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The impact of internal audit attributes on the effectiveness of internal control over operations and compliance☆

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ABSTRACT

The internal audit function (IAF) assists management in improving internal controls over operations, reporting, and compliance. While many studies examine the association between the IAF and the internal control over financial reporting (ICFR), little is known about internal control over operations and compliance. Using a unique dataset from Taiwan, this paper examines the association between IAF quality and internal control deficiencies in operations and compliance. The results suggest that a larger internal audit team can enhance internal audit performance for both operations and compliance, whereas internal auditor competence is positively associated with the effectiveness of internal control over compliance, but not operations. This study contributes to the literature by shedding light on the determinants of the achievement of operations and compliance objectives. It also provides important implications for stakeholders and practitioners, as a company's control over operations and compliance may mutually influence its ICFR and ultimately its business success.

1. Introduction

An effective internal audit function (IAF) can ensure quality corporate governance by assisting management in improving internal controls (Chartered Institute of Internal Auditors, 2015). The key responsibilities of internal auditors are to examine, evaluate, and monitor the adequacy and effectiveness of internal control objectives over operations, reporting, and compliance (American Institute of Certified Public Accountants [AICPA], 2008; Committee of Sponsoring Organizations of the Treadway Commission [COSO], 2012; Institute of Internal Auditors [IIA], 2012).[1] While many studies investigate internal control over financial reporting (ICFR) (e.g., Abbott et al., 2016; Ege, 2015; Lin et al., 2011; Prawitt et al., 2009), data constraints have ensured that so far there has been relatively little empirical research that assesses internal control over operations and compliance. Our study, using a unique, publicly

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[1] According to Committee of Sponsoring Organizations of the Treadway Commission (COSO), internal control is a process designed to provide reasonable assurance of achieving objectives in the following categories: effectiveness and efficiency of operations, reliability of financial reporting, and compliance with applicable laws and regulations (COSO, 1992).

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unavailable dataset from Taiwan, examines the association between IAF characteristics and the effectiveness of internal control over operations and compliance. Understanding this relationship is critical, as the achievement of operations and compliance objectives is likely to reflect the strength of a company's corporate governance and compliance culture, mutually influences its ICFR, and ultimately contributes to its overall success.

Internal control is a process designed to assist management in achieving three organizational objectives: effectiveness and efficiency of operations, reliability of reporting, and compliance with applicable laws and regulations (COSO, 2013). A review of the literature on internal audit function and internal control effectiveness reveals that the majority of the studies investigate the determinants and/or economic consequences of the effectiveness of ICFR (e.g., Dellai and Omri, 2016; Doyle et al., 2007; Feng et al., 2009; Ge and McVay, 2005; Hammersley et al., 2008; Lin et al., 2011; Naiker and Sharma, 2009; Rice and Weber, 2012). Focusing on the reporting objective leads to an incomplete understanding of IAF and internal control effectiveness, as the control activities related to the three objectives should support or overlap each other (COSO, 2011). A recent study by Feng et al. (2015) supports this interdependence by documenting a positive association between the effectiveness of ICFR and a company's operations. They find that companies with inventory-related material weaknesses have lower inventory turnover ratios and are more likely to report inventory impairments. Indeed, in an interview extolling the advantages of the revision of the internal control framework, David Landsittel, COSO Chairman, describes the "opportunity to use this framework … to achieve not just financial reporting objectives, but objectives relating to the operations of the business and compliance with laws and regulations as well" (Tysiac, 2012).

This study, using publicly unavailable data obtained from Taiwan's regulatory agency, examines a nearly unexplored area of research relating to a company's disclosure of internal control deficiencies in operations and compliance. Specifically, we investigate whether the size and the competence of the internal audit affect internal control quality over operations and compliance. The results indicate that the size of the IAF staff is negatively associated with the incidence of internal control deficiencies in operations and compliance. In addition, the competence of the IAF staff (i.e., collective educational level, professional certifications, and external auditing work experience) is negatively associated with internal control deficiencies in compliance, but not in operations. The findings partially support the contention that IAF quality is positively associated with the effectiveness of internal control over operations and compliance.

While numerous studies assess internal audit quality with a focus on ICFR, our study differs from prior research by extending the examination of internal control quality to two critical but less studied objectives–operations and compliance. Specifically, our findings help to bridge a gap in the literature by exploring the effects of the IAF attributes on the company's achievement of the operations and compliance objectives, and expand our understanding of the association between IAF and internal control objectives. In addition, the unique dataset obtained from the Taiwan regulatory authority allows us to avoid some of the shortcomings of prior archive-based papers that depend mainly on the Global Auditing Information Network (GAIN) Database, which collects chief audit executives' responses to the IIA's questionnaires. Such studies are subject to a small sample size constraint (Lin et al., 2011; Prawitt et al., 2009) and to a non-random sample problem, as large companies with relatively sophisticated internal audit functions are the ones that tend to participate in the GAIN survey. Our data includes most, if not all, of the publicly traded companies' reports and thus avoids potential self-selection bias. Further, Newton et al. (2016) suggest that firms can successfully shop for opinions that express judgments of clean internal control. Therefore, studies that use such disclosures of material weaknesses in internal control mandated by SOX could be subject to the effects of opinion shopping. Our data is from companies' self-reporting, and we assume that the companies have no incentives to hide or falsify such disclosures, as their reports are not available to the public. In sum, the paper takes advantage of an opportunity to study the subject of internal control with a less biased and more complete set of data. Its findings have implications for management and stakeholders concerning the recruitment of IAF staff and the achievement of effective internal control.

The remainder of the paper is organized as follows. The next section reviews the institutional background and the IAF requirements in Taiwan. Section 3 provides a review of the literature on internal control and develops the hypotheses, and Section 4 describes the research design and the model. We present the results of the empirical analysis and additional analysis in Sections 5 and 6, respectively. Section 7 concludes the study.

2. Institutional background and regulations of internal control in Taiwan

It is important to understand the institutional background and regulatory requirements in Taiwan, the source of the unique dataset in the current study. In the following, we briefly introduce the regulatory environment in Taiwan, identify the differences in internal control regulations between the U.S. and Taiwan, and provide details of some relevant internal control reporting requirements in Taiwan.

Nowadays, the Financial Supervisory Commission (FSC, the Taiwan counterpart to the SEC) is responsible for regulating two principal securities markets in Taiwan: the Taiwan Stock Exchange Corporation (TWSE) and the GreTai Securities Market (GTSM).[2] Since 1986, the regulator has enforced IAF-related government regulations, which require publicly traded companies to establish internal control systems.[3] In 1992, the regulator further required listed companies to maintain full-time internal auditors and to

[2] Prior to 1981, the regulating agency of securities markets in Taiwan was the Ministry of Economic Affairs (MOEA); from 1981 to 2004, the Ministry of Finance (MOF); and from July 1, 2004 to the present, the FSC. In this paper, the terms "regulator" and "FSC" are used interchangeably unless otherwise noted.

[3] In 1986, the MOF published a set of relevant guidelines titled "Requirements for the Establishment of Internal Control Systems by Public Companies."

disclose the staff's names, ages, educational background, experience, seniority, and training by the end of January each year.[4] Such reporting, however, is made available only to the regulator rather than the public. In 2002, the FSC issued the *Regulations Governing Establishment of Internal Control Systems by Public Companies* (IC Regulations, hereafter), which are based on the internal control framework established by COSO (1992). The IC Regulations specify that internal control should provide reasonable assurance regarding the achievement of objectives in the following categories: (a) effectiveness and efficiency of operations, (b) reliability, timeliness, transparency, and regulatory compliance of reporting, and (c) compliance with applicable laws, regulations, and bylaws.[5]

While adopting the COSO internal control framework, the IC Regulations in Taiwan are dissimilar to the internal control reporting requirements in the U.S. (i.e., Sections 302 and 404 of the Sarbanes-Oxley Act of 2002) in terms of *reporting scope*. For example, the IC Regulations require publicly-traded companies to include in their annual report an Internal Control System Statement (ICSS).[6] Although the ICSS is similar to the signed assertions mandated by Section 302 (i.e., the requirement of the signatures of the chair of the board of directors, the CEO, and the chief internal auditor), it requires the additional disclosure of a company's weaknesses, if any, concerning internal control over operations and compliance. Regarding the role of external auditors, Section 404 requires the auditor to attest and issue an opinion on a company's internal control over financial reporting (but not on operations or compliance) as part of the company's annual report, whereas the regulations in Taiwan require the external auditors to issue opinions on internal control over all three objectives of operations, financial reporting, and compliance, but only as part of the company's IPO application process.

In accordance with the IC Regulations, a public company in Taiwan shall assess its internal control system and report any defects to the FSC on an annual basis. The company is required to submit the following information to the FSC: (a) an audit plan for the following year, to be submitted by the end of the current fiscal year; (b) a report on the results of the execution of its previous year's annual audit plan, to be submitted within the first two months of the next fiscal year; and (c) a report on corrections of prior year's internal control defects or irregularities, to be submitted within the first five months of the next fiscal year.[7] The IC Regulations further specify that the company shall include the following ten audit items in its annual audit plan and report any internal control deficiencies (ICDs hereafter) in terms of those control activities: (1) acquisition or disposal of assets, (2) engagement of derivatives transactions, (3) extension of loans, (4) endorsements or guarantees for others, (5) management of related party transactions, (6) supervision and management of subsidiaries, (7) procedures governing board meetings, (8) inspection of information and communications security, (9) sales and receipts cycle, and (10) purchase and payment cycle. We note that there are laws that explicitly regulate the first seven activities listed above. That is, a company is required to comply with certain rules in evaluating those control activities and reporting any related defects or irregularities accordingly. An

appendix provides a list of the audit items and their corresponding regulations, if any.

It is especially important to note that the IC Regulations were amended on July 17, 2007 to regulate public companies' assessment of internal control over financial reporting. In other words, prior to the 2007 amendment, public companies in Taiwan were required to report in their annual audit plans the ICDs related to operations and compliance only.

3. Literature review and hypothesis development

3.1. Internal control objectives

Internal control is a dynamic and iterative process designed to assist management in staying focused on the organization's operational and financial goals. Implementing an internal control system provides reasonable assurance regarding the achievement of three objectives: effectiveness and efficiency of operations, reliability of reporting, and compliance with applicable laws and regulations (COSO, 2013). Operations objectives, which vary with management's choices, pertain to the achievement of a firm's basic mission and may relate to improving quality and innovation, and to reducing costs and production time. Reporting objectives pertain to the preparation of reliable reports including financial or non-financial and internal or external reporting. Compliance objectives relate to a firm's adherence to laws and regulations in the course of its business operations. The three objectives should be interdependent, as the respective control activities can support or overlap each other (COSO, 2011). For example, an effective internal control in safeguarding assets against loss (i.e., operations objectives) helps to ensure reliable reporting (i.e., reporting objectives) when management relies solely on perpetual inventory records without performing periodic physical inspection to detect inventory losses.

While the three internal control objectives may influence each other and are important to an organization's performance, a review

[4] In 1992, the MOF published "Guidelines for Establishment of Internal Control Systems and Internal Audits by Public Companies." The 1992 regulations are considered a revision of the 1986 requirements.

[5] Article 3 of the IC Regulations defines "internal control systems of a public company" as management processes designed by its managers, passed by its board of directors, and implemented by the board of directors, managers, and other employees for the purpose of promoting sound operations of the company. An English version of the IC Regulations can be found at the FSC website: http://law.fsc.gov.tw/law/EngLawContent.aspx?Type=E&id=1347.

[6] In 2003, the TWSE and the GTSM published a document titled *Directions for Auditing Internal Control System of Listed Companies*, mandating an on-site audit of a listed company, which reports any material weakness in its internal control system.

[7] Refer to Articles 18, 19, and 20 of the IC Regulations. While the latter two reports, the execution result report (b) and the correlation report (c), are also provided to the company's signing audit partners, most of the information mentioned above is not disclosed to the public. One of our authors has been granted access to the execution result reports issued from 2005 to 2007. More discussion is provided in the Data and Sample section.

of the literature shows that most research on internal control has focused on ICFR. For example, numerous archival-based papers examine the *determinants* and *consequences* of disclosure of ICDs with a focus on the disclosures mandated by SOX 302 and/or SOX 404. Studies examining the determinants of ICDs investigate several IAF quality attributes and firm characteristics (e.g., Ashbaugh-Skaife et al., 2008; Bronson et al., 2006; Dellai and Omri, 2016; Doyle et al., 2007; Ge and McVay, 2005; Lin et al., 2011; Naiker and Sharma, 2009). Identifying the determinants is critical, as many empirical studies indicate the significant economic consequences of ICDs. Researchers suggest that material weaknesses in ICFR negatively affect market reactions to announcements of earnings (Ashbaugh-Skaife et al., 2009; Hammersley et al., 2008), cost of capital (Beneish et al., 2008; Ogneva et al., 2007), reporting quality (Ashbaugh-Skaife et al., 2008; Hoitash et al., 2008; Rice and Weber, 2012), accuracy of analysts' forecasts (Feng et al., 2009), and audit report lags (Munsif et al., 2012).

As mentioned previously, due to limited archival data, relatively few researchers have empirically investigated internal control over operations and compliance. While not directly examining operations and compliance objectives, researchers generally suggest a positive relationship among the achievements of the three internal control objectives. For example, Boritz and Lim (2008) suggest a positive association between ICFR and financial performance (i.e., improved performance from lower regulatory compliance costs and improved operations). Feng et al. (2015) argue that, as some controls play both operational and financial reporting roles, there should be mutually beneficial effects on financial reporting quality and firms' operating performance. By examining the association between inventory-related material weaknesses in ICFR and firms' inventory management, their study shows a positive link between ICFR quality and firm operations. Similarly, Cheng et al. (2017) provide systematic evidence for the relation between effective ICFR and firm operational efficiency. Kedia et al. (2016) also find a significant association between a firm's culture of noncompliance and financial misreporting risk. Furthermore, a recent study by Lawrence et al. (2017) provides evidence that operational control risk indicates potential financial reporting control weaknesses. Specifically, Lawrence et al. (2017) measure operational control risk in two ways: data breaches (i.e., cybersecurity attacks) and a control risk index developed through textual analysis of Form 10-Ks. Their findings indicate that the proxies for operational control risk are positively related to subsequent financial reporting deficiencies, restatements, SEC comment letters, and audit fees. Our study complements and differs from theirs in that (1) we investigate ICDs in operations and regulatory compliance, (2) the ICDs in our data are disclosed by management (i.e., direct and realized outcomes) in contrast to the indirect measurement of operational control weaknesses used by Lawrence et al., and (3) the occurrence of ICDs is relatively high in our sample (i.e., in over 50 percent of firm years compared to less than two percent in their study).

In the following section, we discuss IAF quality as it is relevant to our study.

3.2. Internal audit function quality

An effective IAF creates added value to an organization by helping management and board of directors to evaluate and improve the effectiveness of risk management, internal control, and corporate governance processes (e.g., Gramling et al., 2004; Hass et al., 2006; Walter and Guandaru, 2012; Yee et al., 2008). Several studies, using different proxies, examine how IAF quality attributes affect financial reporting or internal audit performance (e.g., Abbott et al., 2016; Ege, 2015; Lin et al., 2011; Prawitt et al., 2009). For example, Prawitt et al. (2009) construct a firm-year *aggregated index*[8] to measure internal audit quality, and find that the quality index is negatively related to earnings management. Lin et al. (2011) complement the study of Prawitt et al. by examining the association between the IAF and financial reporting quality through prevention and detection of material weaknesses. Specifically, Lin et al. (2011) find that IAF attributes (i.e., education level) and activities (i.e., incorporation of quality assurance techniques, auditing activities relating to financial reporting, and monitoring of remediation) can reduce the likelihood of the disclosure of material weaknesses reported under Section 404 of SOX. Ege (2015) also provides evidence that internal audit quality (i.e., competence and objectivity) is negatively associated with the likelihood of management misconduct. Similarly, Abbott et al. (2016) indicate that IAF quality, as measured by the joint presence of competence and independence, positively impacts financial reporting quality. While likewise examining the effects of IAF competence on ICDs, our study differs from the above research mainly in that we investigate the disclosure of internal control weaknesses related to *operations* and *compliance*.

3.3. Hypothesis development

3.3.1. Competence of internal auditor

The competence and objectivity of the internal audit function are the key factors that external auditors should assess in their audit planning procedures (AU Section 322). Competence generally refers to the auditor's ability to perform tasks diligently and in accordance with professional standards (e.g., IAASB, 2012). IIA defines competence as "the ability of an individual to perform a job or task properly, being a set of defined knowledge, skills and behavior" (IIA, 2013), and stipulates that such competencies are needed for internal auditors to effectively carry out their responsibilities (IIA, 2012). Supporting the IIA's claim, prior studies find mainly that internal auditors' competence contributes to the effectiveness of IAF and financial reporting quality (e.g., Al-Twaijry et al., 2003;

[8] Prawitt et al. (2009) construct the aggregated internal control quality index based on the following six dimensions: *experience* (average number of years of internal auditing), *certification* (percentage of members with one or more audit certifications), *training* (average of annual training hours per internal auditor), *financial audit work* (the percentage of time that internal auditors have spent in financial audit work), *report recipient* (a dummy to indicate whether an audit committee is the recipient of the internal audit report), and *committed resources* (total annual operating costs for internal auditing divided by firm assets, the result being adjusted by industry).

Alzeban and Gwilliam, 2014; Lin et al., 2011; Prawitt et al., 2009). Furthermore, some studies recognize the competence of the internal auditors as an element essential to improving the organization's operations (e.g., Ali and Owais, 2013; Mihret and Woldeyohannis, 2008) or contributing to the effectiveness of the organization as a whole (e.g., Dittenhofer, 2001). The proxies for competence generally include education, professional qualifications, experience, and training.

According to prior research, IAF competence is positively associated with the effectiveness of ICFR, but we may not find such an association with internal control over operations and compliance, for the following reasons. First, the primary, intended objective of SOX 404 is to improve the reliability of firms' financial reporting for external users (PCAOB, 2004), rather than the internal users who make operational decisions. This view is shared by few managers, as they do not believe that SOX 404 compliance can improve the efficiency of their firms' operations (Alexander et al., 2013). With the regulators' and stakeholders' focus on ICFR, it is reasonable to doubt whether internal auditors pay as much attention to the control activities in operations and compliance as to those in financial reporting. If they do not, we may not observe a positive effect of IAF competence on the effectiveness of internal control over operations and compliance. Second, control activities in operations vary across entities and industries, and thus entity-specific knowledge and experience are likely necessary if internal auditors are to implement and manage those activities effectively. Therefore, we may not find results as expected if our competence proxies capture only the general, not entity-specific, knowledge and experience of internal auditors.

Notwithstanding the conflicting arguments above, we state our first hypothesis in alternative form by predicting that more competent IAF personnel can enhance IAF quality by helping management establish stronger controls, and thus reduce the existence of control problems in operations and/or compliance. Hypothesis 1 is as follows:

H1: The likelihood that a company reports an internal control deficiency in operations and/or compliance is negatively associated with IAF competence.

It is worth noting that, during our sample period, the internal auditors of publicly traded companies are required to report to the board of directors rather than to management. Since this requirements prevents variations in auditor independence, we do not examine IAF objectivity in the current study.

3.3.2. Commitment of IAF resources

Allocating greater resources to IAF can improve the effectiveness of IAF consulting and assurance activities (e.g., Ge and McVay, 2005; Gramling et al., 2004). Studies indicate that internal control quality is positively related to the sufficiency of resources to IAF (Ge and McVay, 2005), and that companies with fewer resources available for IAF are more likely to disclose internal control deficiencies (e.g., Ashbaugh-Skaife et al., 2007; Doyle et al., 2007). While those studies suggest a positive association between IAF resources and the effectiveness of internal control over operations and compliance, we may not observe such a relationship if companies assign most of their IAF resources to control procedures over financial reporting (i.e., an extreme focus on ICFR as discussed above), rather than proportionately to the procedures over operations and compliance. Nevertheless, to be consistent with our H1, we hypothesize that companies with great IAF resources will implement stronger control procedures in support of management's operations and compliance objectives. Thus, our second hypothesis is stated in alternative form as follows:

H2: The likelihood that a company reports an internal control deficiency in operations and/or compliance is negatively associated with IAF resources.

4. Research design

The purpose of this study to is test whether IAF quality is negatively associated with the likelihood of the disclosure of ICDs in operations and compliance. Accordingly, we regress the ICD variables on the proxy variables for IAF quality (i.e., IAF competence and size) along with other control variables. In the next sections, we discuss the data and the sample, our measures of variables of interest, and the model.

4.1. Data and sample

As discussed previously, publicly traded companies in Taiwan are required to submit to the FSC an annual execution result report, which is not available to the public. For research purpose, the regulator has granted one of our authors access to the 2005–2007 reports.[9] In those reports, management discloses whether any ICD was identified in operations and/or in compliance for the prior year. Moreover, we collect from the reports the following data as proxies for IAF quality: internal audit staff certification, audit work experience, education level, and the size of the IA staff. All other necessary financial statement data is obtained from the Taiwan Economic Journal (TEJ) database. Table 1 provides a description of our sample selection procedure. We begin with 3658 company-year observations ending in 2005 through 2007. After excluding observations in the financial industry (157 observations), those with missing data for internal audit performance (142 observations), and those with missing data for control variables (19), we have a final sample consisting of 3340 company-year observations. The majority of our observations are from the electronic industry (56.6 percent), followed by the chemical industry (6.1 percent) and the electric machinery industry (6 percent), which are proportional to the population.

[9] The regulator determined the sample period and the length of the period to be granted to the authors.

Table 1
Sample selection.

Company-year observations between 2005 and 2007		3658
Less:	observations in financial industry	(157)
	company-year observations with missing data for internal audit performance	(142)
	company-year observations with missing data for control variables	(19)
Company-years available for final sample		3340

4.2. Internal control weakness model and measurements of variables

We use the following model to test the relationship between internal audit quality and ICDs:

$$\begin{aligned}\Pr(ICD|\ x)=\Phi(&\alpha_0+\alpha_1 LnIASIZE+\alpha_2 CERTIFICATIONS+\alpha_3 EXPERIENCE\\&+\alpha_4 EDUCATION+\alpha_5 BOARDSIZE+\alpha_6 DUAL+\alpha_7 BIGN+\alpha_8 AGE\\&+\alpha_9 SIZE+\alpha_{10} ARINVENTORY+\alpha_{11} LEV+\alpha_{12} ROA+\alpha_{13} LOSS\\&+\alpha_{14} CFO+\alpha_{15} SALESGROWTH+\text{Year Effect}+\text{Industry Effect})\end{aligned} \quad (1)$$

The dependent variable, *ICD*, represents three binary variables tested in our study: *ICD*, *ICD_OP*, and *ICD_ LAW*, which capture the existence of internal control deficiencies disclosed in a company's report. As mentioned in the prior section, a publicly traded company evaluates and reports its ICDs in terms of ten control activities required by the regulator. Based on the nature of the activities and related regulatory requirements, we classify those activities into two groups: operations and compliance. Specifically, if an identified internal control weakness is related to an activity that is regulated by a particular set of rules imposed by the FSC, this weakness will be classified as a deficiency in the compliance group (i.e., *ICD_ LAW)*; otherwise, as a deficiency in the operations group (i.e., *ICD_OP*). Following this criterion, we classify deficiencies related to the activities in the category (1) to (7) as deficiencies in compliance and (8) to (10) as deficiencies in operations.[10] We operationalize our dependent variables as follows: *ICD* equals one when a company discloses at least one internal control deficiency in either operations or compliance; *ICD_OP* (*ICD_ LAW*) equals one when a company discloses at least one internal control deficiency in operations (compliance). Due to the use of the binary dependent variables, we employ a Probit regression model, in which Φ is a cumulative data function that describes a standard normal distribution.

The predictors of interest are four proxies for IAF quality, including *IASIZE*, *CERTIFICATIONS*, *EXPERIENCE*, and *EDUCATION*. *IASIZE*, a proxy for commitment of IA resources, is measured as the number of internal auditors in a company. *LnIASIZE*, used in the regression analysis, is the natural logarithm of *IASIZE*. The other three variables are proxies for IA competence. *CERTIFICATIONS* is calculated as the proportion of internal auditors who hold a CPA (certified public accountant) or CIA (certified internal auditor) certification.[11] *EXPERIENCE* represents the proportion of internal auditors who have two or more years of experience working at an audit firm. *EDUCATION* shows internal auditors' average education level that is calculated based on the values assigned: zero for graduates of high school, two for graduates of junior colleges,[12] four for graduates of universities, and six for those with graduate degrees. As we hypothesize that IAF quality reduces a company's internal control weaknesses in operations and compliance, the sign of the predictor coefficients (i.e., α_1, α_2, α_3, and α_4) is expected to be negative.

We also control for the following company characteristics along with several other factors, which are considered relevant in the literature on internal control. First, a larger board size usually indicates greater agency costs or more complex operations (Boone et al., 2007), both of which may cause a greater likelihood of ICDs. Thus, we include *BOARDSIZE*, measured as the number of board members, in the model to control for such effects. Second, when a board chair serves simultaneously as a CEO of a company, the monitoring power of the board may be weakened, which possibly leads to a weak IAF and results in more internal control weaknesses (Bardhan et al., 2015). Therefore, we include an indicator variable, *DUAL*, which equals one when the board chair is the same person as the CEO. Third, studies suggest that a company reports fewer ICDs in financial reporting when audited by a Big4 audit firm (e.g., Rice and Weber, 2012). We expect the same Big4 effect on ICDs in operations and compliance, and thus include in the model an indicator variable, *BIGN*, which equals one when the company is audited by a Big4 firm. Fourth, older firms and larger firms tend to have fewer weaknesses in internal control (Ashbaugh-Skaife et al., 2007; Doyle et al., 2007; Lin et al., 2011); therefore, we include two variables to control for such effects: *AGE*, measured as the number of years that a company has been listed, and *SIZE*, measured as the logarithm of the total assets of a firm in thousands of NT dollars. Fifth, companies experiencing rapid growth in sales or with high levels of accounts receivable or inventory tend to be more complex (Ashbaugh-Skaife et al., 2007; Lin et al., 2011). To control for the effect of business complexity, we include *ARINVENTORY*, calculated as the proportion of accounts receivable and inventory to total assets, and *SALESGROWTH*, computed as the change in sales divided by the previous year's sales. Moreover, since companies with greater earnings or operating cash flow show fewer weaknesses in internal control (Lin et al., 2011), we control for *ROA*, measured as

[10] See Appendix for the list of the activities, the corresponding laws, and our classification. We classify seven activities as compliance-related controls because there are rules that explicitly regulate those activities.

[11] We cannot split the variable *CERTIFICATIONS* into CPA only, CIA only, or both, because reporting requirements regarding licenses of internal auditors do not require such specification.

[12] After junior high school, students in Taiwan may enter a three-year academic high school and then proceed to a four-year university, or enter a five-year technical college directly. "Junior college" refers to one of these technical colleges.

Table 2
Descriptive statistics of test variables.

Variables	Mean	Q1	Median	Q3	STD
ICD	0.546	0.000	1.000	1.000	0.498
ICD_LAW	0.415	0.000	0.000	1.000	0.493
ICD_OP	0.320	0.000	0.000	1.000	0.467
IASIZE	2.037	1.000	2.000	2.000	1.634
LnIASIZE	0.519	0.000	0.693	0.693	0.568
CERTIFICATIONS	0.156	0.000	0.000	0.043	0.308
EXPERIENCE	0.272	0.000	0.000	0.500	0.392
EDUCATION	3.632	3.000	4.000	4.000	1.163
BOARDSIZE	6.768	5.000	7.000	7.000	2.093
DUAL	0.298	0.000	0.000	1.000	0.457
BIGN	0.828	1.000	1.000	1.000	0.377
AGE	9.434	5.000	7.000	11.000	7.613
SIZE	15.096	14.164	14.950	15.804	1.312
ARINVENTORY	0.318	0.178	0.295	0.429	0.187
LEV	0.386	0.252	0.379	0.500	0.174
ROA	0.056	0.014	0.058	0.111	0.108
LOSS	0.200	0.000	0.000	0.000	0.400
CFO	0.078	0.012	0.073	0.142	0.122
SALESGROWTH	0.135	–0.026	0.096	0.242	0.341

Note: All continuous variables are winsorized at 1% and 99%.
ICD = a dummy to indicate the existence or non-existence of weaknesses (either in compliance or operations) in internal control.
ICD_LAW = a dummy to indicate the existence or non-existence of weaknesses in internal control in compliance.
ICD_OP = a dummy to indicate the existence or non-existence of weaknesses in internal control in operations.
IASIZE = the number of internal auditors.
LnIASIZE = the natural logarithm of *MANPOWER*.
CERTIFICATIONS = the proportion of internal auditors who hold CPA or CIA certifications.
EXPERIENCE = the proportion of internal auditors who have two or more years of experience working at an audit firm.
EDUCATION = average level of education of internal auditors, calculated according to the following values: 0 (high school graduates), 2 (graduates of junior colleges), 4 (graduates of universities), and 6 (those with graduate degrees).
BOARDSIZE = the number of board members.
DUAL = a dummy to indicate a board chair who is also a CEO.
BIGN = a dummy to indicate whether a firm is one of the Big4 accounting firms.
AGE = the number of years that a firm has been listed.
SIZE = the logarithm of the total assets of a firm in thousands of NT dollars.
ARINVENTORY = the proportion of accounts receivable and inventory to total assets.
LEV = total debt divided by total assets.
ROA = net income divided by total assets.
LOSS = a dummy indicator that shows whether a firm has incurred a loss or not.
CFO = operating cash flow divided by total assets, and
SALESGROWTH = the change in sales divided by the previous year's sales.

income divided by total assets, and *CFO*, measured as operating cash flow divided by total assets. Lastly, as companies with losses or high levels of debt disclose more weaknesses (Ashbaugh-Skaife et al., 2007; Doyle et al., 2007; Lin et al., 2011), we control for *LEV*, computed as debt divided by total assets, and *LOSS*, which equals one when a company incurs a loss for that year. The year and industry fixed effects are controlled for as well. All continuous variables mentioned above are winsorized at 1 percent and 99 percent.

5. Results

5.1. Descriptive statistics

Table 2 presents descriptive statistics of the variables in the model. The mean of *ICD* reveals that 54.6 percent of observations show at least one internal control weakness in either operations or compliance. The means of *ICD_LAW* and *ICD_OP* indicate that 41.5 percent and 32 percent of observations have internal control weaknesses in operations and compliance, respectively.[13] The average

[13] In terms of industry, we find that the highest mean value for *ICD*, *ICD_LAW*, and *ICD_OP* is in the textile industry (73 percent), the tourism industry (59 percent), and the cement industry (52 percent), respectively. Interestingly, the lowest mean values for all of the ICD variables appear in the electrical and cable Industry: *ICD* (25 percent), *ICD_LAW* (13 percent), and *ICD_OP* (19 percent). We further note that our sample does not include companies in the highly regulated industries (i.e., petroleum and coal products manufacturing; electric power generation, transmission, and distribution) as those are government-owned businesses, not publicly traded entities, in Taiwan. Besides, we test whether our results are driven by the electronic industry (56.6 percent of the sample) by including an industry dummy variable (electronic *vs*. non-electronic) in the model. The untabulated results show consistent findings.

number of the ICD observations is relatively high as compared to what would be observed in other countries (e.g., the U.S. results indicate that only a few companies report the weaknesses). The high mean value of *ICD* in our sample could be attributed to the nature of the deficiencies reported by companies. Unlike those in the U.S., where the deficiencies reported are either material weaknesses or significant deficiencies in internal control, companies in Taiwan are required to report any defects or irregularities discovered, regardless the degree of severity. The FSC encourages companies to fully disclose their ICDs and generally does not impose a penalty against a company when the company discloses its ICDs by the specified deadline. Furthermore, the disclosure information is not available to the public, which eliminates the concerns about the adverse effect of ICD reporting on the company's reputation. In fact, the high average value of *ICD* in our sample suggests that companies are likely to disclose deficiencies at any level of severity. *IASIZE*, ranging from 1 to 11, has a mean (median) of 2.037 (2.000). As *IASIZE* is highly skewed, we use *LnIASIZE*, the natural logarithm of *IASIZE*, in the model to eliminate the possible effect of extreme values on the results. The mean of *CERTIFICATIONS* indicates that 15.6 percent of internal auditors have either CPA or CIA licenses. The mean of *EXPERIENCE* shows that 27.2 percent of internal auditors have more than two years of work experience in audit firms. Finally, the mean (3.632) and median (4.000) of *EDUCATION* show that internal auditors have, on average, a university-level of education.

The remaining variables complete the picture as follows. The average board (*BOARDSIZE*) has 6.768 members. Almost 30 percent of firms have a board chair who also plays a dual role as its CEO (*DUAL*), and more than 80 percent of the firm observations are audited by a Big 4 audit firm (*BIGN*). The average number of years since a firm has listed (*AGE*) is 9.434, and the average firm size (*SIZE*) is 15.096. The average accounts receivable and inventory to total assets (*ARINVENTORY*) and leverage (*LEV*) are 0.318 and 0.386, respectively. The average return on assets (*ROA*), percentage of firms in our sample that show losses (*LOSS*), and operating cash flow divided by total assets (*CFO*) are 0.056, 0.200, and 0.078, respectively. Finally, the average sales growth rate (*SALESGROWTH*) is 0.135. These statistics are consistent with those reported by prior studies using Taiwan data (e.g., Chen et al., 2008; Chi et al., 2013; Chi et al., 2009; Aobdia et al., 2015).[14]

5.2. Correlation analysis

Table 3 shows the Pearson correlation matrix, in which the bold numbers represent correlations significant at 10 percent or less. The significant correlation between *ICD_LAW* and *ICD_OP* indicates that compliance-related ICDs are positively correlated with operation-related ICDs ($r = 0.244$; p-value < 0.01). Further, as expected, *ICD_LAW* is negatively correlated with all of the IAF quality proxies at a 0.1 significance level. Similarly, *ICD_OP* is negatively correlated with the IAF quality proxies at a 0.1 significance level, except for *(Ln)IASIZE which is not significant*. In addition, the negative correlations between *BIGN* and *ICD*, *ICD_LAW*, and *ICD_OP* suggest that a company that is audited by a large audit firm has fewer internal control weaknesses in operations and compliance. *SIZE* ($r = -0.082$) is negatively correlated with *ICD_LAW* but unrelated to *ICD_OP*. *ARIINVTORY* ($r = 0.016$) and *LEV* ($r = 0.046$) are positively related to *ICD_LAW* but unrelated to *ICD_OP*. *BOARDSIZE* ($r = 0.031$) and *AGE* ($r = 0.065$) are positively correlated with *ICD_OP* but are not statistically correlated with *ICD_LAW*. All the variables discussed above, except for *BOARDSIZE* and *ARINVENTORY*, are statistically correlated with *ICD*. We examine and find that our results are unlikely to be driven by multicollinearity (i.e., the range of variance-inflation-factor (VIF) for all variables is 1.05 to 2.92).[15]

5.3. Univariate analysis

Table 4 provides the results of univariate comparisons (i.e., ICDs existence *vs*. ICDs nonexistence). Panels A to C of Table 4 show the full sample that is classified by the value of *ICD*, *ICD_LAW*, and *ICD_OP*, respectively. Overall, the univariate results shown in Panels A and B are consistent with those in Table 3. The exceptions in Panel A are *AGE* and *LEV* with an insignificant mean difference of 0.52 and 0.01, respectively, and in Panel B is *ARINVENTORY* with an insignificant mean difference of 0.006. Taken together, the results support the study predictions that the IAF quality attributes (i.e., staff competence and sufficient IAF resources) enhance internal audit performance and thus reduce the ICDs in compliance. On the other hand, Panel C in Table 4 indicates that, in terms of operations, internal auditors' work experience (*EXPERIENCE*; mean difference = 0.041, $p < 0.05$) is the only quality attribute that affects internal audit performance and the ICDs in operations. Besides, *BIGN* and *AGE* consistently differ between the *ICD_OP* existence and nonexistence groups.

5.4. Probit analysis

Table 5 reports the probit regression results for estimating the likelihood of the ICDs. In Column (1), three of the four IAF quality variables (except for *EDUCATION*) significantly predict the disclosure of ICDs in either operations or compliance: *LnIASIZE* ($\beta = -0.146$, $p < 0.01$); *CERTIFICATIONS* ($\beta = -0.148$, $p < 0.05$); *EXPERIENCE* ($\beta = -0.148$, $p < 0.05$). Column (2) shows that all of the four IAF quality variables predict the disclosure of ICDs in compliance: *LnIASIZE* ($\beta = -0.125$, $p < 0.05$); *CERTIFICATIONS* ($\beta = -0.176$, $p < 0.05$); *EXPERIENCE* ($\beta = -0.159$, $p < 0.01$); *EDUCATION* (marginally significant, $\beta = -0.036$, $p < 0.1$). Interestingly, Column (3), with all the controlling variables included in the model, shows that *LnIASIZE* is the only significant predictor ($\beta = -0.122$, $p < 0.05$) for the disclosure of ICDs in operations. This result is not consistent with that reported in

[14] *BOARDSIZE* is the only variable that has not been reported in the prior studies.

[15] Kennedy (1998, p. 190) states that, as a rule of thumb, VIF larger than 10 indicates harmful multicollinearity.

Table 3
Pearson correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) *ICD*																		
(2) *ICD_LAW*	**0.768**																	
(3) *ICD_OP*	**0.626**	**0.244**																
(4) IASIZE	**−0.053**	**−0.071**	−0.014															
(5) LnIASIZE	**−0.058**	**−0.077**	−0.017	**0.912**														
(6) *CERTIFICATIONS*	**−0.049**	**−0.064**	**−0.030**	0.000	0.006													
(7) *EXPERIENCE*	**−0.062**	**−0.063**	**−0.449**	**−0.070**	**−0.075**	**0.069**												
(8) *EDUCATION*	**−0.046**	**−0.077**	**−0.029**	**0.050**	**0.031**	**0.193**	**0.245**											
(9) *BOARDSIZE*	0.020	0.015	**0.031**	**0.319**	**0.282**	0.007	**−0.059**	**0.080**										
(10) *DUAL*	0.008	0.011	0.027	**−0.065**	**−0.061**	−0.019	0.012	−0.015	**−0.141**									
(11) *BIGN*	**−0.065**	**−0.060**	**−0.047**	0.026	0.003	**0.049**	**0.096**	**0.132**	**0.004**	−0.016								
(12) *AGE*	**0.034**	0.001	**0.065**	**0.348**	**0.360**	−0.018	**−0.191**	**−0.065**	**0.235**	−0.018	**−0.096**							
(13) *SIZE*	**−0.045**	**−0.082**	0.012	**0.622**	**0.610**	**0.098**	−0.026	**0.156**	**0.343**	**−0.094**	**0.091**	**0.414**						
(14) *ARINVENTORY*	0.002	**0.016**	−0.019	**−0.198**	**−0.189**	−0.011	**0.122**	**−0.034**	**−0.197**	0.018	**−0.055**	**−0.253**	**−0.137**					
(15) *LEV*	**0.030**	**0.046**	0.011	0.021	0.027	**−0.067**	−0.022	**−0.071**	**−0.064**	0.003	**−0.123**	−0.007	**0.068**	**0.412**				
(16) *ROA*	−0.014	−0.013	−0.022	**0.029**	0.006	**0.070**	**0.090**	**0.098**	0.028	**−0.077**	**0.121**	**−0.102**	**0.214**	**0.044**	**−0.366**			
(17) *LOSS*	0.023	0.024	0.023	**−0.067**	**−0.059**	**−0.036**	**−0.038**	**−0.030**	**−0.032**	**0.078**	**−0.096**	0.026	**−0.181**	**−0.087**	**0.281**	**−0.689**		
(18) *CFO*	−0.014	−0.012	−0.018	**0.065**	**0.045**	**0.053**	**0.033**	**0.110**	**0.059**	**−0.039**	**0.133**	**−0.100**	**0.107**	**−0.276**	**−0.373**	**0.502**	**−0.289**	
(19) *SALESGROWTH*	0.007	0.015	−0.001	**0.011**	0.002	**0.030**	**0.046**	0.021	0.014	−0.027	0.025	0.007	**0.157**	**0.108**	0.026	**0.333**	**−0.257**	**0.067**

Note: All variables are defined in Table 2, and the bold figures represent that the corresponding correlations are significant at least at 10%.

Table 4
Univariate results.

Panel A: The univariate analysis of with-vs-without any internal control weakness

	ICD = 0		*ICD* = 1		Difference	
Variables	Mean	Median	Mean	Median	Mean	Median
LnIASIZE	0.556	0.693	0.489	0.693	0.067***	0.000**
CERTIFICATIONS	0.172	0.000	0.142	0.000	0.030**	0.000***
EXPERIENCE	0.298	0.000	0.250	0.000	0.048***	0.000***
EDUCATION	3.691	4.000	3.583	4.000	0.108**	0.000**
BOARDSIZE	6.723	7.000	6.805	7.000	−0.082	0.000
DUAL	0.294	0.000	0.301	0.000	−0.007	0.000
BIGN	0.855	1.000	0.806	1.000	0.049***	0.000***
AGE	9.151	7.000	9.668	7.000	−0.517	0.000
SIZE	15.160	14.999	15.042	14.921	0.118**	0.078*
ARINVENTORY	0.318	0.296	0.318	0.294	0.000	0.002
LEV	0.381	0.379	0.391	0.379	−0.010	0.000
ROA	0.058	0.060	0.055	0.057	0.003	0.003
LOSS	0.189	0.000	0.208	0.000	−0.019	0.000
CFO	0.079	0.074	0.076	0.072	0.003	0.002
SALESGROWTH	0.133	0.103	0.137	0.093	−0.004	0.010
Number of Obs.		1515		1825		

Panel B: The univariate analysis of with-vs-without law-related internal control weakness

	ICD_LAW = 0		*ICD_LAW* = 1		Differences	
Variables	Mean	Median	Mean	Median	Mean	Median
LnIASIZE	0.556	0.693	0.468	0.693	0.088***	0.000***
CERTIFICATIONS	0.173	0.000	0.132	0.000	0.041***	0.000***
EXPERIENCE	0.293	0.000	0.243	0.000	0.050***	0.000***
EDUCATION	3.708	4.000	3.526	4.000	0.182***	0.000***
BOARDSIZE	6.741	7.000	6.805	7.000	−0.064	0.000
DUAL	0.293	0.000	0.304	0.000	−0.011	0.000
BIGN	0.847	1.000	0.802	1.000	0.045***	0.000***
AGE	9.429	7.000	9.441	7.000	−0.012	0.000
SIZE	15.186	15.021	14.968	14.847	0.218***	0.174***
ARINVENTORY	0.316	0.293	0.322	0.299	−0.006	−0.006
LEV	0.380	0.374	0.396	0.386	−0.016**	−0.012*
ROA	0.057	0.060	0.054	0.056	0.003	0.004
LOSS	0.192	0.000	0.211	0.000	−0.019	0.000
CFO	0.079	0.075	0.076	0.071	0.003	0.004
SALESGROWTH	0.131	0.097	0.141	0.095	−0.010	0.002
Number of Obs.		1953		1387		

Panel C: The univariate analysis of with-vs-without operation-related internal control weakness

	ICD_OP = 0		*ICD_OP* = 1		Differences	
Variables	Mean	Median	Mean	Median	Mean	Median
LnIASIZE	0.526	0.693	0.505	0.693	0.021	0.000
CERTIFICATIONS	0.162	0.000	0.142	0.000	0.020	0.000
EXPERIENCE	0.285	0.000	0.244	0.000	0.041**	0.000**
EDUCATION	3.655	4.000	3.583	4.000	0.072	0.000
BOARDSIZE	6.724	7.000	6.862	7.000	−0.138	0.000
DUAL	0.289	0.000	0.316	0.000	−0.027	0.000
BIGN	0.841	1.000	0.803	1.000	0.038**	0.000**
AGE	9.095	7.000	10.151	8.000	−1.056***	−1.000***
SIZE	15.084	14.947	15.119	14.957	−0.035	−0.010
ARINVENTORY	0.320	0.298	0.313	0.290	0.007	0.008
LEV	0.385	0.379	0.389	0.381	−0.004	−0.002
ROA	0.058	0.060	0.053	0.055	0.005	0.005
LOSS	0.193	0.000	0.213	0.000	−0.020	0.000
CFO	0.079	0.073	0.074	0.073	0.005	0.000
SALESGROWTH	0.136	0.099	0.135	0.092	0.001	0.007
Number of Obs.		2270		1070		

Note: The asterisks *, **, and *** represent the estimated coefficients are significant at 10%, 5%, and 1% respectively. All variables are defined in Table 2.

Table 5
Probit regression model.

Variables	(1) ICD	(2) ICD_LAW	(3) ICD_OP
Constant	1.0058**	1.2835***	−0.5926
	(2.3638)	(3.0256)	(−1.3771)
LnIASIZE	**−0.1463*****	**−0.1253****	**−0.1219****
	(−2.8378)	**(−2.4048)**	**(−2.2714)**
CERTIFICATIONS	**−0.1484****	**−0.1760****	−0.1050
	(−2.0308)	**(−2.3610)**	(–1.3582)
EXPERIENCE	**−0.1480****	**−0.1586*****	–0.0763
	(−2.4733)	**(−2.6218)**	(–1.2134)
EDUCATION	–0.0001	**−0.0357***	0.0030
	(–0.0051)	**(−1.7130)**	(0.1407)
BOARDSIZE	0.0255**	0.0346***	0.0169
	(2.1399)	(2.8965)	(1.3994)
DUAL	0.0223	0.0237	0.0991*
	(0.4525)	(0.4774)	(1.9433)
BIGN	–0.1335**	–0.1064*	–0.0735
	(–2.1463)	(–1.7220)	(–1.1635)
AGE	0.0068*	0.0059	0.0021
	(1.6681)	(1.4465)	(0.5040)
SIZE	–0.0376	–0.0825***	0.0263
	(–1.4584)	(–3.1539)	(0.9813)
ARINVENTORY	–0.0043	–0.0302	–0.0826
	(–0.0266)	(–0.1862)	(–0.4935)
LEV	0.2350	0.4533***	–0.0780
	(1.3897)	(2.6805)	(–0.4527)
ROA	0.3358	0.5373	–0.1878
	(0.9627)	(1.5281)	(–0.5189)
LOSS	0.0355	0.0294	0.0550
	(0.4507)	(0.3716)	(0.6790)
CFO	0.1664	0.1915	0.2133
	(0.7185)	(0.8237)	(0.8868)
SALESGROWTH	0.0362	0.0704	0.0161
	(0.4999)	(0.9859)	(0.2220)
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	3340	3340	3340
Pseudo R^2	0.0292	0.0340	0.0298
LR(χ2)	134.2	154	124.6

Note: The asterisks *, **, and *** represent the estimated coefficients are significant at 10%, 5%, and 1% respectively. Numbers in the parenthesis are z-statistics. All variables are defined in Table 2.

Tables 3 and 4, and thus needs to be interpreted with caution.

In the test of H1, the results suggest that IAF competence improves the company's internal control over compliance but not over operations. We further calculate the economic significance of the findings and find that when the portion of internal auditors with a certification increases from its first to third quartile value, the likelihood of the disclosure of internal control deficiency in compliance decreases by 0.06 percent, while holding other regressors at the mean values. Likewise, the change in auditors' working experience (education level), i.e., moving from the first to the third quartile value, decreases the probability of internal control deficiency disclosure in compliance by 1.39 percent (3.09 percent).[16] In the test of H2, we find evidence that larger IA size (i.e., more IA resources) predicts better internal audit performance and thus reduces ICDs in both operations and compliance. The economic significance analysis demonstrates that moving from first to third quartile of *IASIZE* decreases the likelihood of disclosing ICDs in compliance and operations by 3.39 percent and 3.03 percent, respectively.

With regard to the control variables, *BOARDSIZE* ($\beta = 0.035$, $p < 0.01$) and *LEV* ($\beta = 0.453$, $p < 0.01$) have a significant positive association with *ICD_LAW*. The results indicate that, as expected, a company with greater agency costs, more complex operations, or higher level of debt is more likely to disclose ICDs. However, we find this effect on ICDs related to compliance, not to operations. In addition, *BIGN* ($\beta = –0.106$, $p < 0.1$) and *SIZE* ($\beta = –0.083$, $p < 0.01$) are negatively associated with *ICD_LAW*. The results are consistent with prior studies suggesting that a company, which is larger or audited by a Big4 firm, tends to report fewer weaknesses in internal control. Nevertheless, this negative association is not found for the ICDs in operations. We note that *DUAL* ($\beta = 0.099$, $p < 0.1$) is the only control variable that can marginally explain the disclosure of ICDs in operations. This positive

[16] We follow Lin's et al. (2011) methods to calculate the economic significance of the findings. They (2011, 313) support a negative association between a company's material weakness disclosures and internal auditors' education level and report an economic significance of 1.8 percent, which is consistent with our 1.39 percent.

Table 6
Equation (1) with alternative measurements.

Panel A: Alternative ICD measures

Variables	(1) ICD_N	(2) ICD_LAW_N	(3) ICD_OP_N	(4) ICD_Severity
LOGIASIZE	**−0.2155*** **	**−0.1709*** **	**−0.0446***	**−0.1395*** **
	(−3.5994)	**(−3.4952)**	**(−1.8889)**	**(−3.0527)**
CERTIFICATIONS	**−0.2178*** **	**−0.1882*** **	−0.0297	**−0.1619** **
	(−2.6168)	**(−2.8496)**	(−0.8295)	**(−2.4547)**
EXPERIENCE	**−0.1868*** **	**−0.1511*** **	−0.0357	**−0.1347** **
	(−2.6294)	**(−2.6541)**	(−1.2631)	**(−2.4574)**
EDUCATION	−0.0404	**−0.0355***	−0.0049	−0.0189
	(−1.5368)	**(−1.6533)**	(−0.4881)	(−1.0388)
Controls	YES	YES	YES	YES
YEAR EFFECT	YES	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES	YES
Observations	3340	3340	3340	3340
Pseudo R2	0.057	0.052	0.032	0.024

Panel B: Alternative IAF measure

Variables	(1) ICD	(2) ICD_LAW	(3) ICD_OP
IAF_Combined	**−0.0889*** **	**−0.1288*** **	**−0.0393***
	(−4.0168)	**(−5.7446)**	**(−1.7031)**
Controls	YES	YES	YES
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	3340	3340	3340
Pseudo R2	0.028	0.035	0.028

Note: The asterisks *, **, and *** represent the estimated coefficients are significant at 10%, 5%, and 1% respectively. Numbers in the parenthesis are z-statistics. Variables are defined as below or in Table 2.
ICD_N = Number of the reported internal control deficiencies related to operations or compliance.
ICD_LAW_N = Number of the reported internal control deficiencies related to compliance.
ICD_OP_N = Number of the reported internal control deficiencies related to operations.
ICD_Severity = An ordinal variable equals to 0 when the company does not report any deficiency, 1 when the company reports at least one deficiency in either operations or compliance, or 2 when the company reports deficiencies in both operations and compliance.
IAF_Combined = An ordinal variable ranges from 0 to 4, which is measured by summing up the indicators for above or below the median values of the four IAF quality variables.

association is consistent with our expectation that the duality role of CEO possibly weakens the monitoring power of the board and leads to more ICDs. We also control for the firm fixed effects in the models and note that the main results remain unchanged.

6. Additional analysis

For robustness check, we perform the following additional tests to address some potential issues related to measurements of variables and endogeneity.

6.1. Alternative measurement – ICDs

We employ two alternative measurements of *ICDs* to test our hypotheses. First, we utilize the number of ICDs reported by a company to create three continuous dependent variables. *ICD_N* equals the total number of the internal control deficiencies that a company reported in either operations or compliance. Likewise, *ICD_LAW_N* (*ICD_OP_N*) equals the total number of the internal control deficiencies that a company reported in compliance (operations). Regressing these three dependent variables on the IAF quality variables (i.e., Eq. (1)), we find the results, as shown in Columns (1) to (3) of Panel A in Table 6, remain unchanged. Second, we create an ordinal ICD variable, *ICD_Severity*, that equals 0 when the company does not report any deficiency, 1 when the company reports at least one deficiency in either operations or compliance, or 2 when the company reports deficiencies in both operations and compliance. The results, as reported in Column (4) of Panel A in Table 6, consistently suggest that the internal auditor team size and competence (as proxied by certifications and working experience) have a positive influence on the effectiveness of internal control over operations and compliance.

Table 7
Propensity score matching.

Dependent Variables	ICD	ICD_LAW	ICD_OP
Panel A: Matched sample by D_IASIZE			
D_IASIZE	**−0.1323****	**−0.1209****	−0.0700
	(−2.2654)	**(−2.0739)**	(−1.1553)
Controls	YES	YES	YES
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	1932	1932	1932
Panel B: Matched sample by D_CERTIFICATIONS			
D_CERTIFICATIONS	**−0.1325****	**−0.1098***	**−0.1795*****
	(−2.0529)	**(−1.6686)**	**(−2.6615)**
Controls	YES	YES	YES
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	1598	1598	1598
Panel C: Matched sample by D_EXPERIENCE			
D_EXPERIENCE	**−0.1715*****	**−0.2082*****	**−0.1489****
	(−3.0757)	**(−3.6886)**	**(−2.5345)**
Controls	YES	YES	YES
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	2174	2174	2174
Panel D: Matched sample by D_EDUCATION			
D_EDUCATION	0.0155	**−0.1116***	0.0934
	(0.2554)	**(−1.8334)**	(1.4885)
Controls	YES	YES	YES
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	2140	2140	2140

Note: z-statistics in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

6.2. Alternative measurement – aggregate IAF measure

We create a measure to proxy for the combined effect of the IAF quality attributes. We dichotomize each quality variable based on its median value into low versus high subgroups. For example, a company will be classified to a high *IASIZE* group (=1) if it has at least two internal auditors (median of *IASIZE* = 2). We next sum up the indicators of the four IAF quality variables to create an ordinal variable, *IAF_Combined*, ranging from 0 to 4. Using this aggregate IAF quality variable in Eq. (1) as the main predictor, we find that the results, as shown in Table 6, Panel B, are consistent with our findings in the main analysis. Specifically, the coefficients on *IAF_Combined* are significantly negative at the 1 percent level for the *ICD* (β = −0.0889) and *ICD_LAW* (β = −0.1288) models and at the 10 percent level for the *ICD_OP* model (β = −0.0393), as reported in Columns (1) to (3), respectively. The findings suggest a positive association between IAF quality and the effectiveness of internal control over compliance and/or operations.

6.3. Propensity-score matched test

In the current study, the non-random treatment effects and potential correlated omitted variables would create a problem of endogeneity. To address this concern, we develop a matched-pair sample for each of the IAF attributes on the basis of a propensity-score matching (PSM) process. Specifically, we create an indicator variable for each IAF attribute, which is then used to assign an observation to either a treatment or control group before matching (Shipman et al., 2017). Take *IASIZE* for example, we create an indicator variable, *D_IASIZE*, which equals 1 if a company's IAF size is equal to or greater than the average IAF size in the sample (i.e., treatment group), and 0 otherwise (i.e., control group). In the first stage of matching each company with large IAF size (*D_IASIZE* = 1) a company with small IAF size (*D_IASIZE* = 0) of similar characteristics, we estimated propensity score from a binary choice model, in which *D_IASIZE* is the dependence variable and all of the other covariates used in Table 5 serve as the independent variables. To create a matched sample for *IASIZE*, we use the approach of one-to-one matching without replacement (i.e., Shipman, Swanquist, and Whited 2017) and match the observations within a predefined propensity score caliper distance of 0.03. For the 1807 large IAF size firm-years, we find matches for 966 large IAF size firm-years yielding a total sample size of 1932. We also perform mean comparison tests of matched pairs, which indicate a successful matching procedure with balanced covariates as the t-values of the mean

differences for all covariates are small. Table 7, Panel A, reports the results from the second-stage probit models,[17] which show that *D_IASIZE* is significantly negatively associated with *ICD* and *ICD_LAW*, but not with *ICD_OP*. The findings are consistent with our main results in that the IAF size negatively influences the likelihood of the disclosure of ICDs in compliance. We then repeat the above procedures for the other three IAF attributes: *CERTIFICATIONS*, *EXPERIENCE*, and *EDUCATION*. Similarly, covariate balancing tests suggest successful matching procedures (i.e., statistical insignificance of differences in the mean between groups) for all of them. Table 7, Panels B to D, report the model results for *D_CERTIFICATIONS*, *D_EXPERIENCE*, and *D_EDUCATION*, respectively. Overall, the results of the PSM tests are consistent with those of the main analyses. We also note that the IA staff certification and experience are negatively associated with the disclosure of ICDs in operations, which while consistent with our expectations, are not found in our main analyses.

A caveat for PSM is that the matching process results in attrition in sample size. To address this issue, we relax the matching criteria to only include firm size, ROA, and industry as those factors are more likely to explain the IAF strength. Following the matching procedures described above, we note that the matched-pair sample size increases under this simple matching approach.[18] Table 8 shows that the results are mainly consistent with those in the main analysis, except for an insignificant result reported on *Education* ($\beta = -0.0323$; $z = -1.3315$). To sum up, both of the PSM tests support most of the findings draw from our main analysis.

6.4. The effect of lagged ICDs and IAF variables

To address the concern about the autocorrelation of the variables of interest, we first perform and report Pearson's Chi-square tests for the ICDs dummy variable as shown in Table 9, Panels A to C. The results suggest that the current-year ICD variables are not statistically independent of their corresponding lagged ICD variables (p-value < 0.000). The correlation matrix reported in Panel D shows that the IAF variables are highly correlated with their corresponding lagged IAF variables at the 1 percent significance level. Second, in a lead-lag analysis, we control for the lagged ICD variables in the models and find that, as shown in Table 10, Panel A, Columns (1) to (3), the prior ICD incidences have a significant, predictive power for the current- year ICDs, which consequently weaken the influence of the IAF quality attributes. Nevertheless, we find in Column (3) that the size and the certifications of the IAF staff retain their impact on the effectiveness of internal control over operations. To further understand whether the changes in IAF quality affect the current-year ICDs when the lagged ICD variable is controlled for, we separate the IAF quality variables into two components: the prior-year IAF effects and the changes in IAF in the current year. Specifically, we control for the lagged ICD and lagged IAF variables (e.g., *LAG_LOGIASIZE*) in the models to examine whether the changes in the IAF effects (e.g., GHANGE_LOGIASIZE) influence the current-year ICDs. The results in Columns (4) to (6) consistently support the contention that prior ICD incidences have a significant, predictive power for current-year ICDs. In addition, the result in Column (6) shows that the size and the certifications of the IAF staff in the prior year, and not the changes in IAF in the current year, have an impact on the effectiveness of internal control over operations. This finding suggests that, while the effectiveness of internal control depends on IAF quality, an improvement in IAF in the short term may not have sufficient efficacy to mitigate ICDs.

A possible explanation for the insignificant IAF quality variables after controlling for the lagged ICDs is that IAF is multi-dimensional, composed of several quality components that need to be incorporated with each other to have efficient influence on the effectiveness of internal control. In other words, each of our IAF variables may capture only a single dimension of IAF quality and, as a result, does not show enough explanatory power for ICDs. Therefore, we re-run the models in Columns (1) to (3) in Panel A using the aggregate IAF quality variable mentioned above, and report the results in Panel B, which suggest that the aggregate IAF quality variable is significantly positively associated with the effectiveness of internal control even while holding the lagged ICDs constant. This finding is consistent with our expectation that the efficacy of IAF on internal controls should be attributed to its various dimensions as a whole, rather than to any of its quality attributes alone.

Furthermore, we investigate whether one type of ICDs can be informative of future incidences of the other type of ICDs. Specifically, we regress current-year ICDs in compliance (operations) on prior-year ICDs in operations (compliance) and on the current-year aggregate IAF quality variable.[19] The results demonstrated in Table 11 Columns (1) and (3) show that prior-year ICDs in operations (compliance) have a positive, main effect on current-year ICDs in compliance (operations) and that the aggregate IAF quality variable has a negative, main effect on current-year ICDs. We also examine whether IAF quality mitigates the positive relationship between the prior- and current-year ICDs in Columns (2) and (4). The results show that this mitigation effect exists only when current-year ICDs in operation are regressed on prior-year ICDs in compliance.

7. Discussion and conclusion

In accordance with our hypotheses, we find that internal audit quality, as proxied by IAF staff competence and size, has a negative

17In the models, the ICD variables were regressed on *D_IASIZE* (i.e., the independent variable of interest) along with all of the other covariates used in Table 5, which include *CERTIFICATIONS, EXPERIENCE, EDUCATION, BOARDSIZE, DUAL, BIGN, AGE, SIZE, ARINVENTORY, LEV, ROA, LOSS, CFO,* and *SALESGROWTH.*

[18] Under the simple matching approach, the total sample size for *D_IASIZE*, *D_CERTIFICATIONS*, *D_EXPERIENCE*, and *D_EDUCATION* increases to 2888, 1674, 2522, and 2160, respectively.

[19] We use the current-year aggregate IAF quality variable, instead of the individual IAF quality variables, in the models, as the previous tests have indicated that the efficacy of IAF on ICDs is attributed to its various dimensions as a whole, not to any single attribute alone.

Table 8
Simple propensity score matching.

Dependent Variables	ICD	ICD_LAW	ICD_OP
Panel A: Matched sample by D_IASIZE			
D_IASIZE	**−0.1479*****	**−0.1217****	**−0.1415****
	(−2.7042)	**(−2.2045)**	**(−2.4856)**
Controls	YES	YES	YES
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	2888	2888	2888
Panel B: Matched sample by D_CERTIFICATIONS			
D_CERTIFICATIONS	**−0.1412***	**−0.1599***	-0.0967
	(−1.6511)	**(−1.8386)**	(-1.0740)
Controls	YES	YES	YES
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	1674	1674	1674
Panel C: Matched sample by D_EXPERIENCE			
D_EXPERIENCE	**−0.1187***	**−0.1552****	-0.0600
	(−1.8720)	**(−2.4184)**	(-0.9025)
Controls	YES	YES	YES
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	2522	2522	2522
Panel D: Matched sample by D_EDUCATION			
D_EDUCATION	0.0060	-0.0323	-0.0098
	(0.2471)	(-1.3315)	(-0.3938)
Controls	YES	YES	YES
YEAR EFFECT	YES	YES	YES
INDUSTRY EFFECT	YES	YES	YES
Observations	2160	2160	2160

Note: z-statistics in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 9
Autocorrelation of ICDs and IAF variables.

Panel A	$ICD_t = 0$	$ICD_t = 1$	Total	
$ICD_{t-1} = 0$	667	318	985	
$ICD_{t-1} = 1$	376	900	1276	
Total	1043	1218	2261	
Pearson χ^2 (1) = 327, P value < 0.000				
Panel B	$ICD\_LAW_t = 0$	$ICD\_LAW_t = 1$	Total	
$ICD\_LAW_{t-1} = 0$	986	281	1267	
$ICD\_LAW_{t-1} = 1$	365	629	994	
Total	1351	910	2261	
Pearson χ^2 (1) = 391, P value < 0.000				
Panel C	$ICD\_OP_t = 0$	$ICD\_OP_t = 1$	Total	
$ICD\_OP_{t-1} = 0$	1192	369	1561	
$ICD\_OP_{t-1} = 1$	286	414	700	
Total	1478	783	2261	
Pearson χ^2 (1) = 269, P value < 0.000				
Panel D	$LOGIASIZE_t$	$CERTIFICATIONS_t$	$EXPERIENCE_t$	$EDUCATION_t$
$LOGIASIZE_{t-1}$	**0.844*****	0.012	**−0.079*****	0.030
$CERTIFICATIONS_{t-1}$	0.023	**0.779*****	**0.085*****	**0.174*****
$EXPERIENCE_{t-1}$	**− 0.082*****	**0.076*****	**0.827*****	**0.221*****
$EDUCATION_{t-1}$	0.042**	**0.157*****	**0.209*****	**0.805*****

Pearson correlation matrix for the current-year and lagged internal audit variables. ***, **, and * denote significance level at the 1%, 5%, and 10% levels or better (two tailed), respectively.

association with the likelihood of the disclosure of ICDs. Specifically, the results suggest that a company with a stronger internal audit function (i.e., a large IAF team, IAF staff with more certifications, more audit work experience, and higher level of education) is more likely to have a better internal control system and thus less likely to report ICDs in compliance. Our findings, however, are subject to

Table 10
Lead-lag analysis.

Panel A: The effect of lagged ICD and IAF

	(1) ICD_t	(2) ICD_LAW_t	(3) ICD_OP_t	(4) ICD_t	(5) ICD_LAW_t	(6) ICD_OP_t
ICD_{t-1}	**0.964*****			**0.963*****		
	(16.955)			**(16.579)**		
ICD_LAW_{t-1}		**1.069*****			**1.090*****	
		(18.497)			**(18.410)**	
ICD_OP_{t-1}			**0.935*****			**0.935*****
			(15.317)			**(15.050)**
$LOGIASIZE_t$	−0.050	0.000	**−0.119***			
	(−0.763)	(0.001)	**(−1.777)**			
$CERTIFICATIONS_t$	−0.118	−0.087	**−0.265*****			
	(−1.282)	(−0.910)	**(−2.736)**			
$EXPERIENCE_t$	−0.121	−0.093	−0.045			
	(−1.599)	(−1.200)	(−0.578)			
$EDUCATION_t$	−0.005	−0.030	0.003			
	(−0.203)	(−1.129)	(0.127)			
$LOGIASIZE_{t-1}$				−0.070	−0.001	**−0.165****
				(−0.975)	(−0.006)	**(−2.244)**
$CERTIFICATIONS_{t-1}$				−0.123	−0.103	**−0.271****
				(−1.206)	(−0.978)	**(−2.509)**
$EXPERIENCE_{t-1}$				−0.101	−0.056	−0.077
				(−1.225)	(−0.667)	(−0.911)
$EDUCATION_{t-1}$				0.013	−0.024	0.014
				(0.462)	(−0.812)	(0.483)
CHG_LOGIASIZE				−0.021	−0.019	−0.062
				(−0.219)	(−0.194)	(−0.622)
CHG_CERTIFICATIONS				−0.140	−0.133	−0.162
				(−0.942)	(−0.854)	(−1.043)
CHG _EXPERIENCE				−0.152	−0.106	0.063
				(−1.149)	(−0.783)	(0.457)
CHG_EDUCATION				−0.022	−0.004	−0.029
				(−0.515)	(−0.102)	(−0.677)
Constant	0.315	0.521	−0.512	0.244	0.491	−0.675
	(0.582)	(0.957)	(−0.949)	(0.439)	(0.877)	(−1.222)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
YEAR EFFECT	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY EFFECT	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2261	2261	2261	2261	2261	2261

Panel B: The effect of lagged ICD and aggregate IAF

	(1) ICD_t	(2) ICD_LAW_t	(3) ICD_OP_t
ICD_{t-1}	**0.964*****		
	(16.989)		
ICD_LAW_{t-1}		**1.064*****	
		(18.409)	
ICD_OP_{t-1}			**0.938*****
			(15.390)
$IAF\_Combined_t$	**−0.059****	**−0.065****	**−0.065****
	(−2.122)	**(−2.268)**	**(−2.262)**
Constant	0.298	0.303	−0.272
	(0.590)	(0.601)	(−0.548)
Controls	Yes	Yes	Yes
YEAR EFFECT	Yes	Yes	Yes
INDUSTRY EFFECT	Yes	Yes	Yes
Observations	2261	2261	2261

Note: z-statistics in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.
CHG_LOGIASIZE = The change in LOGIASIZE from time t-1 to t.
CHG_CERTIFICATIONS = The change in CERTIFICATIONS from time t-1 to t.
CHG _EXPERIENCE = The change in EXPERIENCE from time t-1 to t.
CHG_EDUCATION = The change in EDUCATION from time t-1 to t.

the type of ICDs. That is, we find evidence that a large IAF staff can reduce the likelihood of ICDs in operations, but we find no supporting evidence for IAF competence. A possible explanation is that control activities in operations vary from company to company more than those in regulatory compliance and thus are more difficult to measure consistently across companies. This difficulty may lead to measurement error and result in insignificant findings. Besides, internal control activities in operations may

Table 11
Inter-influence of ICDs across types.

	ICD_LAW_t		ICD_OP_t	
Variables	(1)	(2)	(3)	(4)
ICD_OP_{t-1}	**0.489*****	**0.504*****		
	(8.195)	**(4.459)**		
ICD_LAW_{t-1}			**0.489*****	**0.675*****
			(8.626)	**(6.178)**
$IAF\_Combined_t$	**−0.103*****	**−0.101*****	**−0.052***	−0.006
	(−3.764)	**(−3.090)**	**(−1.872)**	(−0.168)
ICD_OP_{t-1}* $IAF\_Combined_t$		−0.008		
		(−0.158)		
ICD_LAW_{t-1}* $IAF\_Combined_t$				**−0.103****
				(−1.997)
Constant	**1.058****	**1.056****	−0.424	−0.468
	(2.193)	**(2.190)**	(−0.875)	(−0.966)
Controls	Yes	Yes	Yes	Yes
YEAR EFFECT	Yes	Yes	Yes	Yes
INDUSTRY EFFECT	Yes	Yes	Yes	Yes
Observations	2261	2261	2261	2261

Note: z-statistics in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

require more internal auditors' company-specific knowledge than do those in compliance. For the most part, our competence proxies measure the IAF staff's general knowledge in internal auditing and thus are not able to capture the complete dimensions of competence. Therefore, our findings on the ICDs related to operations may not be conclusive and need to be interpreted with caution. Further investigation into these specific aspects of IAF quality is warranted.

The study contributes to the literature in the following ways. First, we employ a unique dataset that allows us to explore and directly measure the disclosure of operations- and compliance-related ICDs. Our study is among the first to empirically examine companies' self-reporting on ICDs related to operations and compliance. Second, the study expands the scope of research beyond a focus on ICFR by documenting associations between various measures of IAF quality and ICDs in operations and compliance. With this unique dataset and novel focus, we provide direct empirical support of the important role of IAF quality on internal control over operations and compliance, which helps to mitigate the empirical limitations of prior IAF research that substantially focuses on ICFR. Third, our result suggests that internal auditors' external auditing experience and certifications have a positive association with the effectiveness of internal control in compliance, but not in operations. Given that competence is a multi-dimensional construct, this finding implies that different abilities and skills are necessary for internal auditors to fulfill different control objectives and carry out their duties successfully. For example, managers should be aware that internal auditors' general auditing experience may not be sufficient for them to effectively perform control procedures for operations, as those procedures typically require more industry and/or company-specific knowledge. Lastly, this study has implications for corporate culture and governance environment. Our empirical findings help researchers and practitioners to better understand how IAF quality results in an improved ability of the IAF to influence a company's achievement in its operations and compliance objectives. Since the reported ICDs in operations and compliance can be indicative of weak control environment or organizational culture as suggested by Kedia et al. (2016), our results point out that IAF quality may also enhance corporate governance and reduce financial misreporting due to deviant behavior. From a policy perspective, our findings provide insights to the regulator by confirming standard-setters' assertions that IAFs improve corporate governance by assisting and monitoring management in achieving corporate objectives.

We note that our results are subject to the following caveats. First, due to the use of a publicly unavailable dataset, our access to the companies' ICD reports granted by the regulator is limited to those issued from 2005 to 2007. As the IC Regulations were initially promulgated in 2002 and the data might not be complete in the first couple of years, we have taken the reasonable step of using data starting from the year 2005. Besides, due to the sensitive and confidential information disclosed in those reports, the regulator has granted us the access only to the subsequent three years of data.[20] Although the data is not recent, there have been no dramatic changes in Taiwan's business or regulatory environment that would lead us to believe that our conclusions drawn from the data are no longer relevant or valid. It is worth noting that our study does not empirically test the association between IAF and ICFR due to limits in the data (as mentioned earlier, the ICFR data was not available until 2007 in Taiwan). Future studies may provide direct evidence of the relationship among the three internal control objectives if the relevant data becomes available. Second, a self-reporting bias may be inevitable in our study, as companies assess and self-report the internal control deficiencies. A related issue would be the incentives that drive management to report or not to report the ICDs faithfully. The regulator encourages companies to fully disclose ICDs on their own initiative and generally does not take action against a company unless the company fails to meet the reporting deadline or to provide a remediation plan for material weakness in internal control. Moreover, companies do not need to

[20] While we cannot completely rule out the possibility that the regulator chooses to provide us the data from the specific period of 2005 to 2007 for political reasons (e.g., low incidence of ICDs which shows the efficacy of the regulator), the high mean value of ICDs reported in our sample could potentially alleviate this concern.

worry about market reactions, as their reporting on ICDs are not available to the public. While the high reporting rate of ICDs in our sample may suggest that the majority of the companies are motivated to report under the IC Regulations, we cannot rule out the possibility that companies, intentionally or unintentionally, fail to comply with the IC Regulations. Given that management may have incentives to misreport and that we couldn't entirely verify the validity or the completeness of the ICDs reported by the companies, our study's findings may be limited by unobservable management misconduct in ICD reporting. Third, we cannot completely rule out the possibility of endogeneity. For example, a prudent company that has fewer internal control weaknesses is inherently likely to hire competent internal auditors. In this case, there would be no significant association between IAF quality and the discovery of weaknesses. Fourth, the results may be subject to the measurements of auditor competence, as the proxies we used in the study may not be able to capture all the dimensions of competence. For instance, due to limits in the data, we do not measure auditors' on-the-job training or their internal audit work experience in the current company (i.e., company-specific expertise and knowledge). Lastly, we are aware that our findings may not be generalizable to other settings, as the operational and compliance issues in Taiwan could differ from those in other countries.

Appendix

Control Activities and Related Regulations

Audit Items	Regulations	Classification
Acquisition or disposal of assets	Regulations Governing the Acquisition and Disposal of Assets by Public CompaniesArticles 9–12	Compliance
Engagement of derivatives transactions	Regulations Governing the Acquisition and Disposal of Assets by Public CompaniesArticles 18–21	Compliance
Extension of loans	Regulations Governing Loaning of Funds and Making of Endorsements/Guarantees by Public CompaniesArticles 8–10	Compliance
Endorsements or guarantees for others	Regulations Governing Loaning of Funds and Making of Endorsements/Guarantees by Public CompaniesArticles 11–13	Compliance
Management of related party transactions	Regulations Governing the Preparation of Financial Reports by Securities IssuersArticle 15	Compliance
Supervision and management of subsidiaries	Regulations Governing Establishment of Internal Control Systems by Public CompaniesArticle 39	Compliance
Procedures governing board meetings	Regulations Governing Procedure for Board of Directors Meetings of Public Companies	Compliance
Inspection of information and communications security	NA	Operations
Sales and receipts cycle	NA	Operations
Purchase and payment cycle	NA	Operations

References

Abbott, L.J., Daugherty, B., Parker, S., Peters, G.F., 2016. Internal audit quality and financial reporting quality: the joint importance of independence and competence. J. Acc. Res. 54 (1), 3–40.

Al-Twaijry, A.A.M., Brierley, J.A., Gwilliam, D.R., 2003. The development of internal audit in Saudi Arabia: an institutional theory perspective. Crit. Perspect. Acc. 14 (5), 507–531.

Alexander, C.R., Bauguess, S.W., Bernile, G., Lee, Y.H.A., Marietta-Westberg, J., 2013. Economic effects of SOX Section 404 compliance: a corporate insider perspective. J. Account. Econ. 56 (2–3), 267–290.

Ali, O.A., Owais, W.O., 2013. Internal auditors' intellectual (knowledge) dimension in creating value for companies empirical study of Jordanian industrial public shareholding companies. Int. Bus. Res. 6 (1), 118–129.

Alzeban, A., Gwilliam, D., 2014. Factors affecting the internal audit effectiveness: a survey of the Saudi public sector. J. Int. Account. Audit. Tax. 23 (2), 74–86.

American Institute of Certified Public Accountants (AICPA), 2008. Managing the Business Risk of Fraud: A Practical Guide. Also sponsored by the Institute of Internal Auditors and Association of Certified Fraud Examiners.

Aobdia, D., Lin, C.J., Petacchi, R., 2015. Capital market consequences of audit partner quality. Account. Rev. 90 (6), 2143–2176.

Ashbaugh-Skaife, H., Collins, D.W., Kinney, W.R., 2007. The discovery and reporting of internal control deficiencies prior to SOX-mandated audits. J. Account. Econ. 44 (1–2), 166–192.

Ashbaugh-Skaife, H., Collins, D.W., Kinney, W.R., LaFond, R., 2008. The effect of SOX internal control deficiencies and their remediation on accrual quality. Account. Rev. 83 (1), 217–250.

Ashbaugh-Skaife, H., Collins, D.W., Kinney, W.R., LaFond, R., 2009. The effect of SOX internal control deficiencies on firm risk and cost of equity. J. Acc. Res. 47 (1), 1–43.

Bardhan, I., Lin, S., Wu, S.L., 2015. The quality of internal control over financial reporting in family firms. Account. Horiz. 29 (1), 41–60.

Beneish, M.D., Billings, M.B., Hodder, L.D., 2008. Internal control weaknesses and information uncertainty. Account. Rev. 83 (3), 665–703.

Boone, A.L., Field, L.C., Karpoff, J.M., Raheja, C.G., 2007. The determinants of corporate board size and composition: an empirical analysis. J. Fin. Econ. 85 (1), 66–101.

Boritz, J.E., Lim, J.H., 2008. IT control weaknesses, IT governance and firm performance. Working paper. University of Waterloo.

Bronson, S.N., Carcello, J.V., Raghunandan, K., 2006. Firm characteristics and voluntary management reports on internal control. Audit. J. Pract. Theor. 25 (2), 25–39.

Chartered Institute of Internal Auditors (CIIA), 2015. What is Internal Auditor? Available at: < https://www.iia.org.uk/media/1462847/What-is-internal-audit.pdf > .

Chen, C.Y., Lin, C.J., Lin, Y.C., 2008. Audit partner tenure, audit firm tenure, and discretionary accruals: does long auditor tenure impair earnings quality? Contemp. Account. Res. 25 (2), 415–445.

Cheng, Q., Goh, B.W., Kim, J.B., 2017. Internal control and operational efficiency. Contemp. Account. Res Forthcoming.

Chi, W., Huang, H., Liao, Y., Xie, H., 2009. Mandatory audit partner rotation, audit quality, and market perception: evidence from Taiwan. Contemp. Account. Res. 26 (2), 359–391.

Chi, W., Dhaliwal, D., Li, O.Z., Lin, T.H., 2013. Voluntary reporting incentives and reporting quality: evidence from a reporting regime change for private firms in Taiwan. Contemp. Account. Res. 30 (4), 1462–1489.

Committee of Sponsoring Organizations of the Treadway Commission (COSO), 1992. Internal Control—Integrated Framework.

Committee of Sponsoring Organizations of the Treadway Commission (COSO), 2011. Internal Control—Integrated Framework. December 2011.

Committee of Sponsoring Organizations of the Treadway Commission (COSO), 2012. Internal Control—Integrated Framework. Exposure Draft, September. http://www.ic.coso.org.
Committee of Sponsoring Organizations of the Treadway Commission (COSO), 2013. Internal Control—Integrated Framework.
Dellai, H., Omri, M.A.B., 2016. Factors affecting the internal audit effectiveness in Tunisian organizations. Res. J. Fin. Acc. 7 (16), 208–221.
Dittenhofer, M., 2001. Internal audit effectiveness: an expansion of present methods. Managerial Audit. J. 16 (8), 443–450.
Doyle, J., Ge, W., McVay, S., 2007. Determinants of weaknesses in internal control over financial reporting. J. Account. Econ. 44 (1–2), 193–223.
Ege, M.S., 2015. Does internal audit function quality deter management misconduct? Account. Rev. 90 (2), 495–527.
Feng, M., Li, C., McVay, S., 2009. Internal control and management guidance. J. Account. Econ. 48 (2–3), 190–209.
Feng, M., Li, C., McVay, S.E., Skaife, H.A., 2015. Does ineffective internal control over financial reporting affect a firm's operations? Evidence from Firms' Inventory Management. Account. Rev. 90 (2), 529–557.
Ge, W., McVay, S., 2005. The disclosure of material weaknesses in internal control after the Sarbanes-Oxley Act. Account. Horiz. 19 (3), 137–158.
Gramling, A.A., Maletta, M.J., Schneider, A., Church, B.K., 2004. The role of the internal audit function in corporate governance: a synthesis of the extant internal auditing literature and directions for future research. J. Account. Lit. 23, 194–244.
Hammersley, J.S., Myers, L.A., Shakespeare, C., 2008. Market reactions to the disclosure of internal control weaknesses and to the characteristics of those weaknesses under section 302 of the Sarbanes Oxley Act of 2002. Rev. Account. Stud. 13 (1), 141–165.
Hass, S., Abdolmohammadi, M.J., Burnaby, P., 2006. The Americas literature review on internal auditing. Managerial Audit. J. 21 (8), 835–844.
Hoitash, R., Hoitash, U., Bedard, J.C., 2008. Internal control quality and audit pricing under the Sarbanes-Oxley Act. Audit. J. Pract. Theor. 27 (1), 105–126.
Institute of Internal Auditors (IIA), 2012. International Standards for the Professional Practice of Internal Auditing. IIA, Altamonte Springs, FL http://www.theiia.org/guidance/standards-andguidance/ippf/standards/.
Institute of Internal Auditors (IIA), 2013. Global Internal Audit Competency Framework. IIA, Altamonte Springs, FL.
International Auditing and Assurance Standards Board (IAASB). 2012. Using the Work of Internal Auditors. International Standards on Auditing 610 (Revised). http://www.ifac.org/sites/default/files/publications/files/A047%202012%20IAASB%20Handbook%20ISA%20610%20(Revised).pdf.
Kedia, S., Luo, S., Rajgopal, S., 2016. Culture of weak compliance and financial reporting risk. Working paper. Rutgers Business School, NUS Business School, and Columbia University.
Kennedy, P., 1998. A Guide to Econometrics, Fourth ed. The MIT Press, Cambridge, Massachusetts.
Lawrence, A., Minutti-Meza, M., Vyas, D., 2017. Is operational control risk informative of financial reporting deficiencies? Audit. J. Pract. Theor In-Press.
Lin, S., Pizzini, M., Vargus, M., Bardhan, I.R., 2011. The role of the internal audit function in the disclosure of material weaknesses. Account. Rev. 86 (1), 287–323.
Mihret, D.G., Woldeyohannis, G.Z., 2008. Value-added role of internal audit: an Ethiopian case study. Managerial Audit. J. 23 (6), 567–595.
Munsif, V., Raghunandan, K., Dasaratha, V.R., 2012. Internal control reporting and audit report lags: further evidence. Audit. J. Pract. Theor. 31 (3), 203–218.
Naiker, V., Sharma, D.S., 2009. Former audit partners on the audit committee and internal control deficiencies. Account. Rev. 84 (2), 559–587.
Newton, N.J., Persellin, J.S., Wang, D., Wilkins, M.S., 2016. Internal control opinion shopping and audit market competition. Account. Rev. 91 (2), 603–623.
Ogneva, M., Subramanyam, K.R., Raghunandan, K., 2007. Internal control weakness and cost of equity: evidence from SOX Section 404 disclosures. Account. Rev. 82 (5), 1255–1297.
Prawitt, D.F., Smith, J.L., Wood, D.A., 2009. Internal audit quality and earnings management. Account. Rev. 84 (4), 1255–1280.
Public Company Accounting Oversight Board (PCAOB), 2004. Auditing Standard No. 2 (AS2): An Audit of Internal Control over Financial Reporting Performed in Conjunction with an Audit Of Financial Statements. PCAOB, Washington, DC.
Rice, S.C., Weber, D.P., 2012. How effective is internal control reporting under SOX 404? Determinants of the (non-)disclosure of existing material weaknesses. J. Acc. Res. 50 (3), 811–843.
Shipman, J.E., Swanquist, Q.T., Whited, R.L., 2017. Propensity score matching in accounting research. Account. Rev. 92 (1), 213–244.
Tysiac, K., 2012. COSO Chair says updated framework is a 'refresh'. J. Account. 23, 2012.
Walter, O.B., Guandaru, K.C., 2012. A study to explore internal auditors' compliance with Quality Assurance Standards: A case of state owned corporations in Kenya. Int. J. Res. Stud. Manag. 1 (1), 109–126.
Yee, C.S., Sujan, A., James, K., Leung, J.K., 2008. The perception of the Singaporean internal audit customers regarding the role and effectiveness of internal audit. Asian J. Bus. Acc. 1 (2), 147–174.