355398555702)

Hammersley, J. S., L. A. Myers, and C. Shakespeare. 2008. Market reactions to the disclosure of internal control weaknesses and to the characteristics of those weaknesses under Section 302 of the Sarbanes Oxley Act of 2002. *Review of Accounting Studies* 13 (March): 141-165. (DOI: 10.1007/s11142-007-9046-z)

Hartman, T. E. 2007. The cost of being public in the era of Sarbanes–Oxley. Available at: https://www.foley.com/files/Publication/6202688d-eebc-42bc-8169-5dfb14ef3ced/Presentation/PublicationAttachment/666c1479-ea9c-4359-bb07-5f71a18166f6/Foley2007SOXstudy.pdf. Accessed: June 15, 2018.

Haugen, R. A., and L. W. Senbet. 1981. Resolving the agency problems of external capital through options. *Journal of Finance* 36 (June): 629-647. (DOI: 10.2307/2327523)

Hayes, R. M., M. Lemmon, and M. Qiu. 2012. Stock options and managerial incentives for risk-taking: Evidence from FAS 123R. *Journal of Financial Economics* 105 (July): 174-190. (DOI: 10.1016/j.jfineco.2012.01.004)

Hochberg, Y. V., P. Sapienza, and A. Vissing-Jorgensen. 2009. A lobbying approach to evaluating the Sarbanes–Oxley Act of 2002. *Journal of Accounting Research* 47 (March): 519-583. (DOI: 10.1111/j.1475-679X.2009.00321.x)

Hogan, C. E., T. A. Lambert, and J. J. Schmidt. 2013. Do management internal control certifications increase the likelihood of restatement-related litigation? Working Paper, Michigan State University, Lehigh University, and University of Texas at Austin.

Hoitash, R., U. Hoitash, and K. M. Johnstone. 2012. Internal control material weaknesses and CFO compensation. *Contemporary Accounting Research* 29 (June): 768-803. (DOI: 10.1111/j.1911-3846.2011.01122.x)

Holmstrom, B. 1979. Moral hazard and observability. *The Bell Journal of Economics* 10 (Spring): 74-91. (DOI: 10.2307/3003320)

Hsu, A. W., and C. Liao. 2012. Do compensation committees pay attention to Section 404 opinions of the Sarbanes-Oxley Act? *Journal of Business Finance & Accounting* 39 (September): 1240-1271. (DOI: 10.1111/j.1468-5957.2012.02302.x)

Indjejikian, R., and M. Matějka. 2009. CFO fiduciary responsibilities and annual bonus incentives. *Journal of Accounting Research* 47 (July): 1061-1093. (DOI: 10.1111/j.1475-679X.2009.00343.x)

Jensen, M. C., and K. J. Murphy. 1990. Performance pay and top-management incentives. *Journal of Political Economy* 98 (April): 225-264. (DOI: 10.1086/261677)

Jiang, J., K. R. Petroni, and I. Y. Wang. 2010. CFOs and CEOs: Who have the most influence on earnings management? *Journal of Financial Economics* 96 (June): 513-526. (DOI: 10.1016/j.jfineco.2010.02.007)

John, T. A., and K. John. 1993. Top management compensation and capital structure. *The Journal of Finance* 48 (July): 949-974. (DOI: 10.2307/2329022)

Kim, J. B., Song, B. Y., and L. Zhang. 2011. Internal control weakness and bank loan contracting: Evidence from SOX Section 404 disclosures. *The Accounting Review* 86 (July): 1157-1188. (DOI: 10.2308/accr-10036)

Lambert, R., C. Leuz, and R. E. Verrecchia. 2007. Accounting information, disclosure, and cost of capital. *Journal of Accounting Research* 45 (March): 385-420. (DOI: 10.1111/j.1475-679X.2007.00238.x)

Leuz, C., A. Triantis, and. T. Y. Wang. 2008. Why do firms go dark? Causes and economic consequences of voluntary SEC deregistrations. *Journal of Accounting and Economics* 45 (August): 181-208. (DOI: 10.1016/j.jacceco.2008.01.001)

Li, C., L. Sun, and M. Ettredge. 2010. Financial executive qualifications, financial executive turnover, and adverse SOX 404 opinions. *Journal of Accounting and Economics* 50 (May): 93-110. (DOI: 10.1016/j.jacceco.2010.01.003)

Nagy, A. L. 2010. Section 404 compliance and financial reporting quality. *Accounting Horizons* 24 (September): 441-454. (DOI: 10.2308/acch.2010.24.3.441)

Ogneva, M., K. R. Subramanyam, and K. Raghunandan. 2007. Internal control weakness and cost of equity: Evidence from SOX Section 404 Disclosures. *The Accounting Review* 82 (October): 1255-1297. (DOI: 10.2308/accr.2007.82.5.1255)

Pástor, L., M. Sinha, and B. Swaminathan. 2008. Estimating the intertemporal risk-return trade-off using the implied cost of capital. *Journal of Finance* 63 (November): 2859-2897. (DOI: 10.1111/j.1540-6261.2008.01415.x)

Petersen, M. A. 2009. Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies* 22 (January): 435-480. (DOI: 10.1093/rfs/hhn053)

Piotroski, J. D., and S. Srinivasan. 2008. Regulation and bonding: the Sarbanes–Oxley Act and the flow of international listings. *Journal of Accounting Research* 46 (March): 383-425. (DOI: 10.1111/j.1475-679X.2008.00279.x)

Plumlee, M., and T. L. Yohn. 2010. An analysis of the underlying causes attributed to restatements. *Accounting Horizons* 24 (March): 41-64. (DOI: 10.2308/acch.2010.24.1.41)

Public Company Accounting Oversight Board (PCAOB). 2004. Auditing Standard No. 2. An Audit of Internal Control over Financial Reporting Performed in Conjunction with an Audit of Financial Statements. Available at: https://pcaobus.org/Standards/Archived/Pages/Auditing_Standard_2.aspx. Accessed: June 15, 2018.

Raghunandan, K., and D. V. Rama. 2006. SOX Section 404 material weakness disclosures and audit fees. *Auditing: A Journal of Practice and Theory* 25 (May): 99-114. (DOI: 10.2308/aud.2006.25.1.99)

Rajgopal, S., and T. Shevlin. 2002. Empirical evidence on the relation between stock option compensation and risk taking. *Journal of Accounting and Economics* 33 (June): 145-171. (DOI: 10.1016/S0165-4101(02)00042-3)

Rice, S. C., D. P. Weber, and B. Wu. 2015. Does SOX 404 have teeth? Consequences of the failure to report existing internal control weaknesses. *The Accounting Review* 90 (May): 1169-1200. (DOI: 10.2308/accr-50974)

Rosenbaum, P. R., and D. B. Rubin. 1983. The central role of the propensity score in observational studies for causal effects. *Biometrika* 70 (April): 41-55. (DOI: 10.1093/biomet/70.1.41)

Shu, S. Q., and W. B. Thomas. 2017. Managerial equity holdings and income smoothing incentives. *Journal of Management Accounting Research* in-press. (DOI: 10.2308/jmar-51822)

Smith, C. W., and R. M. Stulz. 1985. The determinants of firms' hedging policies. *Journal of Financial and Quantitative Analysis* 20 (December): 391-405. (DOI: 10.2307/2330757)

Smith Jr., C. W., and R. L. Watts. 1992. The investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Financial Economics* 32 (December): 263-292. (DOI: 10.1016/0304-405X(92)90029-W)

Sun, Y. 2016. Internal control weakness disclosure and firm investment. *Journal of Accounting, Auditing & Finance* 31 (2): 277-307. (DOI: 10.1177/0148558X15598027)

Wang, X. 2010. Increased disclosure requirements and corporate governance decisions: Evidence from chief financial officers in the pre and post-Sarbanes Oxley periods. *Journal of Accounting Research* 48 (September): 885-920. (DOI: 10.1111/j.1475-679X.2010.00378.x)

Zhang, Y., J. Zhou, and N. Zhou. 2007. Audit committee quality, auditor independence, and internal control weaknesses. *Journal of Accounting and Public Policy* 26 (May-June): 300-327. (DOI: 10.1016/j.jaccpubpol.2007.03.001)