

Internal Control Weakness and Information Quality

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Abstract

This paper explores the effect of internal control weaknesses (hereafter ICW) and their remediation on information precision for firms who filed Section 404 reports with the SEC. First, we find that the presence of ICW is associated with lower precision of both *public* and *private* information. Second, we find that the effect of ICW on public information precision is stronger for firms with firm-level ICW than for those with account-specific ICW. However, we find no such a relation for private information precision. Third, we find that the precision of both private and public information are higher for firms remedying previous weaknesses relative to firms who do not remedy their weaknesses. Further analyses indicate that *overall* information uncertainty is higher for ICW firms than non-ICW firms. However, we find no difference in consensus among investors between ICW and non-ICW firms. The results suggest that lower precision of public information is offset by lower precision of private information such that consensus among investors is not affected. Finally, we find that firms with different internal control opinions in successive years exhibit changes in precision of public and private information, consistent with our prediction.

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1 Introduction

Section 404 of the Sarbanes-Oxley (SOX) Act of 2002 requires management to report on the effectiveness of the internal controls over financial reporting and auditors to attest to the validity of these reports. However, in response to SEC registrants' argument that high implementation costs are not commensurate with its perceived benefits (e.g., Ongeva et al. 2007), Congress recently passed the Dodd-Frank Wall Street Reform and Consumer

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Protection Act of 2010 (hereafter Dodd-Frank Act), which affords small issuers an exemption from the internal controls auditor attestation requirement of Section 404. Although regulators and auditors argue that Section 404 requirements should lead to a higher quality of financial reporting, and in turn lower cost of capital (Donaldson, 2005b; KPMG, 2005), research results regarding the success in achieving these goals are mixed.⁴ One effective way to study the economic consequences of this Act is to directly explore the channels by which Section 404 audit reports affect investor (or analyst) behavior and sort out the source of the effects of Section 404 audit reports. Specifically, internal control weaknesses (therefore ICWs) can have a direct effect on not only the information that is common across all investors (or analysts) but also on the information that is idiosyncratic (private) to individual investors (or analysts). Alternatively, the precision of public and private information can be related to Section 404 audit reports. In this paper, we examine whether and how ICWs affect public and private information precision, and, in turn, overall information environment.

Our first question to be addressed is whether the presence of ICW is associated with lower precision of public and private information. Prior empirical research suggests that weak internal controls result in intentional earnings management and fraud, and unintentional accounting estimation errors (Ashbaugh-Skaife et al. 2008; Doyle et al. 2007b). This will, in turn, lead to a coarser information environment. However, when firm-provided information is an important determinant of the information environment (Verrecchia 1982; Diamond 1985), little work, to date, directly examines the effect of internal control quality on information precision.

A firm's information environment is comprised of public and private information. Gonedes (1980) argues that the effectiveness of disclosure rule cannot be assessed independently of private information-production activities when there exists a substitutive or complementary relation among the signals produced on private account and those covered by disclosure rules.⁵ Hence, empirical evidence dealing with the effects of disclosure rules should reflect both the direct effects of the disclosure rules on produced information and the indirect effects of any change in private-information production activities.⁶ If Section 404 audit reports lead to greater incentive for investors to develop more precise private information, public information quality (i.e., earnings quality) alone cannot provide clear inferences about changes in the overall information environment. In the context of this study, we thus explore whether and how internal control weaknesses affect the precision of public and private information. Another major advantage for an examination of the precision of public and private information is that it can provide direct evidence on how Section 404 audit

⁴For accruals tests, Doyle et al. (2007a) document no significant difference in accrual quality between ICW firms and non-ICW firms under Section 404, while Ashbaugh-Skaife et al. (2008) find that ICW firms have lower accrual quality than non-ICW firms. However, Doyle et al. (2007a) further demonstrate that when material weakness disclosures are broken down by account-specific versus firm-level weaknesses, firm-level Section 404 weaknesses are related to poorer accrual quality. For cost of capital tests, Ogneva et al. (2007) document no significant difference in their implied cost of equity estimates between ICW firms and non-ICW firms. In contrast, Ashbaugh-Skaife et al. (2009) find that ICW firms exhibit a significantly higher cost of equity capital, relative to non-ICW firms.

⁵There are two opposite perspectives about the association between public and private information precision (e.g., Verrecchia 1982; Kim and Verrecchia 1997). We will discuss in more detail below.

⁶Recent paper indicates that the precision of both public and private information are related to cost of equity capital (Botosan et al., 2004).

report affects information production process or activities. Specifically, these analyses can provide further insight into the channels by which Section 404 audit report affects investors (or analysts) behavior and can help identify the source of the effects of Section 404 audit report.

The second question we address is whether the effect of internal control weaknesses on information precision systemically varies with the types of internal control weaknesses disclosed. As indicated by Moody's Investors Service (2007), the severity of weaknesses varies significantly within material internal control weaknesses. *Account-specific* weaknesses are auditable and thus do not represent as serious a concern regarding the reliability of the financial statements. In contrast, *firm-level* material weaknesses are less "auditable" and thus more likely to result in inaccurate financial reports. Accordingly, we hypothesize that firm-level weaknesses have a stronger negative effect on public and/or private information precision than account-specific weaknesses. The final question we address is whether firms whose auditors confirm remediation of previously reported ICW have higher precision of public and private information relative to firms that do not remediate their internal control problems.

To measure properties of information environment, we follow prior studies (e.g., Barron et al., 2002a, 2002b; Botosan et al. 2004; Byard and Shaw 2002) and use the methods developed by Barron et al. (1998, hereafter BKLS) to derive our empirical proxies. These proxies are based on the assumption that analysts' earnings forecasts reflect both public information shared by all analysts and private information available only to individual analysts. Specifically, we measure our separate proxies for public and private information based on the observed error in mean forecast, forecast dispersion, and number of analysts. Information quality is a function of the precision of public and private information. In our additional analyses section, we further examine the effect of Section 404 audit report on two important and unobservable properties of information environment developed by BKLS: *overall* information uncertainty and consensus. Likewise, following BKLS, we then define *overall* uncertainty as the reciprocal of the sum of the precision of public and private information and define consensus as the ratio of the precision of public information to the sum of the precision of public and private information.

Using a sample of firms that have at least one Section 404 audit report on internal control system for the period 2007-2010, we find that ICW firms have lower precision of both public and private information. The results remain unchanged when internal control effectiveness is captured by the number of internal control weaknesses instead of an indicator variable. The results lend support to the complementary relation between public and private information, at least in the ICW context. Second, we find that the negative association between the presence of ICW and public information precision is stronger for firms with firm-level weaknesses than for those with account-specific weaknesses. However, we find no such a relation for private information. Finally, empirical analyses show that private and public information precision are significantly higher for firms remedying previous weaknesses compared to firms which do not remedy their weaknesses. Further analyses reveal that *overall* information uncertainty is higher for ICW firms than non-ICW firms. Next, despite the observed change in precision of public and private information, we do not detect, however, the difference in consensus among investors between ICW firms and non-ICW firms. The absence of the difference in consensus suggests that the lower public information precision due to ICW is offset by the lower private information precision such that consensus among investors remains unaffected.

As a robustness check, we conducted several analyses. First, an important concern

regarding our specifications is the endogeneity issue. After controlling for the endogeneity problem, our primary findings are robust and remain qualitatively unchanged. Second, we conduct intertemporal analysis of Section 404 audit reports across successive years and the results indicate that firms with internal control improvements exhibit an increase in public and private information precision.

This paper contributes to the literature on internal control in several important aspects. First, we contribute to the literature on the economic consequences of internal control weaknesses by directly linking the strength of a firm's internal control over financial reporting to quality of overall information environment. Prior studies examining the effect of ICW on information quality (e.g., Ashbaugh-Skaife et al., 2008; Doyle et al., 2007a) focus exclusively on public information (i.e., earnings quality). In contrast, we investigate the effects of Section 404 audit reports on the precision of public and private information. These analyses provide insight into how investors use information in the presence of ICWs. Our results reveal that the presence of ICW not only decreases the precision of information that is common across all investors (or analysts), but also limits investors' (or analysts') abilities to develop private insights from public information. When the effectiveness of disclosure rules (e.g., Section 404 audit reports) cannot be assessed independently of private information production activities (Gonedes, 1980), an examination of the effects of ICW on both public and private information can provide better inferences about change in overall information due to ICW announcement.

In addition, we also show the effect of Section 404 audit report on two important but unobservable information properties: overall uncertainty and consensus among investors (or analysts). Although we find that the presence of ICW lowers overall information uncertainty, we are unable to detect the difference in the consensus among financial analysts between ICW firms and non-ICW firms.

Second, this paper also contributes to the intense debate regarding costs and benefits of Section 404 provisions of SOX and has implications for regulators. Due to high compliance cost of Section 404 provisions, Congress recently passed the Dodd-Frank Act which grants small issuers an exemption from the internal controls auditor attestation requirement of Section 404(b). Based on a sample of accelerated firms, we do document the effectiveness of Section 404 (b). Therefore, while small firms have lower information transparency and higher information asymmetry than large firms, the additional information provided by auditor attestation requirement of Section 404 can greatly benefit investors of these small firms. Therefore, whether and how small firms should be permanently exempted from compliance with auditor attestation requirement of Section 404 (b) are worth further consideration.

The remainder of this study is organized as follows. Section 2 discusses background on internal control weakness disclosures and develops our hypotheses. Sample and research design are explained in Section 3. The empirical results are presented and discussed in Section 4, and conclusions summarized in Section 5.

2 Background and Literature Review

2.1 Background and Regulatory Debate on Internal Control

Section 404 mandates that annual reports filed with SEC contain management's assessment of the effectiveness of the internal control over financial reporting, and that this assessment

must be audited by the external auditor of its financial statements. However, since the passage of SOX Act in 2002, Section 404 requirements have been subject to considerable debate, and much of the controversy seems to be focused on the high costs of complying with Section 404, which are not commensurate with perceived benefits (see Ogneva et al. 2007).

The earlier studies on internal control focus primarily on the types of firms disclosing internal control deficiencies (e.g., Ashbaugh-Skaife et al. 2007; Doyle et al. 2007b; Ge and McVay 2005). Subsequent papers investigate the economic consequence of ICW disclosure and have provided mixed evidence. For example, one stream of research focuses on the effect of SOX on financial reporting quality, in particular, accruals quality, and finds mixed evidence (Bedard 2006; Doyle et al. 2007a; Ashbaugh-Skaife et al. 2008). Another stream of research examines the effect of SOX on cost of capital (see Ogneva et al. 2007; Ashbaugh-Skaife et al. 2009) or stock return (Hammersley et al. 2008; Beneish et al. 2008) and also provides mixed evidence.

In contrast to prior research, which focuses on the effect of SOX on financial reporting quality and cost of capital (or stock return), this study directly examines the effect of Section 404 audit reports on information production activities, as proxied by the precision of public and private information. Our findings add to the debate on the benefits of Section 404, suggesting that material weakness disclosures are appropriately identifying firms with lower precision of public and private information and then firms with larger information uncertainty. While the Dodd-Frank Act gives SEC power to create exemption, a further understanding of the potential effect of Section 404 can lead to a more informative decision on whether and how certain groups of firms should be exempted from such requirements.

2.2 Literature and Hypotheses

2.2.1 The impact of internal control weaknesses on information precision

Since much of the information which market participants use in deriving their investment decisions is directly provided by a firm (Verrecchia 1982; Diamond 1985), a firm with more public disclosure has less dispersion among individual analysts and lower information asymmetry (e.g., Hope 2003a, 2003b; Lang and Lundholm 1996). However, ineffective internal controls allow or introduce both intentional and unintentional misstatements into the financial reporting process and, in turn, lead to lower earnings quality (Ashbaugh-Skaife et al. 2008, 2009; Doyle et al. 2007b) and a coarser information environment. Hence, firms with internal control weaknesses likely have poorer-quality information, and investors of such ICW firms with internal control weaknesses tend to face larger information asymmetry than those of other firms.

In addition to financial reporting, management guidance has been shown to be a public and informative disclosure (e.g., Waymire 1984; Pownall and Waymire 1989). Recent research finds that the quality of internal control over financial reporting, though its effect on the accuracy of internal reports used by managers to form the guidance, affects the accuracy of management guidance. Specifically, firms with internal control weaknesses have significantly larger management forecast errors than do firms that report effective internal controls (Fang et al. 2009).

Consequently, ICW firms do not only have lower financial reporting quality, but only have less accurate guidance. As such, we could conceptualize the presence of ineffective internal control system under Section 404 audit report as a movement from a finer to a coarser

information environment. The coarser information environment can further lead to a less precise public information signal. As a result, we expect that the precision of public information is lower for ICW firms, compared to non-ICW firms, which leads to the following hypothesis:

H1a: Internal control weaknesses are negatively associated with public information precision.

Each firm's information environment is comprised of public and private information. Extant literature posits that there are two competing perspectives about the association between public and private information. The "*substitutive*" perspective argues that higher degree of public information precision reduces market participants' incentives to generate more precise private information. This, in turn, reduces the amount and the precision of uniquely private information in the capital market (e.g., Verrecchia 1982). In contrast, the "*complementary*" perspective argues that public announcements create private beliefs (Harris and Raviv 1993; Kandel and Pearson 1995) since there are differential prior beliefs or likelihood functions among market investors. Holthausen and Verrecchia (1990) model public disclosures as signals with both common and private error components, which implicitly assume that public announcements can create private beliefs. Kim and Verrecchia (1994, 1997) argue that a public release of information triggers analysts with diverse information-processing skills to generate new idiosyncratic information from the public announcement. Recent empirical research supports the latter (Lundholm 1988; Barron et al. 2002a)

In the context of internal controls, the "*substitute*" perspective argues that ICW firms reveal poor information disclosure to the public and thereby reduce public information precision which results in greater incentives for analysts to develop more precise private information to enhance earnings forecast accuracy. Thus ICW leads to higher level of private information precision. This argument is consistent with those by Lang and Lundholm (1996), who show that analysts place more weight on their private information as the firm's disclosure policies decrease. On the other hand, "*complementary*" perspective posits that due to different prior beliefs or likelihood function among analysts or other market participants, higher level of public information precision arising from non-ICW firms enhances the possibility of triggering the generation of private information, which in turn leads to more precise private information. In this case, analysts have less motivation to acquire more precise private information even when they anticipate a less precise public information disclosure for ICW firms.⁷

⁷In his analytical model, Indjejikian (1991) also indicates that when individual investors are risk averse and equally informed, the utility from all investors becoming equally less informed by decreased public disclosure decreases investor demand for private interpretation of the disclosure.

Thus, the lower level of public information precision for ICW firms results in lower accurate private information.⁸

According to the above arguments, we do not predict the sign of the effect of ICW on the precision of private information. Thus, our hypothesis is as follows:

H1b: Internal control weaknesses are associated with the private information precision.

2.2.2 The severity of internal control weaknesses and information precision

Moody's Investors Service (2006, 2007) indicates that the severity of internal control problems varies substantially within the material weakness classification, and proposes that material weaknesses fall into one of two categories. Account-specific weaknesses are auditable by performing additional substantive procedures, and do not result in a serious concern of reliability of the financial statements. However, firm-level material weaknesses are related to more fundamental problems, which auditors may not be able to audit effectively (Doss and Jonas 2004; Doyle et al. 2007b). Thus, firm-level weaknesses lead to doubt about not only management's ability to report accurate financial statements, but also its ability to control the financial reporting processes. Firm-level weaknesses may significantly result in an increased likelihood of financial reporting problems in the future because of the weak foundation of internal control. Doyle et al. (2007b) suggest that firms with firm-level weaknesses have lower accruals quality than those with account-specific weaknesses. In addition, due to the inability to efficiently maintain internal control systems and processes, managements of firms with firm-level control problems are not capable of preparing accurate financial information to the public (Doss and Jonas 2004).

Given the previous arguments and findings, we thus predict that firm-level weaknesses have a stronger effect on public and private information precision than account-specific weaknesses. This leads to the second hypothesis:

H2: Firm-level control weaknesses have a stronger association with information precision than account-specific control weaknesses.

2.2.3 The effect of remediation of ICW firms

In this section, we further examine the time-series changes in precision of public and private information. In the analyses of successive year Section 404 audit reports, Ashbaugh-Skaife et al. (2008) document that firms whose auditors confirm remediation of previously reported internal control deficiencies (going from adverse to unqualified Section 404 audit report) exhibit a significant improvement in accrual quality relative to ICW firms that fail

⁸Furthermore, analysts' own benefits will affect their incentives to convey their private information into their forecasts, making hypothesis H1b more unclear. For example, regardless of how ICW affects the precision of private information, there are opposite incentives for analysts to convey their private information (Fischer and Verrecchia 1998). On the one hand, risk-averse analysts prefer to release their private information because they care more about the adverse effects of price changes resulted from inconsistent forecast of other analyst. Conversely, less risk-averse analysts prefer to hold their private information because they expect they can gain more benefit if they impound more private information in their forecasts. Therefore, analysts have differential incentives to decide whether they should convey their private information in their forecasts. This, in combination with the unclear association between the public and private information, makes it more unclear whether the effect of ICW is positively or negatively related.

to remediate their control problems. Li et al. (2010) find that ICW firms are more likely to experience CFO turnover, and the quality of a new CFO is positively related to an improvement in internal control systems. Therefore, in order to receive an unqualified SOX 404 audit opinion in successive years, ICW firms will use several mechanisms to remediate their weak control system, such as effective monitoring of operations, effective internal audit, continuous risk analysis and follow-up to unusual results (Krishnan et al. 2008). When ICW firms which previously received adverse Section 404 audit reports remedy their control systems in successive years, the improvements can result in more effective design and operation of internal control systems and thus in turn better information quality (Ashbaugh-Skaife et al. 2008).

Since the remediation firms will exhibit more improvements in quality of financial information disclosure than non-remediation firms, we posit that public information would be more precise for ICW firms remedying their internal control problems compared to ICW firms that do not remediate their internal control weaknesses. This leads to the following hypothesis:

H3a: Remediation firms exhibit an increase in public information precision relative to non-remediation firms.

As discussed earlier, there are two opposite perspectives about the relation between public and private information precision: *substitute* and *complementary* effects. Therefore, it is unclear that public information disclosure reduces or enhances analysts' incentive to collect and process more accurate private information. In the same vein, when remediation firms disclose higher-quality earnings, the change in precision of private information is unclear. Thus, we do not predict the direction of the influence of remediation on analysts' private information precision. This hypothesis is as follows:

H3b: Remediation firms exhibit a stronger association with private information precision compared to non-remediation firms.

3 Research Hypotheses, Design and Data Sources

3.1 Research Design

In this section, we present the regression models and discuss in detail the measures of the precision of public and private information, followed by a discussion of the choice of sample.

3.1.2 The impact of internal control weaknesses on information precision

To test Hypotheses 1a and 1b that the presence of ICW is associated with information precision, we estimate the following regressions in equations (1) and (2):

$$RPUBLIC_{i,t} = a_0 + a_1 ICW_{i,t} + a_2 Expert_{i,t} + a_3 Opinion_{i,t} + a_4 Horizon_{i,t} + a_5 Size_{i,t} + a_6 Surprise_{i,t} + a_7 ROA_{i,t} + a_8 Lev_{i,t} + a_9 Growth_{i,t} + a_{10} Loss_{i,t} + a_{11} Stdroe_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$RPRIVATE_{i,t} = b_0 + b_1 ICW_{i,t} + b_2 Expert_{i,t} + b_3 Opinion_{i,t} + b_4 Horizon_{i,t} + b_5 Size_{i,t} + b_6 Surprise_{i,t} + b_7 ROA_{i,t} + b_8 Lev_{i,t} + b_9 Growth_{i,t} + b_{10} Loss_{i,t} + b_{11} Stdroe_{i,t} + \varepsilon_{i,t} \quad (2)$$

Dependent variables

Our proxies for the precision of public and private information are drawn from BKLS, whose model relates unobservable properties of analysts' information environment to observable properties of their forecasts.

RPUBLIC = fractional rank of public information precision for firm i, year t. The proxy for public information precision (*PUBLIC*) is drawn from BKLS. The public information precision, *PUBLIC*, is defined as follows:

$$PUBLIC = \frac{SE - (D/N)}{[(SE - (D/N) + D)^2]}$$

RPRIVATE = fractional rank of private information precision for firm i, year t. The proxy for private information precision, (*PRIVATE*) is drawn from BKLS. The private information precision, *PRIVATE*, can be defined as follows:

$$PRIVATE = \frac{D}{[(SE - (D/N) + D)^2]}$$

Where $SE = \text{expected square error in the mean forecast} = (\overline{F_{it}} - A_{it})^2$; $D = \text{expected forecast dispersion} = \frac{1}{N-1} \sum_{i=1}^N (\overline{F_{it}} - F_{ijt})^2$. $N = \text{the number of forecasts}$; $\overline{F_{it}} = \text{mean forecast for firm i, year t}$; $A_{it} = \text{actual earnings forecasts for firm i, year t}$; and $F_{ijt} = \text{analyst j's forecast of earnings for firm i, year t}$.

Following Botosan et al. (2004), we estimate public and private information precision using analysts' most recent one-quarter-ahead forecasts *before* the announcement of Section 404 audit report. Prior studies show that estimated measures of public and private information, *PUBLIC* and *PRIVATE*, are heavily skewed to the right (Botosan et al., 2004), we thus follow Botosan et al. (2004) and use fractional ranks of public and private information precision, *RPUBLIC* and *RPRIVATE*, as proxies for public and private information precision, respectively, in equations (1) and (2).

Independent variable

ICW = a dummy variable that takes on a value of 1 if the firm discloses material weaknesses in internal control, and 0 otherwise.

To be consistent with Hypothesis 1a, the coefficient on *ICW* (a_1) is expected to be negative in equation (1). In addition, as mentioned in Hypothesis 1b, we do not hypothesize a directional relation between the presence of *ICW* and private information precision. As a consequence, we do not predict the sign of coefficient on *ICW* (b_1) in equation (2).

Control variables

<i>Expert</i>	=	the industrial market share of the auditors;
<i>Opinion</i>	=	a dummy variable that takes on a value of 1 if a firm reveals a clean opinion and 0 otherwise;
<i>Horizon</i>	=	the period between analyst forecast date and financial reporting date;
<i>Size</i>	=	logarithm of assets, measured at the end of fiscal year t-1;
<i>Surprise</i>	=	(net income in current year - net income in last year)/net income in last year;
<i>ROA</i>	=	the ratio of return to asset, calculated as earnings before extraordinary items scaled by average total assets;
<i>Lev</i>	=	the ratio of debt to averaged total assets;
<i>Growth</i>	=	market value of equity divided by book value of equality;
<i>Loss</i>	=	a dummy variable that takes on a value of 1 if earnings in previous year are negative and 0 otherwise;
<i>Stdroe</i>	=	standard deviation of return of equity over the previous five years;

Regarding control variables, we include *Expert* in equation (1) since auditor quality is inversely associated with analysts' consensus forecast error and dispersion (Behn et al. 2008).⁹ *Opinion* is included since an unclean audit opinion increases the likelihood of financial reporting misstatement (Francis and Krishnan, 1999; Bradshaw et al., 2001), and, in turn, may affect analysts' forecasts and their public information precision. The unqualified opinions and the modified opinions with harmless explanatory language are coded *Opinion*=1 and are labeled as clean opinions. The other opinions (mostly going concern, qualified opinions, adverse opinions and disclaimer of opinions) are coded *Opinion*=0 and are labeled as unclean opinions. *Horizon* is included since a forecast announced closer to the actual earnings announcement date is more accurate than a forecast announced in an earlier period (Baginski and Hassell 1997; Behn et al. 2008).

We also control for several firm-specific variables. *Size* is included since there is a positive association between firm size and forecast accuracy (Lang and Lundholm, 1996). However, firm size could also proxy for the complication for which prediction for the relation to public information precision is negative. Thus, we do not expect the direction of the coefficient on *Size*. *Surprise* is used to control for any effect on analysts' reaction to the level of surprise in earnings (Byard and Shaw 2003). We expect that larger earnings surprises are associated with less precise public information. We include *ROA* because management is willing to disclose their information truly while a firm's performance is strong and healthy (Gong et al. 2009). Thus, we expect that *ROA* is positively related to public information precision. We include *Lev* as a control variable since firms with higher leverage have less accurate forecasts (Hope 2003a, 2003b) and thus have lower information precision.

We also include *Growth* in these regressions, although empirical evidence regarding its effect on analysts' accuracy and bias is mixed (Ajinkya et al. 2005; Dechow and Sloan 1997). We do not expect the sign of the coefficient on *Growth*. *Loss* is included since there is a negative correlation between analyst information precision and previous loss (Mohanram and Sunder 2006). We thus posit that public information precision is lower in the presence of previous loss. Since the volatility (*Stdroe*) is likely to affect analysts' ability

⁹In this paper, when we replace proxy for industry auditor specialist, *Expert*, with proxy for big 4 audit firms in all specifications, the results remain qualitatively unchanged.

to forecast a firm's earnings and their forecast characteristics (Lang and Lundholm 1996; Behn et al. 2008), we expect this control variable to be negatively related to information precision.

Thus far, we focus on control variables used in public information precision tests. For the private information precision test, we include the same set of control variables as those used in equation (1). As mentioned previously, since there are two opposite arguments about the effect of ICW on private information precision, we do not predict the signs of all control variables in equation (2). We also include year and industry dummies in all of our regressions to control the year effect and industry effect.

3.1.2 The impact of severity of ICW on information precision

In order to test H2 that the negative effect of ICW on information precision systematically varies with the severity of ICW, we first classify internal control weaknesses as either account-specific or firm-level weaknesses. The classification of firm-level and account-specific weaknesses is similar to Moody's Investors Service's classification scheme (Moody's Investors Service 2006, 2007) and (Doyle et al. 2007a). We expect that firm-level weaknesses will be more strongly related to analyst information precision. The regressions testing the impact of the severity of internal control problems on analyst information precision are as follows:

$$\begin{aligned}
 RPUBLIC_{i,t} = & c_0 + c_1 ICW_acc_{i,t} + c_2 ICW_firm_{i,t} + c_3 Expert_{i,t} + c_4 Opinion_{i,t} + c_5 Horizon_{i,t} \\
 & + c_6 Size_{i,t} + c_7 Surprise_{i,t} + c_8 ROA_{i,t} + c_9 Lev_{i,t} + c_{10} Growth_{i,t} + c_{11} Loss_{i,t} \\
 & + c_{12} Stdroe_{i,t} + \varepsilon_{i,t}
 \end{aligned} \tag{3}$$

$$\begin{aligned}
 RPRIVATE_{i,t} = & d_0 + d_1 ICW_acc_{i,t} + d_2 ICW_firm_{i,t} + d_3 Expert_{i,t} + d_4 Opinion_{i,t} + d_5 Horizon_{i,t} \\
 & + d_6 Size_{i,t} + d_7 Surprise_{i,t} + d_8 ROA_{i,t} + d_9 Lev_{i,t} + d_{10} Growth_{i,t} + d_{11} Loss_{i,t} \\
 & + d_{12} Stdroe_{i,t} + \varepsilon_{i,t}
 \end{aligned} \tag{4}$$

Independent variable

ICW_acc = a dummy variable that takes on a value of 1 if the firm discloses account-specific material weaknesses in internal control, and 0 otherwise. Following prior studies (Moody's Investors Service 2006, 2007; Doyle et al. 2007a), account-specific weaknesses are defined as the internal control issues related to internal control over specific account balances or transaction-level processes.

ICW_firm = a dummy variable that takes on a value of 1 if the firm discloses firm-level material weaknesses in internal control, and 0 otherwise. Following prior studies (Moody's Investors Service 2006, 2007; Doyle et al. 2007a), firm-level weaknesses are defined as the internal control issues related to a firm's overall controls, such as an ineffective control environment, weak financial reporting processes, or ineffective personnel.

To test Hypothesis 2 that firm-level control weaknesses have a stronger association with information precision than account-specific control weaknesses, we search 10-Ks in the EDGAR from November 2004 to December 2007 to classify firms into two categories: firms with firm-level ICW and firms with account-specific ICW. Following the classification of Doyle et al. (2007a; 2007b), if a firm both has account-specific and firm-

level weaknesses, we consider this firm as an ICW firm with firm-level weaknesses. All other variables are as previously defined in equations (1) and (2).

3.1.3 The impact of ICW firms with remediation

To explore Hypothesis 3 that whether remediation firms exhibit an increase in public and private information precision relative to non-remediation firms, we follow Ashbaugh-Skaife et al. (2008) and perform the following regressions:

$$\begin{aligned} RPUBLIC_{i,t} = & m_0 + m_1 Weakness_{i,t} + m_2 Remediation_{i,t} + m_3 Expert_{i,t} + m_4 Opinion_{i,t} \\ & + m_5 Horizon_{i,t} + m_6 Size_{i,t} + m_7 Surprise_{i,t} + m_8 ROA_{i,t} + m_9 Lev_{i,t} + m_{10} Growth_{i,t} \\ & + m_{11} Loss_{i,t} + m_{12} Stdroe_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (5)$$

$$\begin{aligned} RPRIVATE_{i,t} = & n_0 + n_1 Weakness_{i,t} + n_2 Remediation_{i,t} + n_3 Expert_{i,t} + n_4 Opinion_{i,t} \\ & + n_5 Horizon_{i,t} + n_6 Size_{i,t} + n_7 Surprise_{i,t} + n_8 ROA_{i,t} + n_9 Lev_{i,t} + n_{10} Growth_{i,t} \\ & + n_{11} Loss_{i,t} + n_{12} Stdroe_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (6)$$

Weakness is an indicator variable which equals 1 if a firm received an adverse Section 404 audit report in the current or previous year, and 0 otherwise. *Remediation* is an indicator variable that takes on a value of 1 if a firm received an adverse Section 404 audit report in the current year, but received an unqualified Section 404 audit report in successive years. *Remediation* captures the incremental effect of the remediation for ICW firms that previously received an adverse opinion, but resolved internal control problems in successive years. All other variables are as previously defined in equations (1) and (2).

To be consistent with our predictions, we expect the coefficient on *Weakness* to be negative and the coefficient on *Remediation* to be positive in equation (5). We do not expect directions of the coefficients on *Weakness* and *Remediation* in equation (6).

3.2 Sample Selection

We obtain an initial sample of 12,459 observations that filed first-time Section 404 reports between November 2007 and December 2010 from the *Audit Analytics* database. This sample comprises 1,361 observations with ineffective internal control and 11,098 observations with effective internal control. The financial statement data are retrieved from *COMPUSTAT North America* database. The variables related to analysts' behavior, such as analyst following, horizon, and analyst information precision are retrieved from *I/B/E/S* database. Following Doyle et al. (2007a) and Ashbaugh-Skaife et al. (2007), we use the overall non-material internal control weakness population as the control group, rather than a matched sample, to eliminate choice-based sample bias.

The sample selection procedure and its effect on sample size are described in Panel A of Table 1. First, we delete 2,903 observations without analyst forecast information. Second, we exclude 3,044 observations due to insufficient financial data. This selection procedure yields 6,512 firm-year observations for our information precision analyses including 546 observations with weak internal control. To classify 546 observations into two categories, i.e., account-specific or firm-level weaknesses, we search SEC 10-Ks in the EDGAR from November 2007 to December 2010. Of the 546 firms-year observations with non-missing data, 361 observations are classified as account-specific and 185 observations as firm-level weaknesses.

Table 1: Sample Selection and Descriptive Statistics

Panel A: Sample Selection						
Number of company-years during 2007-2010 period						12,459
Less: Non analyst forecast data						(2,903)
Less: Missing financial data						(3,044)
Total sample for market liquidity						<u>6,512</u>
Panel B: Comparison of Firm Characteristics between Non-ICW and ICW Firms						
Variables	Non-ICW firms		ICW firms		t- statistics	Wilcoxon z-statistics
	Mean	Median	Mean	Median		
<i>RPUBLIC</i>	82.6170	79.3000	71.5700	64.7000	5.87***	4.84**
<i>RPRIVATE</i>	79.0480	76.0000	65.3510	58.8000	4.80***	6.06***
<i>Expert</i>	0.2461	0.2401	0.2319	0.2380	2.24**	1.69*
<i>Opinion</i>	0.5321	1.0000	0.6019	1.0000	-3.12***	-3.07***
<i>Horizon</i>	50.4345	53.0000	48.3815	51.0000	1.60	1.39
<i>Size</i>	7.7519	7.6394	7.0232	6.7156	8.70***	9.62***
<i>Surprise</i>	0.2311	0.1055	-0.6921	-0.1784	1.03	7.43***
<i>ROA</i>	0.0380	0.0493	0.0108	0.0181	4.24***	10.38***
<i>Loss</i>	0.1499	0.0000	0.3315	0.0000	-	-10.90***
					11.03***	
<i>Lev</i>	0.5673	0.5639	0.5456	0.5267	1.81*	2.12**
<i>Growth</i>	4.3020	2.4137	3.1962	2.2725	0.68	2.43**
<i>Stdroe</i>	0.4662	0.08295	0.6083	0.1579	-1.07	-8.98***
Panel C: Comparison of Firm Characteristics between ICW Firms with Account-specific Weaknesses and ICW Firms with Firm-level Weaknesses						
Variables	Account-specific Weaknesses		Firm-level Weaknesses		t- statistics	Wilcoxon z-statistics
	Mean	Median	Mean	Median		
<i>RPUBLIC</i>	74.8952	69.6000	65.1111	55.8500	2.27**	2.28**
<i>RPRIVATE</i>	67.4866	63.3000	61.2783	53.9000	1.38*	1.13
<i>Expert</i>	0.2360	0.2303	0.2237	0.2426	0.94	0.57
<i>Opinion</i>	0.6277	1.0000	0.6277	1.0000	-0.81	-0.80
<i>Horizon</i>	48.2646	51.0000	47.8111	51.500	0.15	-0.61
<i>Size</i>	6.9849	66.6635	7.1143	6.9257	-0.74	-0.69
<i>Surprise</i>	-1.3170	-0.1551	0.4589	-0.2711	-1.95**	0.30
<i>ROA</i>	0.0113	0.0174	0.0090	0.0195	0.21	0.36
<i>Loss</i>	0.3175	0.0000	0.3611	0.0000	-1.01	-1.01
<i>Lev</i>	0.5417	0.5238	0.5520	0.5431	-0.42	-0.34
<i>Growth</i>	3.1142	2.2995	3.3950	2.1650	-0.47	0.10
<i>Stdroe</i>	0.6799	0.1532	0.4833	0.1794	1.02	-0.10

a. Variable definition

- RPUBLIC* = the rank value of precision of public information, which are drawn from BKLS,
- RPRIVATE* = the rank value of precision of private information, which are drawn from BKLS,
- ICW* = a dummy variable that takes on a value of 1 if the firm discloses material weakness in internal control under Section 404, and 0 otherwise.
- Expert* = the industrial market share of the auditors.
- Opinion* = a dummy variable that takes on a value of 1 if a firm reveals a clean opinion and 0 otherwise;
- Horizon* = the period between analyst forecast date and financial reporting date;

<i>Size</i>	=	logarithm of assets, measured at the end of fiscal year t-1;
<i>Surprise</i>	=	(net income in current year- net income in last year)/net income in last year;
<i>ROA</i>	=	the ratio of return to asset, calculated as earnings before extraordinary items scaled by average total assets;
<i>Lev</i>	=	the ratio of debt to averaged total assets;
<i>Growth</i>	=	market value of equity divided by book value of equality;
<i>Loss</i>	=	a dummy variable that takes on a value of 1 if earnings in previous year are negative and 0 otherwise;
<i>Stdroe</i>	=	standard deviation of return of equity over the previous five years;

b. ***, **, * Denote significant at the 0.01, 0.05, 0.10 levels, respectively.

4 Empirical Results

4.1 Univariate Analyses

Panel B of Table 1 presents the descriptive statistics for the variables on which our analyses are based, tabulated by ICW firm and non-ICW firms. The table also presents the results of statistics analyses from t-tests and Wilcoxon Z-tests for differences in means and medians between the two types of firms.

As shown in Panel B, the mean (median) values of the proxies for the precision of public information, *RPUBLIC*, for ICW firms and non-ICW firms are 71.57 (64.7) and 82.617 (79.3), respectively. The results indicate that the mean and median values of *RPUBLIC* for ICW firms are significantly smaller than those for non-ICW firms. Similarly, the mean (median) value of the precision of private information for ICW firms 65.351(58.8) is also significantly smaller than that for non-ICW firms 79.048 (76).

Regarding the control variables, the auditors of non-ICW firms have higher expertise than those of ICW firms. We also find that ICW firms have smaller size, negative surprise, poor profitability, loss in previous year, lower opportunity of growth and more volatility relative to non-ICW firms.

Panel C provides descriptive statistics for firms with account-specific weaknesses and those with firm-level weaknesses separately. Regarding public information precision proxy, the mean and median for firms with firm-level weaknesses are significantly lower than those for firms with account-specific weaknesses, as predicted. In addition, regarding private information precision proxy, the mean and median for firms with firm-level weaknesses are also lower than those for firms with account-specific weaknesses, although only the difference in the mean is significant. Overall, panel C provides the preliminary evidence that firm-level weaknesses have more adverse effect on information precision than account-specific weaknesses, regardless of public or private information. There are no significant differences in other control variables between the two groups, except for *Surprise*. It can be seen that firms with account-specific weaknesses, on average, exhibit lower earnings surprise than those with firm-level weaknesses when evaluated by t-test.

Table 2 provides statistics on the characteristics of quintile portfolios formed by ranking firms on the magnitude of public (private) information precision. Firm-years are ranked and assigned in equal numbers to five portfolios. Panel A reports the mean values of *RPRIVATE*, *ICW*, *ICW_acc*, and *ICW_firm* for each portfolio. Consistent with the “complementary” perspective, Panel A reveals that there is evidence of a strong positive relation between public and private information precision. The mean value of private information precision,

RPRIVATE, increases monotonically from 46.719 for the lowest *RPUBLIC* portfolio to 118.771 for the highest *RPUBLIC* portfolio, and the difference between these two portfolios is significant at the one percent level. In addition, we find that the means of *ICW* decrease monotonically with the degree of public information precision, consistent with H1a. For example, the mean values of *ICW* are 0.0718 and 0.0981, respectively, for the highest and lowest *RPUBLIC* portfolios, and the difference is significant at the 5 percent level. Finally, Panel A further shows that the mean values of *ICW_firm* decrease monotonically with *RPUBLIC*, while the mean values of *ICW_acc* does not show this pattern. This indicates that firms with firm-level weaknesses have relatively lower public information precision than firms with account-specific firms.

Similar patterns are observed in Panel B of Table 2. For example, the mean values of both *ICW* and *ICW_firm* decrease monotonically with the degree of private information precision, *RPRIVATE*. The primary difference in Panels A and B is that the mean values of *ICW_acc* decrease monotonically with private information precision, *RPRIVATE*, while this pattern does not hold in Panel A. We will discuss this difference in more detail after controlling for other determinants related to information precision in section 4.2.2.

Table 2: Rank Portfolio

Panel A: Average rank of private information precision and control weaknesses by firm category: from large to small public information precision

<i>RPUBLIC</i>	<i>RPRIVATE</i>	<i>ICW</i>	<i>ICW_acc</i>	<i>ICW_firm</i>
Q5(highest)	118.7710	0.0718	0.0491	0.0227
Q4	94.4050	0.6732	0.0483	0.0249
Q3	72.6870	0.0740	0.0549	0.0205
Q2	57.2270	0.0755	0.0549	0.0256
Q1(lowest)	46.7190	0.0981	0.0571	0.0418
Q5-Q1	72.0520***	- 0.0263**	- 0.0080	- 0.0191***

Panel B: Average rank of public information precision and control weaknesses by firm category: from large to small private information precision

<i>RPRIVATE</i>	<i>RPUBLIC</i>	<i>ICW</i>	<i>ICW_acc</i>	<i>ICW_firm</i>
Q5(highest)	122.8834	0.0594	0.0432	0.0168
Q4	97.6369	0.0623	0.0454	0.0176
Q3	76.7073	0.0747	0.0483	0.0271
Q2	58.9882	0.0857	0.0520	0.0351
Q1(lowest)	52.5181	0.1144	0.0755	0.0389
Q5-Q1	70.3652***	- 0.0550***	- 0.0323***	- 0.0220***

a. Variable definition

- RPUBLIC* = the rank value of precision of public information, which are drawn from BKLS,
RPRIVATE = the rank value of precision of private information, which are drawn from BKLS,
ICW = a dummy variable that takes on a value of 1 if the firm discloses material weakness in internal control under Section 404 and 0 otherwise.
ICW_acc = a dummy variable that takes on a value of 1 if the firm discloses account-specific control weaknesses under Section 404 and 0 otherwise.
ICW_firm = a dummy variable that takes on a value of 1 if the firm discloses firm-level control weaknesses under Section 404 and 0 otherwise.

b. ***, **, * Denote significant at the 0.01, 0.05, 0.10 levels, respectively.

Table 3 presents the results of Pearson correlation for the sample of information precision. The results reveal that the dummy variable for internal control weaknesses (*ICW*) is negatively associated with the public (*RPUBLIC*) and private (*RPRIVATE*) information precision. This evidence provides preliminarily supporting evidence of our hypotheses. Moreover, *RPUBLIC* and *RPRIVATE* are highly positively correlated (0.5260). This finding is consistent with prior evidence of a complementary association between public and private information precision. It also can be seen that the firms with shorter analyst forecast horizon (*Horizon*), less profitability (*ROA*), and loss in previous year (*Loss*) exhibit a higher possibility of having internal control problems. Finally, smaller firms (*Size*) tend to have a higher likelihood of having internal control weaknesses. In summary, all the univariate analyses provide preliminary evidence supporting our hypothesis that internal control weaknesses lead to less precision of public and private information. We will examine the effect of internal control weaknesses on the precision of public and private information after controlling for other variables documented to be associated with information precision in the following multivariate analyses.

Table 3: Pearson Correlation Matrix

	<i>RPUBLIC</i>	<i>RPRIVATE</i>	<i>ICW</i>	<i>Expert</i>	<i>Opinion</i>	<i>Horizon</i>	<i>Size</i>	<i>Surprise</i>	<i>ROA</i>	<i>LEV</i>	<i>Growth</i>	<i>Loss</i>	<i>Stdroe</i>
<i>RPUBLIC</i>	1												
<i>RPRIVATE</i>	0.5260***	1											
<i>ICW</i>	-0.0581***	-0.0709***	1										
<i>Expert</i>	-0.0578***	0.0027	-0.0272	1									
<i>Opinion</i>	0.0445***	0.0727***	0.0371***	0.0936***	1								
<i>Horizon</i>	-0.0022	-0.0183	-0.0221*	0.0068	-0.0270**	1							
<i>Size</i>	-0.1607***	-0.0640***	-0.1035***	0.2233***	0.0598***	0.0096	1						
<i>Surprise</i>	0.0266**	0.0185	-0.0129	-0.0238***	-0.0081	0.0011	-0.0094	1					
<i>ROA</i>	0.0912***	0.0902***	-0.0513***	0.0731***	-0.0035	0.0240**	0.2012***	-0.0067	1				
<i>Lev</i>	-0.1053***	-0.0983***	-0.0223*	0.0208*	0.0034	0.0144**	0.4343***	-0.0020	-0.1277***	1			
<i>Growth</i>	0.0218*	0.0260**	-0.0083	-0.0108	0.0192	0.0042	-0.0348***	0.0053	0.0071	0.0316**	1		
<i>Loss</i>	-0.1350***	-0.1180***	0.1319***	-0.0738***	0.0447***	-0.0329***	-0.2765***	-0.0062	-0.6428***	0.0117	0.0194	1	
<i>Stdroe</i>	0.0042	-0.0262**	0.0134	0.0037	0.0135	-0.0107	-0.0578***	-0.0149	-0.0376***	0.0818***	0.1111***	0.0680***	1

a. *RPUBLIC* equals the rank value of precision of public information, which are drawn from BKLS; *RPRIVATE* equals the rank value of precision of private information, which are drawn from BKLS; *ICW* equals one if the firm discloses material weakness in internal control under Section 404; *Expert* equals the industrial market share of the auditors; *Opinion* equals one if a firm reveals a clean opinion; *Horizon* equals the period between analyst forecast date and financial reporting date; *Size* equals logarithm of assets, measured at the end of fiscal year t-1; *Surprise* equals (net income in the current year- net income in the last year)/net income in the last year; *ROA* equals the ratio of return to asset, calculated as earnings before extraordinary items scaled by average total assets; *Lev* equals the ratio of debt to averaged total assets; *Growth* equals market value of equity divided by book value of equality; *Loss* equals one if earnings in previous year are negative; *Stdroe* equals standard deviation of return of equity over the previous five years.

b. ***, **, * Denote significant at the 0.01, 0.05, 0.10 levels, respectively

4.2 Regression Results

4.2.1 The effect of ICW on public and private information precision

Table 4 presents summary results of estimating regressions in equations (1) and (2). In the column labeled (1) where *RPUBLIC* is the dependent variable, the coefficient of *ICW* is negative and statistically significant (coef. = -7.4383; $p < 0.01$), which is consistent with Hypothesis 1a, indicating that the public information precision is lower for ICW firms relative to non-*ICW* firms. The results are in line with prior studies (Ashbaugh-Skaife et al. 2008; Doyle et al. 2007b) which posit that internal control weaknesses result in intentional earnings management and fraud, unintentional errors and misunderstanding.

Regarding the control variables, the coefficients on firm size (*Size*), financial leverage (*Lev*) and whether firms reported losses in prior year (*Loss*) are significant in the expected directions. The coefficient on *Surprise* is positively associated with public information precision, consistent with Hope (2003b), who suggests that firms with more positive earnings in the current year can reduce analysts' forecast dispersion and errors. The coefficient on *Growth* is significantly positive at the 6.8% level, consistent with Ajinkya et al. (2005), who find that high growth firms are likely to have more accurate and less optimistically biased forecasts.

The results in Column (2) indicate that the coefficient on *ICW* is significantly negative (coef. = -8.8706; $p < 0.01$), suggesting that ICW firms are negatively related to the precision of idiosyncratic information. The fact that both public and private information precision are lower for ICW firms than for other firms lends support to the notion that public and private information serve as complements to each other. Specifically, more precise public information increases the quality of private information.

Turning to the control variables, we find that the coefficient on *Expert* is positively related to private information precision, suggesting that firms reveal higher private information precision when audited by an industrial expertise auditor. The coefficient of *Lev* is significantly negative, indicating that firms with higher leverage tend to have less precision on private information. The coefficient on *Growth* is positively related to private information precision at the 5% level, suggesting that analysts tend to develop more accurate private information in deriving earnings forecasts for higher-growth firms. Consistent with our prediction, the coefficient on *Loss* is significant in the expected direction, indicating that when issuing earnings forecasts for firms with previous loss, analysts on average have lower precision of private information. However, the coefficient on *Surprise* is positively related to private information precision, indicating that analysts have more accurate private information for firms with more positive earnings in the current year than in the previous year (Hope, 2003b).

Table 4: Information precision and internal control weaknesses

Table 4				
	(1) RPUBLIC		(2) RPRIVATE	
	<u>Coef.</u>	<u>P value</u>	<u>Coef.</u>	<u>P value</u>
<i>Intercept</i>	54.9629	0.0020***	45.4727	0.0150**
<i>ICW</i>	- 7.4383	0.0000***	- 8.8706	0.0000***
<i>Expert</i>	- 0.2365	0.9550	10.5202	0.0170**
<i>Opinion</i>	0.7570	0.5510	1.5432	0.2460
<i>Horizon</i>	0.0036	0.8440	- 0.0317	0.1050
<i>Size</i>	- 4.0815	0.0000***	- 0.6803	0.0910*
<i>Surprise</i>	0.0559	0.0300**	0.0417	0.1230
<i>ROA</i>	8.0113	0.1180	5.0364	0.3480
<i>Lev</i>	- 7.9327	0.0020***	-14.1640	0.0000***
<i>Growth</i>	0.0273	0.0680*	0.0379	0.0160**
<i>Loss</i>	- 20.1264	0.0000***	- 15.0086	0.0000***
<i>Stdroe</i>	0.1518	0.4850	- 0.1572	0.4910
<i>Year</i>	Yes		Yes	
<i>Industry</i>	Yes		Yes	
<i>N</i>	6512		6512	
<i>Adj. R²</i>	0.2415		0.1835	

a. Variable definition

- RPUBLIC* = the rank value of precision of public information, which are drawn from BKLS;
- RPRIVATE* = the rank value of precision of private information, which are drawn from BKLS;
- ICW* = a dummy variable that takes on a value of 1 if the firm discloses material weakness in internal control under Section 404, and 0 otherwise;
- Expert* = the industrial market share of the auditors;
- Opinion* = a dummy variable that takes on a value of 1 if a firm reveals a clean opinion and 0 otherwise;
- Horizon* = the period between analyst forecast date and financial reporting date;
- Size* = logarithm of assets, measured at the end of fiscal year t-1;
- Surprise* = (net income in the current year- net income in the last year)/net income in the last year;
- ROA* = the ratio of return to asset, calculated as earnings before extraordinary items scaled by average total assets;
- Lev* = the ratio of debt to averaged total assets;
- Growth* = market value of equity divided by book value of equality;
- Loss* = a dummy variable that takes on a value of 1 if earnings in previous year are negative and 0 otherwise;
- Stdroe* = standard deviation of return of equity over the previous five years;

b.***, **, * Denote significant at the 0.01, 0.05, 0.10 levels, respectively.

4.2.2 The severity of internal control weaknesses

In this section, we further examine whether there are differential effects on the precision of public and private information between firms with account-specific weaknesses and those with firm-level weaknesses. Table 5 displays summary results of estimating regressions in equations (3) and (4).

Column (1) in Table 5 reveals that the coefficients of account-specific (*ICW_acc*) and firm-

level (*ICW_firm*) weaknesses are both significantly and negatively associated with the public information precision at the one percent level ($c_1 = -5.5040$, $c_2 = -12.0737$, respectively). Consistent with our prediction, F-test further shows that there are significant differences in coefficients for *ICW_firm* and *ICW_acc* ($F=2.75$, $p=0.0970$, two-tailed). The results indicate that the negative association between the presence of ICW and public information precision is stronger for firms with firm-level weaknesses than for those with account-specific weaknesses.

Regarding the private information, Column (2) shows that the coefficients of *ICW_acc* and *ICW_firm* are negatively related to private information precision at the 1% level ($d_1 = -7.7958$, $d_2 = -10.4542$, respectively), but there are no significant differences in the coefficients under an F-test. One possible explanation for the results is that public information is directly produced by internal control system, private information is not. As a result, the differential effect on information precision between these two types of ICW can be reflected in the information common to all analysts. In contrast, private information is not directly produced by internal control system but idiosyncratically inferred by individual analysts. Therefore, any “material” internal control weakness disclosure, regardless of account-specific or firm-level weaknesses, triggers equally significant change in the precision of private information.

In summary, our results provide further evidence that the presence of ICW is associated with a lower level of public and private information precision, regardless of account-specific and firm-level control weaknesses. More importantly, firm-level weaknesses have a more negative effect on public information precision than account-specific weaknesses, while there are no differential effects on private information precision between firms with firm-level weaknesses and those with account-specific weaknesses. Finally, the adverse effect of ICW on public or private information precision is stronger for firms with firm-level weaknesses than for firms with account-specific weaknesses.

Table 5 : Information precision and the severity of internal control weaknesses

	(1) <i>RPUBLIC</i>		(2) <i>RPRIVATE</i>	
	Coef.	P value	Coef.	P value
<i>Intercept</i>	54.9262	0.0020***	45.4391	0.0150***
<i>ICW_acc</i>	- 5.5040	0.0220**	- 7.7958	0.0020***
<i>ICW_firm</i>	- 12.0737	0.0000***	- 10.4542	0.0030***
<i>Expert</i>	- 0.4073	0.9230	10.4441	0.0180**
<i>Opinion</i>	0.8133	0.5220	1.5619	0.2410
<i>Horizon</i>	0.0036	0.8450	- 0.0316	0.1050
<i>Size</i>	- 4.0710	0.0000***	- 0.6730	0.0950*
<i>Surprise</i>	0.0564	0.0290**	0.0420	0.1210
<i>ROA</i>	8.1054	0.1140	5.0585	0.3460
<i>Lev</i>	- 7.9048	0.0020***	- 14.1803	0.0000***
<i>Growth</i>	0.0272	0.0680*	0.0379	0.0160**
<i>Loss</i>	- 20.0153	0.0000***	- 14.9839	0.0000***
<i>Stdroe</i>	1.4792	0.4970	- 0.1589	0.4860
<i>ICW_firm>ICW_acc</i>	F=2.75	0.0970*	F=0.41	0.5218
<i>Year</i>	Yes		Yes	
<i>Industry</i>	Yes		Yes	
<i>N</i>	6512		6512	
<i>Adj. R²</i>	0.2418		0.1833	

a. Variable definition

- RPUBLIC* = the rank value of precision of public information, which are drawn from BKLS;
- RPRIVATE* = the rank value of precision of private information, which are drawn from BKLS;
- ICW_acc* = a dummy variable that takes on a value of 1 if the firm discloses account-specific weaknesses in internal control under Section 404;
- ICW_firm* = a dummy variable that takes on a value of 1 if the firm discloses firm-level weaknesses in internal control under Section 404;
- Expert* = the industrial market share of the auditors;
- Opinion* = a dummy variable that takes on a value of 1 if a firm reveals a clean opinion and 0 otherwise;
- Horizon* = the period between analyst forecast date and financial reporting date;
- Size* = logarithm of assets, measured at the end of fiscal year t-1;
- Surprise* = (net income in the current year- net income in the last year)/net income in the last year;
- ROA* = the ratio of return to asset, calculated as earnings before extraordinary items scaled by average total assets;
- Lev* = the ratio of debt to averaged total assets;
- Growth* = market value of equity divided by book value of equality;
- Loss* = a dummy variable that takes on a value of 1 if earnings in previous year are negative and 0 otherwise;
- Stdroe* = standard deviation of return of equity over the previous five years;

b. ***, **, * Denote significant at the 0.01, 0.05, 0.10 levels, respectively.

4.2.3 The regression results from ICW firms with remediation

The results reported thus far indicate that ICW firms have lower precision of public and

private information. In this section, we further examine whether firms whose auditors confirm remediation of previously reported internal control weaknesses have higher information precision than firms who do not remedy their weaknesses. Table 6 provides the summary results of regressing *ICW* on information precision and other well-documented control variables to be related to *ICW*.

As shown in Columns (1) and (2) of Table 6, the coefficients of *Weakness* are negative and significant, as predicted, indicating that ICW firms have lower precision of public and private information. More importantly, the coefficients on *Remediation* are significantly and positively associated with public and private information precision ($m_2 = 14.2864$, $p < 0.01$; $n_2 = 16.8916$, $p < 0.01$), indicating that ICW firms which remedy their internal control problems have higher levels of the precision of public and private information than those which fail to remedy those problems. The results are in line with the prior studies that *ICW* firms may become more aggressive to disclose their information and try to rebuild investors' confidence in the year of remediation (e.g., Ashbaugh-Skaife et al., 2008), and thereby increase the precision of public and private information, which are complementary. Collectively, the empirical results provide supporting evidence of our Hypothesis 3a and 3b that ICW firms that remediate previously disclosed material weaknesses exhibit improvements in public and private information precision relative to ICW firms that fail to remediate their control problems.

Table 6: Information precision and remediation

	(1) <i>RPUBLIC</i>		(2) <i>RPRIVATE</i>	
	<u>Coef.</u>	<u>P value</u>	<u>Coef.</u>	<u>P value</u>
<i>Intercept</i>	126.4567	0.0000***	99.3601	0.0000***
<i>Weakness</i>	- 10.7924	0.0000***	- 12.2991	0.0000***
<i>Remediation</i>	14.2864	0.0000***	16.8916	0.0000***
<i>Expert</i>	- 10.9864	0.0100***	1.2771	0.7710
<i>Opinion</i>	7.9116	0.0000***	9.5420	0.0000***
<i>Horizon</i>	- 0.0091	0.6540	- 0.0365	0.0820*
<i>Size</i>	- 5.0986	0.0000***	- 1.9197	0.0000***
<i>Surprise</i>	0.0506	0.0770*	0.0407	0.1650
<i>ROA</i>	3.1826	0.5550	3.4081	0.5370
<i>Lev</i>	- 2.8450	0.2580	- 10.7596	0.0000***
<i>Growth</i>	0.0254	0.1210	0.0390	0.0200***
<i>Loss</i>	- 24.5922	0.0000***	- 17.6419	0.0000***
<i>Stdroe</i>	- 0.0550	0.8160	- 0.2787	0.2510
<i>N</i>	6512		6512	
<i>Adj. R²</i>	0.0656		0.0397	

a. Variable definition

- RPUBLIC* = the rank value of precision of public information, which are drawn from BKLS;
- RPRIVATE* = the rank value of precision of private information, which are drawn from BKLS;
- Weaknesses* = a dummy variable that takes on a value of 1 if the firm discloses weaknesses in internal control under Section 404 in the current or prior year;
- Remediation* = a dummy variable that takes on a value of 1 if the ICW firm subsequently received an unqualified SOX 404 internal control audit opinion;
- Expert* = the industrial market share of the auditors;
- Opinion* = a dummy variable that takes on a value of 1 if a firm reveals a clean opinion

	and 0 otherwise;
<i>Horizon</i>	= the period between analyst forecast date and financial reporting date;
<i>Size</i>	= logarithm of assets, measured at the end of fiscal year t-1;
<i>Surprise</i>	= (net income in the current year- net income in the last year)/net income in the last year;
<i>ROA</i>	= the ratio of return to asset, calculated as earnings before extraordinary items scaled by average total assets;
<i>Lev</i>	= the ratio of debt to averaged total assets;
<i>Growth</i>	= market value of equity divided by book value of equality;
<i>Loss</i>	= a dummy variable that takes on a value of 1 if earnings in previous year are negative and 0 otherwise;
<i>Stdroe</i>	= standard deviation of return of equity over the previous five years;

b.***, **, * Denote significant at the 0.01, 0.05, 0.10 levels, respectively.

4.3 Further Test

4.3.1 The impact of ICW on overall information environment

A firm's information environment is comprised of public and private information. However, our results reported thus far focus primarily on the impact of ICW on the precision of public or private information. To shed light on whether and how weak internal controls influence the *overall* information environment, we further examine the effect of ICW on two fundamental properties of information: uncertainty and consensus. Uncertainty represents a lack of precision in individual analysts' total information, and is measured as the *expected* squared error in individual forecasts averaged across analysts. BKLS show that overall information uncertainty can be measured by the sum of the reciprocal of the precision of public and private information.

As mentioned earlier, estimated measures of public and private information precision are heavily skewed to the right (Botosan et al. 2004). Accordingly, in this paper, we define overall information uncertainty (denoted *UNCER*) as follows:

$$UNCER = \frac{1}{R_{PUBLIC} + R_{PRIVATE}}$$

As shown by the definition of *uncertainty*, the lower level of public (or private) information precision implies a higher level of uncertainty. We use the following regression to explore the impact of ICW on overall information environment:

$$UNCER_{i,t} = f_0 + f_1 ICW_{i,t} + f_2 Expert_{i,t} + f_3 Opinion_{i,t} + f_4 Horizon_{i,t} + f_5 Size_{i,t} + f_6 Surprise_{i,t} + f_7 ROA_{i,t} + f_8 Lev_{i,t} + f_9 Growth_{i,t} + f_{10} Loss_{i,t} + f_{11} Stdroe_{i,t} + \varepsilon \quad (7)$$

Where all variables are as previously defined.

As shown in Column (1) of Table 7, the coefficient of *ICW* is significantly positive at the one percent level, indicating that there is a greater level of uncertainty among firms with material internal control weaknesses. The results, coupled with those in Table 4, suggest that weak internal controls adversely affect public and private information precision, respectively, and, in turn, reduce overall information environment, at least in terms of information uncertainty.

Column (2) reveals that the coefficients of *ICW_acc* and *ICW_firm* are negative and

significant at the 1% level in the sense that *ICW_acc* and *ICW_firm* are negatively related to overall information uncertainty (*UNCER*). The results suggest that regardless of firm-level or account-specific weaknesses, the presence of ICW leads to an increase in overall information uncertainty. More importantly, F-test further reveals that the coefficient of *ICW_firm* is significantly greater than that of *ICW_acc* ($F=3.14$, $p=0.0762$), indicating that the adverse effect of ICW on overall information uncertainty is pronounced for firms with firm-level weaknesses than for those with account-specific weaknesses.

4.3.2 The impact of ICW on consensus among investors

In addition to overall information uncertainty, another important information property developed by BKLS is the degree of consensus among investors (or analysts) (denoted *CONSENSUS*). Consensus represents the degree to which individual analysts' forecasts contain the same information. In other words, consensus can be thought of as simply a means of calculating the across-analyst correlation in forecast errors (see Holthausen and Verrecchia 1990; Barron et al. 1998). As a result, high (low) consensus is consistent with common information being a high (low) proportion of the total information individual analysts impound in their forecasts. BKLS reveal that *CONSENSUS* can be measured by the ratio of the precision of public information to the sum of the precision of public and private information:

$$CONSENSUS = \frac{RPUBLIC}{RPUBLIC + RPRIVATE}$$

Despite the observed change in the precision of both public and private information, we are unable to predict the directional effect on consensus. If the public information sets decrease more in precision than the private information sets, the consensus likely decreases. Conversely, if the private information sets decrease more in precision than the public information sets, consensus likely increases. Accordingly, the directional effect on consensus is an open question.

To examine the effect of ICW on consensus among investors, we rerun regression (7) by replacing *UNCER* with *CONSENSUS*. The results are presented in Panel B of Table 7. It can be seen that the coefficients of ICW are not statistically significant at the 10% level in Columns (1) and (2). The results, in conjunction with those in Table 4, indicate that the decrease in the precision of public information is offset by the decrease in the precision of private information such that consensus among investors (or analysts) is not affected.

Taken together, the presence of ICW results not only in lower precision of public and private information, respectively, but also in greater overall information uncertainty. However, we are unable to find a change in consensus among investors (or analysts) for ICW firms.

Table 7

Panel A Results from regression of uncertainty on ICW firms				
	(1) UNCER		(2) UNCER	
	<u>Coef.</u>	<u>P value</u>	<u>Coef.</u>	<u>P value</u>
<i>Intercept</i>	16.3199	0.3530	16.3725	0.3520
<i>ICW</i>	10.2669	0.0000***		
<i>ICW_acc</i>			8.0348	0.0010***
<i>ICW_firm</i>			14.9815	0.0000***
<i>Expert</i>	- 6.1385	0.1420	- 5.9594	0.1540
<i>Opinion</i>	- 2.4380	0.0530*	- 2.4933	0.0480**
<i>Horizon</i>	0.0269	0.1450	0.0269	0.1450
<i>Size</i>	3.4399	0.0000***	3.4270	0.0000***
<i>Surprise</i>	- 0.0507	0.0480**	- 0.0512	0.0450**
<i>ROA</i>	- 6.8895	0.1750	- 6.9782	0.1690
<i>Lev</i>	14.3940	0.0000***	14.3796	0.0000***
<i>Growth</i>	- 0.0368	0.0130**	- 0.0368	0.0130**
<i>Loss</i>	20.9221	0.0000***	20.8195	0.0000***
<i>Stdroe</i>	- 0.1212	0.5740	- .1.1706	0.5870
<i>Year</i>	Yes		Yes	
<i>Industry</i>	Yes		Yes	
<i>N</i>	6512		6512	
<i>Adj. R²</i>	0.2150		0.2153	
Panel B Results from regression of consensus on ICW firms				
	(1) Consensus		(2) Consensus	
	<u>Coef.</u>	<u>P value</u>	<u>Coef.</u>	<u>P value</u>
<i>Intercept</i>	0.9150	0.0000***	0.9153	0.0000***
<i>ICW</i>	0.0104	0.6260		
<i>ICW_acc</i>			0.0012	0.9260
<i>ICW_firm</i>			0.0264	0.5530
<i>Expert</i>	0.0111	0.5450	0.0116	0.5390
<i>Opinion</i>	- 0.0120	0.2340	- 0.0120	0.2390
<i>Horizon</i>	- 0.0000	0.4910	- 0.0000	0.5030
<i>Size</i>	0.0006	0.6750	0.0006	0.6890
<i>Surprise</i>	0.0001	0.3500	0.0001	0.3440
<i>ROA</i>	0.0017	0.9020	0.0015	0.9090
<i>Lev</i>	- 0.0100	0.2730	- 0.0100	0.2650
<i>Growth</i>	- 0.0000	0.2030	- 0.0000	0.2040
<i>Loss</i>	- 0.0041	0.5100	- 0.0043	0.4740
<i>Stdroe</i>	0.0002	0.7850	0.0002	0.7660
<i>Year</i>	Yes		Yes	
<i>Industry</i>	Yes		Yes	
<i>N</i>	6512		6512	
<i>Adj. R²</i>	0.43		0.43	

a. Variable definition

- UNCER* = the rank value of information uncertainty, which are drawn from BKLS;
- Consensus* = the value of $RPUBLIC/(RPUBLIC+RPRICISION)$;
- ICW* = a dummy variable that takes on a value of 1 if the firm discloses material weakness in internal control under Section 404, and 0 otherwise;
- ICW_acc* = a dummy variable that takes on a value of 1 if the firm discloses account-specific weaknesses in internal control under Section 404;
- ICW_firm* = a dummy variable that takes on a value of 1 if the firm discloses firm-level

	weaknesses in internal control under Section 404;
<i>Expert Opinion</i>	= the industrial market share of the auditors; = a dummy variable that takes on a value of 1 if a firm reveals a clean opinion and 0 otherwise;
<i>Horizon</i>	= the period between analyst forecast date and financial reporting date;
<i>Size</i>	= logarithm of assets, measured at the end of fiscal year t-1;
<i>Surprise</i>	= (net income in the current year- net income in the last year)/net income in the last year;
<i>ROA</i>	= the ratio of return to asset, calculated as earnings before extraordinary items scaled by average total assets;
<i>Lev</i>	= the ratio of debt to averaged total assets;
<i>Growth</i>	= market value of equity divided by book value of equality;
<i>Loss</i>	= a dummy variable that takes on a value of 1 if earnings in previous year are negative and 0 otherwise;
<i>Stdroe</i>	= standard deviation of return of equity over the previous five years;

b.***, **, * Denote significant at the 0.01, 0.05, 0.10 levels, respectively.

4.4 Sensitivity Analyses

4.4.1 Controlling for the endogeneity effect

An important concern regarding our specifications (e.g., equation [1] or [2]) is the endogeneity issue. It is possible that firms with low information precision are likely to have material internal control weaknesses for other reasons unrelated to their information precision. If this is the case, we might infer a link between analysts' information precision variables and internal control weaknesses when none exists. For example, suppose that

$$Y = \alpha x + \beta D + e,$$

where D is the dummy variable equal to one if a firm has at least one material weakness in internal control. Because whether firms disclose material internal control is based on various factors, we can use the probit model linking the likelihood of a firm disclosing internal control weaknesses as follows:

$$D^* = \varphi Z + u$$

$$D = 1 \text{ if } D^* > 0, 0 \text{ otherwise.}$$

If the typical firm selects to disclose internal control weaknesses due to some expected benefit in Y , OLS estimates of β will not correctly measure the effect of internal control weaknesses. This self-selection issue can be handled with a treatment effect model (e.g., see Greene 2008). To address this potential endogeneity issue, we use a self-selection model that controls for this bias. Specifically, following the prior studies (Doyle et al. 2007a; Ashbaugh-Skaife et al. 2008), we use the following probit model to predict the presence of internal control weakness disclosure:

$$ICW_{i,t} = \delta_0 + \delta_1 Market_{i,t} + \delta_2 Loss_{i,t} + \delta_3 Restatement_{i,t} + \delta_4 CPA_{CHANGE_{i,t}} + \delta_5 M\&A_{i,t} + \delta_6 Restructure_{i,t} + \delta_7 Foreign_{i,t} + \varepsilon \quad (8)$$

ICW is an indicator variable that takes on a value of 1 if the auditor's Section 404 report

suggests that the internal control system is ineffective and 0 otherwise. *Market* is a proxy for size, computed as the natural logarithm of a firm's market value. We also control for a firm's loss in the previous year (*Loss*), and restatement in the previous year (*Restatement*). *Loss* and *Restatement* are dummy variables that take on a value of 1 if the firm suffered a loss or had to restate its financial statements in the previous year. In addition, when a firm undergoes significant auditor change (*CPA_change*) and organization change, such as mergers and acquisitions (*M&A*) or restructuring (*Restructure*), their existing internal control systems probably cannot meet the requirement of section 404. Therefore, we include dummy variables for auditor change (*CPA_change*), mergers and acquisitions (*M&A*) and restructuring (*Restructure*) in our analyses to control for such effects. We also account for the complexity of a firm's business environment by including a dummy variable, *Foreign*, that takes on a value of 1 if a portion of the firm's revenues comes from foreign sales and 0 otherwise, in our analysis. Firms with a larger portion of foreign sales are more likely to encounter complex control and reporting issues and have a higher probability of reporting an effective internal control system.

Panel A in Table 8 reveals the estimated results from the two-stage treatment effect model. In the first stage, we find that firms with higher market value of equity or firms with mergers and acquisitions have less control weaknesses. The results also indicate that firms with previous loss, previous restatements, organization change, and more complex operations are more likely to have internal control problems. These results are generally similar to previous research (Doyle et al., 2007a; Ashbaugh-Skaife et al., 2008).

In our second analyses of information precision, it can be seen that both coefficients of *ICW* in public and private information analyses are negative and significant at the 1 % level, consistent with those in Table 4. The results indicate that the precision of public and private information are lower for ICW firms relative to non-ICW firms even after controlling for the self-selection bias, regardless of public or private information. As a consequence, overall, after correcting for selectivity bias and controlling for other known factors related to information precision, our findings are qualitatively unchanged.

4.4.2 The results of change sample

The empirical results reported thus far focus on the cross-sectional relationship between information precision and ICW. However, the cross-sectional analyses have a limitation in drawing inference about the cause-effect relationship between information precision and the effectiveness of internal control systems. In this section, we use change model to provide further insight into whether the changes in information precision are contemporaneous with the changes in effectiveness of internal control systems. The change analysis also allows us to overcome the potential issues arising from correlated omitted variables.

To do so, we confine our sample to firm-years with internal control weaknesses in previous year, resulting in a sample of 3,385 firm-years. To assess the effect of an improved control system in ICW firms from year *t* to *t+1* on public or private information precision, we perform the following change regression using this reduced sample:

$$\begin{aligned} \Delta RPUBLIC \text{ or } \Delta RPRIVATE \\ = g_0 + g_1 Improved + g_2 \Delta Expert + g_3 \Delta Opinion + g_4 \Delta Horizon + g_5 \Delta Size \\ + g_6 \Delta Surprise + g_7 \Delta Lev + g_8 \Delta Growth + g_9 \Delta Loss + g_{10} \Delta ROA + g_{11} \Delta Stdroe + \varepsilon \end{aligned} \quad (9)$$

Where Δ refers to the within-firm difference in variables of interest, i.e., the t year value less the $t-1$ year value. *Improved* is an indicator variable coded as one if the firms received an adverse Section 404 audit report last year, but remediate their internal control problems in the following year and 0 otherwise. All other control variables are as defined previously in equations (1) and (2).

Panel B of Table 8 reports the results of regressions in equation (9). In support of our predictions, Columns (1) and (2) indicate that the coefficients on *Improved* are significantly positive at the 1% level, suggesting that for firms that have weak internal control problems in year $t-1$, the remediation of the problems in year t leads to the increased precision of public and private information. The results provide supporting evidence that changes in information precision are concurrent with improvements of the internal control systems, indicating that modified internal control systems can increase information quality simultaneously.

In sum, the results shown in Panel B of Table 8 provide supporting evidence that the change in effectiveness of internal control systems results in predictable changes in information precision, regardless of public and private information. In addition, the observed changes in information precision are concurrent with changes in the quality of internal controls, which mitigate concerns about a possible lag effect between changes to internal controls and when these changes manifest changes in information precision.

4.4.3 Relation between private and public information

Recall that there is a relationship between public and private information precision. This suggests that the dependent variables in equations (1) and (2) may be simultaneously and jointly determined. Therefore, we estimate systems of simultaneous equations where the dependent variable of each equation appears as a predictor variable in the other equation(s). First, we add *RPRIVATE* and *RPUBLIC* to equations (1) and (2), respectively, and then estimate the two equations as a simultaneous system with *RPUBLIC* and *RPRIVATE* as jointly determined endogenous variables. For brevity, we only present the empirical results of the second-stage analysis in Panel C of Table 8. It can be seen that the results are broadly comparable to those in Table 4. Specifically, the coefficients of *ICW* are negative and significant at the traditional level in Columns (1) and (2), as predicted.

Similarly, we add *RPRIVATE* and *RPUBLIC* to equations (3) and (4), respectively, and estimate the two equations as a simultaneous system. Panel B also indicates that the coefficients of both *ICW_acc* and *ICW_firm* are negative and significant at the 1% in Columns (3) and (4), consistent with those in Table 5. Therefore, our conclusions are robust to the adjustment for the endogeneity issues.

4.4.4 The number of internal control weaknesses

Most prior research exploring the economic consequence of internal control weaknesses (Ogneva et al. 2007; Doyle et al. 2007b; Ashbaugh-Skaife et al. 2008) employ an indicator variable to capture “whether there are material internal control weaknesses”. However, it is possible that the use of an indicator variable to capture an ineffective internal control system may neglect the differential effects on information precision among firms with different amount of internal control weaknesses. To address this issue, we rerun equations (1) and (2) by replacing the indicator variable, *ICW*, with the number of internal control weaknesses, *NICW*, as our other proxy variable.

The results are shown in Panel D of Table 8. It can be seen that, regardless of public or

private information, the coefficient of *NICW* is negative and significant at the 1 % level, suggesting that precision of public and private information decrease with the number of material internal control weaknesses. The results, in conjunction with findings in Table 4, indicate that the precision of public and private information are not only associated with whether a firm's internal control is effective, but also with the number of internal control weaknesses.

Table 8: Sensitivity tests

Panel A Results of controlling for endogeneity				
Second stage:	(1) <i>RPUBLIC</i>		(2) <i>RPRIVATE</i>	
	<u>Coef.</u>	<u>P value</u>	<u>Coef.</u>	<u>P value</u>
<i>Intercept</i>	48.8263	0.0060***	40.5102	0.0290**
<i>ICW</i>	- 31.8968	0.0000***	- 25.2345	0.0000***
<i>Expert</i>	0.5895	0.8890	11.0543	0.0120**
<i>Opinion</i>	1.1586	0.3630	1.8005	0.1760
<i>Horizon</i>	0.0055	0.7640	- 0.0301	0.1220
<i>Size</i>	- 3.9198	0.0000***	- 0.5314	0.1880
<i>Surprise</i>	0.0582	0.0240**	0.0435	0.1060
<i>ROA</i>	36.0360	0.0000***	26.1861	0.0000***
<i>Lev</i>	- 9.1566	0.0000***	- 15.1100	0.0000***
<i>Growth</i>	0.0243	0.1040	0.0358	0.0220**
<i>Stdroe</i>	0.0650	0.7650	- .22163	0.3300
<i>Lambda</i>	13.838	0.0000***	9.1472	0.0000***
<i>Year</i>	Yes		Yes	
<i>Industry</i>	Yes		Yes	
<i>N</i>	6512		6512	
First stage:	<u>Coef.</u>	<u>P value</u>		
<i>Interecpt</i>	- 0.6281	0.0000***		
<i>Market</i>	- 0.1721	0.0000***		
<i>Loss</i>	0.2737	0.0000***		
<i>Restatement</i>	1.5217	0.0000***		
<i>CPA_{change}</i>	0.1612	0.3270		
<i>M&A</i>	- 0.3130	0.0050***		
<i>Restructure</i>	0.1995	0.0010***		
<i>Foreign</i>	0.3232	0.0000***		
Panel B Results of change analyses				
	(1) $\Delta RPUBLIC$		(2) $\Delta RPRIVATE$	
	<u>Coef.</u>	<u>P value</u>	<u>Coef.</u>	<u>P value</u>
<i>Improved</i>	13.4165	0.0010***	19.8029	0.0000***
$\Delta Expert$	10.4382	0.4900	- 0.1657	0.9920
$\Delta Opinion$	5.4934	0.0010***	5.0215	0.0040***
$\Delta Horizon$	- 0.0114	0.6310	- 0.0122	0.6290
$\Delta Size$	3.3200	0.3340	9.2728	0.0110**
$\Delta Surprise$	0.01188	0.6260	- 0.0063	0.8060
ΔROA	10.7367	0.3850	19.5399	0.1390
ΔLev	- 8.4129	0.3560	- 14.2431	0.1430
$\Delta Growth$	- 0.0199	0.4710	0.0150	0.6100
$\Delta Loss$	- 9.5425	0.0020***	- 10.1225	0.0020***
$\Delta Stdroe$	0.31873	0.7960	2.1081	0.1090

<i>N</i>	3385	3385
<i>Adj. R</i> ²	0.0099	0.0169

Panel C A relation between public and private information

	(1) <i>RPUBLIC</i>		(2) <i>RPRIVATE</i>		(3) <i>RPUBLIC</i>		(4) <i>RPRIVATE</i>	
<i>Intercept</i>	126.7745	0.0000****	99.7223	0.0000***	126.7329	0.0000***	99.6639	0.0000***
<i>ICW</i>	-11.1153	0.0000***	-12.3915	0.0000***				
<i>ICW_acc</i>					-8.4433	0.0010***	-10.8679	0.0000***
<i>ICW_firm</i>					-17.0499	0.0000***	-14.9131	0.0000***
<i>Expert</i>	-11.0031	0.0100***	1.2601	0.7740	-11.2403	0.0090***	1.1254	0.7980
<i>Opinion</i>	7.9349	0.0000***	9.5657	0.0000***	7.9898	0.0000***	9.5956	0.0000***
<i>Horizon</i>	-0.0092	0.6500	-0.0366	0.0810*	-0.0092	0.6510	-0.0365	0.0820*
<i>Size</i>	-5.1277	0.0000***	-1.9531	0.0000***	-5.1184	0.0000***	-1.9447	0.0000***
<i>Surprise</i>	0.0498	0.0820*	0.0398	0.1750	0.0506	0.0770*	0.0402	0.1700
<i>ROA</i>	3.4603	0.5200	3.7314	0.4990	3.6373	0.4990	3.7968	0.4910
<i>Lev</i>	-2.7591	0.2730	-10.6532	0.0000***	-2.7668	0.2710	-10.6671	0.0000***
<i>Growth</i>	0.0251	0.1260	0.0386	0.0220**	0.0251	0.1260	0.0386	0.0220**
<i>Loss</i>	-24.3971	0.0000***	-17.4217	0.0000***	-24.2494	0.0000***	-17.3686	0.0000***
<i>Stdroe</i>	-0.0551	0.8160	-0.2787	0.2510	-0.0601	0.8000	-0.2814	0.2460
<i>N</i>	6512		6512		6512		6512	

Panel D Results using internal control counts as proxy for ICW

	(1) <i>RPUBLIC</i>		(2) <i>RPRIVATE</i>	
	<u>Coef.</u>	<u>P value</u>	<u>Coef.</u>	<u>P value</u>
<i>Intercept</i>	54.6548	0.0020***	45.1144	0.0150**
<i>NICW</i>	-2.1816	0.0010***	-2.6644	0.0000***
<i>Expert</i>	-0.4453	0.9160	10.2583	0.0200**
<i>Opinion</i>	0.6705	0.5970	1.4491	0.2760
<i>Horizon</i>	0.0027	0.8810	-0.0328	0.0930*
<i>Size</i>	-4.0336	0.0000***	-0.6244	0.1200
<i>Surprise</i>	0.0567	0.0280**	0.0427	0.1150
<i>ROA</i>	7.9511	0.1210	4.9832	0.3540
<i>Lev</i>	-7.9051	0.0020***	-14.1200	0.0000***
<i>Growth</i>	0.0274	0.0670*	0.0381	0.0150**
<i>Loss</i>	-20.1601	0.0000***	-15.0268	0.0000***
<i>Stdroe</i>	0.1496	0.4920	-0.1601	0.4830
<i>Year</i>	Yes		Yes	
<i>Industry</i>	Yes		Yes	
<i>N</i>	6512		6512	
<i>Adj. R</i> ²	0.2411		0.1830	

a. Variable definition

<i>RPUBLIC</i>	=	the rank value of precision of public information, which are drawn from BKLS;
<i>RPRIVATE</i>	=	the rank value of precision of private information, which are drawn from BKLS;
<i>ICW</i>	=	a dummy variable that takes on a value of 1 if the firm discloses material weakness in internal control under Section 404, and 0 otherwise;
<i>ICW_acc</i>	=	a dummy variable that takes on a value of 1 if the firm discloses account-specific weaknesses in internal control under Section 404;
<i>ICW_firm</i>	=	a dummy variable that takes on a value of 1 if the firm discloses firm-level weaknesses in internal control under Section 404;

<i>NICW</i>	=	number of internal control weaknesses reported;
<i>Expert</i>	=	the industrial market share of the auditors;
<i>Opinion</i>	=	a dummy variable that takes on a value of 1 if a firm reveals a clean opinion and 0 otherwise;
<i>Horizon</i>	=	the period between analyst forecast date and financial reporting date;
<i>Size</i>	=	logarithm of assets, measured at the end of fiscal year t-1;
<i>Surprise</i>	=	(net income in the current year- net income in the last year)/net income in the last year;
<i>ROA</i>	=	the ratio of return to asset, calculated as earnings before extraordinary items scaled by average total assets;
<i>Lev</i>	=	the ratio of debt to averaged total assets;
<i>Growth</i>	=	market value of equity divided by book value of equality;
<i>Loss</i>	=	a dummy variable that takes on a value of 1 if earnings in previous year are negative and 0 otherwise;
<i>Stdroe</i>	=	standard deviation of return of equity over the previous five years;
<i>MARKET</i>	=	the firm's market value;
<i>RESTATEMENT</i>	=	a dummy variable that takes on a value of 1 if a firms reveals financial restatement and 0 otherwise;
<i>CPA_{CHANGE}</i>	=	a dummy variable that takes on a value of 1 if a firm changes their auditors in the current year and 0 otherwise;
<i>RESTURETURE</i>	=	a dummy variable that takes on a value of 1 if a firm changes the organization and 0 otherwise;
<i>M&O</i>	=	a dummy variable that takes on a value of 1 if a firm acquires other company or is merged;
<i>FOREIGN</i>	=	a dummy variable that takes on a value of 1 if a firm has the foreign sales of the firms operations.

b. Δ refers to the within-firm difference in variables of interest, i.e., the t year value less the t-1 year value.

c. ***, **, * Denote significant at the 0.01, 0.05, 0.10 levels, respectively.

4.4.5 Controlling for fixed effect and random effect for panel data

Because the sample used in our analysis is based on firm-level data for the years 2007 to 2010, we have an unbalanced panel data with 6,512 firm-year observations. To provide comfort that our results are not driven by this potential validity threat, we use a fixed effect and a random effect model to control the serial correlation (Greene 2003). Untabulated results show that our primary results remain qualitatively unchanged after controlling for fixed or random effect.

5 Conclusion

In this study, we investigate the effects of firms' internal control weaknesses on information precision. We identify firms with internal control as those that disclosed a control weakness from November 2007 to December 2010 under Sections 404. Using the public and private information precision measures derived from analyst forecasts and first developed by Barron et al. (1998), our results indicate that firms with weak internal control environment and systems have less precise common and idiosyncratic information, and the results remain unchanged when internal control effectiveness is captured by the number of internal control weaknesses instead of an indicator variable. The results further indicate in the ICW

context that public and private information precision service as compliments to each other, i.e., better public information increases the quality of private information.

Moreover, we find that the negative association between the presence of ICW and public information precision is stronger for firms with firm-level weaknesses than for those with account-specific weaknesses. However, we find no such relation for private information. Third, ICW firms with remediation in the following year will exhibit higher precision of public and private information, compared to ICW firms without remediation. This evidence supports our hypothesis that if ICW firms improve their control system and receive unqualified SOX 404 audit opinion in successive years, they will raise their information quality and reduce information uncertainty. Finally, our results show that firms with different internal control opinions in successive years exhibit changes in precision of public and private information consistent with the changes in internal control quality.

Additional analyses indicate that *overall* information uncertainty, as measured by the reciprocal of the sum of the precision of public and private information, is higher for ICW firms than for non-ICW firms. However, we cannot find that the level of consensus among investors (or analysts) is affected by Section 404 audit report. The plausible reason for this is that in spite of the precision of both public and private information is lower for ICW firms, the decrease in the precision of public information is offset by the decrease in the precision of private information such that consensus remains unaffected.

Overall, the results of this paper provide evidence in support of the notion that public and private information precision will be adversely affected by weak internal controls. Besides, an effective improvement of weak controls offers positive economic benefits for ICW firms that can help reduce information asymmetry and enhance information precision thereby reducing the level of information uncertainty.

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