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Internal Control and Operational Efficiency*

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Abstract

In this study, we examine whether and how internal control over financial reporting affects firm operational efficiency. We find that operational efficiency, derived from the frontier analysis, is significantly lower among firms with material weaknesses in internal control relative to firms without such weaknesses. We document some evidence suggesting that effective internal control leads to greater operational efficiency through reducing the likelihood of misappropriation of corporate resources and through enhancing the quality of internal reports for decision making. We also document that smaller firms benefit more from having effective internal control in terms of operational efficiency. In addition, we find that the market appears to understand the effect of ineffective internal control on operational efficiency: within firms with internal control material weakness, those with more negative market reaction experience a larger deterioration in operational efficiency. Lastly, we find that the firms that remediate their material weaknesses subsequently experience an improvement in operating performance and stock returns, and this effect is mainly driven by the improvement in operational efficiency. Overall, our study extends the literature by presenting systematic evidence on the effects of effective internal control on operational efficiency and firm performance.

Key words: Internal control, operational efficiency, Sarbanes-Oxley Act

JEL codes: G30, L20, M10, M41

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1 Introduction

Section 404 of the Sarbanes-Oxley Act of 2002 (SOX 404) requires companies' auditors to provide an opinion on their clients' internal control over financial reporting (ICFR), in addition to the opinion on their clients' financial statements. Since its effective date, SOX 404 has been subject to intense debate. Many critics argue that its perceived benefits are not commensurate with the high compliance costs (Michaels 2003; DeFond and Francis 2005; Powell 2005; Romano 2005). While studies have documented the benefits of effective ICFR, such as better financial reporting quality and lower cost of capital,[1] the high compliance costs have led to the permanent exemption of non-accelerated filers under the Dodd-Frank Wall Street Reform and Consumer Protection Act in July 2010.[2] These developments after the implementation of SOX 404 suggest that it is still important to examine the costs and benefits of maintaining effective internal control.

In this study, we examine the effect of ICFR on firm operational efficiency. Our examination is important not only because it contributes to the continuous debate on the costs and benefits of SOX 404, but also because it sheds light on the implications of internal control beyond financial reporting. The *Internal Control—Integrated Framework* issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013) explicitly states that one of the objectives of internal control pertains to the "effectiveness and efficiency of the

[1] For examples, see Doyle et al. (2007a) and Ashbaugh-Skaife et al. (2008) on the effect of internal control on financial reporting quality, and Ogneva et al. (2007), Beneish et al. (2008), Ashbaugh-Skaife et al. (2009), Dhaliwal et al. (2011), and Kim et al. (2011) on the effect of internal control on the cost of capital.

[2] For example, CRA International's (2005) survey indicates that the total year-one Section 404 implementation cost is $1.5 million per company with market capitalization between $75 million and $700 million, or 0.46 percent of its revenue, and is $7.3 million per company with market capitalization above $700 million, or 0.09 percent of its revenue. Financial Executives International (2004) arrives at a similar conclusion from its surveys. It estimated that the average year-one 404 compliance cost is over $3 million per company, and over $8 million for companies with more than $5 billion in revenues. Eldridge and Kealey (2005) document that audit fees as a percentage of total assets more than doubled following the enactment of SOX, and that small companies reported larger increases.

entity's operations, including operational and financial performance goals, and safeguarding assets against loss."[3] However, despite its importance, there is limited research on the effect of internal control on operational efficiency.[4]

We expect ineffective internal control to have a negative effect on firm operational efficiency for two non-exclusive reasons. First, ineffective internal control leads to greater information risk, which increases agency problems and the likelihood of misappropriation of corporate resources by managers and other employees (Lambert et al. 2007). In addition, ineffective internal control in the form of inadequate physical security, inadequate segregation of duties, and inadequate documentation further allows the misappropriation of resources by employees. If resources available for production are diverted for managers' and other employees' personal consumption, the outputs generated for a given amount of inputs will be reduced, leading to lower operational efficiency. Second, ineffective internal control can result in erroneous *internal* management reports and untimely financial reporting information (Feng et al. 2009). Managers relying on such reports are more likely to make suboptimal operational decisions, leading to inefficiencies such as inventory obsolescence, increased inventory storage costs, and/or idle capacity. This can lead to higher input costs incurred for a given amount of outputs and hence lower operational efficiency.

Notwithstanding the above arguments, there are two reasons why we might not observe the

[3] This framework replaces the previous one issued in 1992, which defines internal control as "the process designed, implemented and maintained to provide reasonable assurance about the achievement of an entity's objectives with regard to (a) reliability of financial reporting, (b) *effectiveness and efficiency of operation*, (c) safeguarding of assets and (d) compliance with applicable laws and regulations (emphasis added)." Furthermore, Statement of Auditing Standards No. 115, Communicating Internal Control Related Matters Identified in an Audit, defines internal control as "a process—effected by those charged with governance, management, and other personnel—designed to provide reasonable assurance about the achievement of the entity's objectives with regard to the reliability of financial reporting, *effectiveness and efficiency of operations*, and compliance with applicable laws and regulations (emphasis added)."

[4] The exceptions are the two recent studies that examine the effect of internal control effectiveness on firms' investment efficiency (Cheng et al. 2013) and inventory management (Feng et al. 2013). Below we provide more detailed discussion of these studies and how our study differs from them.

hypothesized negative association between ineffective internal control and operational efficiency. First, because the intended objective of SOX 404 is to improve the reliability of firms' financial reporting (PCAOB 2004; Donaldson 2005) and to help external users make better decisions, few have envisaged the potential benefits of internal control for internal operations. According to the survey reported in Alexander et al. (2013), many managers do not believe that effective internal control can improve the quality of internal reports. If this is the case, the hypothesized benefits of effective internal control on operational efficiency may not materialize. Second, internal control is a process that involves human diligence and compliance and, hence, is subject to lapses in judgment and breakdowns resulting from human failures. It also can be circumvented by collusion or improper management override (AICPA 2005; SEC 2007). To the extent that internal control cannot provide absolute assurance due to its inherent limitations, and that managers of firms can circumvent or override internal control to facilitate consumption of private benefits, internal control may not constrain misappropriation of corporate resources and enhance operational efficiency.

We test the association between ineffective internal control and operational efficiency using a large sample of firms that reported internal control opinions under SOX 404 during the period 2004 to 2011. A firm is deemed to have ineffective internal control in a particular fiscal year if it reports at least one material weakness in internal control.[5] Following prior research, we use the frontier analysis—Data Envelopment Analysis (DEA)—to measure firm operational

[5] According to Auditing Standards No. 2 (PCAOB 2004), a material weakness is "a significant deficiency, or combination of significant deficiencies, that results in more than a remote likelihood that a material misstatement of the financial statements will not be prevented or detected." A significant deficiency is "a control deficiency, or combination of control deficiencies, that adversely affects the company's ability to initiate, authorize, record, process, or report external financial data reliably in accordance with generally accepted accounting principles such that there is more than a remote likelihood that a misstatement of the company's annual or interim financial statements that is more than inconsequential will not be prevented or detected."

efficiency.[6] Consistent with our prediction, we find that operational efficiency is significantly lower for firms with material weaknesses compared to firms without such weaknesses. This finding holds after controlling for factors associated with operational efficiency and determinants of material weaknesses. The finding is also robust to various sensitivity checks, which include using the Heckman (1979) two-stage procedure, controlling for lagged return on assets and operational efficiency, using the Fama-Macbeth (1973) approach to estimate our regression by industry, using a decile ranked measure of operational efficiency, using an operational efficiency measure estimated from three input variables as in Baik et al. (2013), and using an alternative measure of operational efficiency derived from the Stochastic Frontier Analysis. We also conduct a change analysis using the sample of material weakness firms as their own control. We find that an improvement (deterioration) in internal control effectiveness is associated with an increase (decrease) in operational efficiency.

Next, we conduct cross-sectional analyses to shed light on the mechanisms through which effective internal control leads to greater operational efficiency: (1) reducing the likelihood of misappropriation of corporate resources and (2) enhancing the quality of internal reports for decision making. Consistent with the first channel, we find that the adverse effect of internal control material weaknesses on operational efficiency is exacerbated for firms with more liquid assets and for firms operating in more geographical regions. This result suggests that when managers/employees have more opportunities for misappropriation of resources, the benefits of effective internal control in enhancing firm operational efficiency are more pronounced. Consistent with the second channel, we find that the negative effect of internal control material

[6] The DEA methodology has been used extensively in operations research and management accounting research to evaluate organizations' efficiency (see Callen 1991 for a review). For example, Murthi et al. (1996) use DEA to measure marketing efficiency, and Leverty and Grace (2012) use DEA to examine the relative efficiency of insurance companies. DEA provides a specific measure of the overall firm-level operational efficiency that is based on the relation between inputs and outputs.

weaknesses on operational efficiency is exacerbated for firms with higher operating cash flow volatility, greater analyst forecast errors, and higher corporate opacity. To the extent that greater uncertainty and poorer information environments are correlated with managers' demand for higher quality internal information for decision making, our result is consistent with the notion that effective internal control leads to greater operational efficiency by enhancing the quality of internal reports.

Because smaller firms experience a disproportional amount of costs for implementing SOX, it is important to understand whether the benefit of effective internal control is also larger for these firms. For this purpose, we investigate whether the effect of internal control effectiveness on operational efficiency varies with firm size. We find that the negative effect of material weaknesses on firm operational efficiency is more pronounced for firms with smaller market capitalization, particularly those with market capitalization between $75million and $250 million. This finding is consistent with smaller firms benefitting more from having effective internal control in terms of operational efficiency, informing the debate over the costs and benefits of SOX 404 as further exemptions are deliberated.

We also investigate whether the market understands the effect of ineffective internal control on operational efficiency. We find that within firms with material weaknesses, those with more negative market reaction experience a larger deterioration in operational efficiency. This finding indicates that the negative market reaction to the disclosure of material weaknesses, as documented in prior research (Hammersley et al. 2008; Beniesh et al. 2008), is partly due to investors' concerns that material weaknesses can harm the firm's operational efficiency and hence future profitability.

In our last analysis, we attempt to shed some light on the "monetary" benefits of effective

internal control in terms of operational efficiency. Specifically, we examine how the changes in internal control effectiveness correspond to future operating performance and stock returns. Focusing on the sample of firms with ineffective internal control, we find that firms that remediate (do not remediate) material weaknesses have better (worse) return on assets in the two years after the material weakness disclosure. Among firms that remediate their material weaknesses, we further document that the improvement in return on assets is mainly attributed to those that improve their operational efficiency upon the discovery of material weaknesses. Remediating firms that show no improvement in operational efficiency continue to suffer deterioration in return on assets. The results are qualitatively similar when we examine one-year or two-year-ahead stock returns. Overall, this finding sheds light on how the operational efficiency benefits of maintaining effective internal control translate to operating and stock performance.

Our study contributes to the literature in several important ways. First, while prior studies have shown that effective internal control mitigates information risk and enhances the quality of internal management reports, no study has linked the effectiveness of internal control to the firm's internal operations. Our study extends prior research by documenting that effective internal control improves firm operational efficiency, presumably through reducing the likelihood of misappropriation of corporate resources and through enhancing the quality of internal reports for decision making. Our study hence adds to an emerging literature that examines the implications of internal control beyond financial reporting quality (e.g., Cheng et al. 2013; Feng et al. 2013; Bauer 2013). Our study also complements Masli et al. (2010), who examine the potential benefits from implementing internal control monitoring technology designed to support and facilitate internal control processes. Our study shows that a potential

benefit of the better internal control processes is improved firm operational efficiency.

Our paper is closely related to Feng et al. (2013). They document that firms with ineffective internal control over inventory have systematically lower inventory turnover and higher inventory impairments. While Feng et al. examine whether a specific type of material weaknesses in internal control adversely affects one aspect of firm operations, our study provides comprehensive evidence on the link between internal control and the operational efficiency by considering all types of material weaknesses in internal control and an overall measure of operational efficiency. Furthermore, Feng et al. focus on inventory turnover and inventory impairments, which are essentially financial ratios that proxy for operational efficiency. As discussed in Baik et al. (2013, p2), the frontier analysis provides an advantage over simple financial ratios by implicitly allowing for differential weightings on inputs, leading to a more precise measure of operational efficiency compared to simple financial ratios. Our study also differentiates from and extends Feng et al. by providing insights into the channels through which internal control affects operational efficiency.

Second, our study contributes to the ongoing debate on the costs versus benefits of SOX 404 reporting. To the extent that greater operational efficiency translates into higher profitability, as documented in this paper, the greater operational efficiency achieved through having effective ICFR can help offset the compliance costs of SOX 404. Finally, our study sheds light on the documented negative market reaction to the disclosure of internal control weaknesses (Hammersley et al. 2008; Beneish et al. 2008). Our findings suggest that the market understands the implications of weak internal control, not just for financial reporting quality as prior research suggests, but also for firm operational efficiency and future profitability.

The remainder of our paper proceeds as follows. The next section discusses the related

literature and develops hypotheses. Section 3 describes the data and research methodology. Sections 4 and 5 present the primary and additional analyses, respectively. Section 6 concludes.

2 Related Literature and Hypothesis Development

2.1 Related literature

In an attempt to restore investor confidence in firms' financial reporting, the Sarbanes-Oxley Act of 2002 requires firms to assess and disclose, and auditors to certify, the effectiveness of ICFR (SEC 2002, 2003). Presumably, regulators hope that these requirements can improve the quality of internal control and enhance the reliability of financial reporting. To shed light on whether the internal control requirements achieve these objectives, prior research has examined whether the effectiveness of internal control is positively correlated with financial reporting quality. For instance, Doyle et al. (2007a) and Ashbaugh-Skaife et al. (2008) find that effective internal control can enhance financial reporting quality, proxied for by accruals quality and the size of abnormal accruals. Beneish et al. (2008) and Ashbaugh-Skaife et al. (2009) find that effective internal control reduces information risk, which in turn lowers a firm's cost of equity. However, Ogneva et al. (2007) fail to find a significant relation between internal control weaknesses and cost of equity after controlling for firm characteristics and analyst forecast bias. Recent studies further document that material weaknesses in internal control are associated with a higher cost of debt (Dhaliwal et al. 2011; Kim et al. 2011).

There is an emerging literature examining the implications of internal control beyond financial reporting. For example, Feng et al. (2009) find a positive relation between internal control quality and management guidance accuracy, consistent with ineffective internal control leading to inaccurate internal management reports. Cheng et al. (2013) examine the investment behavior of a sample of firms that disclosed internal control weaknesses. They find that prior to

the disclosure, these firms under-invest (over-invest) when they are financially constrained (unconstrained). However, after the disclosure, these firms' investment efficiency improves significantly. Their results are consistent with ineffective internal control adversely affecting investment efficiency. Feng et al. (2013) investigate whether ineffective internal control over inventory affects inventory management. The authors argue that inventory-related material weaknesses in internal control can result in suboptimal order quantities, leading to higher inventory levels and higher holding costs. In addition, inaccurate inventory tracking and internal valuation processes can lead to mismanagement of inventory, resulting in larger and more frequent inventory impairments as out-of-date or obsolete product loses market value. Consistent with their expectations, they find that firms with ineffective internal control over inventory have systematically lower inventory turnover and a higher likelihood and magnitude of inventory impairments. Their study hence provides insights into how material weaknesses in internal control over inventory adversely affect inventory management. It is, however, not clear whether material weaknesses in general affect operational efficiency at the overall firm level, the issue that we examine in this paper.

2.2 Hypothesis development

In this study, we argue that ineffective internal control can have a negative effect on firm operational efficiency for two non-exclusive reasons. First, prior studies have shown that firms with ineffective internal control have poorer financial reporting quality (Doyle et al. 2007a; Ashbaugh-Skaife et al. 2008). To the extent that less reliable financial reporting increases information asymmetry between insiders and outsiders (Lambert et al. 2007), ineffective internal control prevents the effective monitoring of managers and exacerbates agency problems. Consistent with this argument, Ashbaugh-Skaife et al. (2013) find that the profitability of insider

trading, a proxy for managerial rent extraction, is larger for firms with material weaknesses in internal control. As such, one can expect managers' misappropriation of corporate resources to be greater among firms with ineffective internal control.[7] Some anecdotal evidence also suggests that ineffective internal control can lead to a lax environment facilitating the diversion of company resources by top management through related party transactions. See the material weakness disclosure by Hollinger International Inc. in its 10-Q report for the quarter ending June 30, 2004 for an example.[8] Ineffective internal control can hence increase the likelihood that inputs available for production are diverted for managers' personal consumption, reducing the outputs generated for a given initial amount of inputs and leading to lower operational efficiency.

Furthermore, material weaknesses in the form of inadequate physical security allow the misappropriation of inputs by employees, and inadequate segregation of duties or inadequate documentation, policies or other means of justifying account balances allow for the alteration of recorded amounts by employees, all of which can have a detrimental effect on the input-output relationship. MGP Ingredients Inc. provides a vivid description of the issue in its 10-K for the fiscal year ending December 31, 2005.[9] Essentially, the lack of proper control over the physical

[7] Similarly, Ashbaugh-Skaife et al. (2009) argue that ineffective internal control over information and assets within the firm can adversely affect firms' real decisions including the misappropriation of firm assets by management, thus reducing the expected value of cash flows to investors.

[8] The company disclosed, among others, the following material weaknesses: (i) the "tone from the top" established by the former executive officers was inappropriate to the establishment of an environment in which strong systems of internal controls and disclosure controls and procedures are encouraged, (ii) the management and corporate organizational structures facilitated extraction of assets from the company by way of related party transactions to benefit direct and indirect controlling stockholders, (iii) common directorships, among certain former executive officers, at the company and its direct and indirect parent companies and their affiliates, facilitated inappropriate related party transactions between the company and those entities, and (iv) clear and appropriate policies for the identification, reporting, approval and disclosure of related party and other significant transactions did not exist.

[9] Specifically, the company disclosed that "Physical security over maintenance materials, electrical materials and chemicals at the Atchison, Kansas facility is not adequate to ensure that items removed from the facilities are documented in accordance with Company policy. This could result in unauthorized or undocumented removal of such materials. As a result, financial statement presentation of such items could be affected, particularly our interim statements in connection with which we do not perform physical inventories at period end….All modules of our computerized purchasing and maintenance system are accessible to various employees with access to the system, which includes purchasing, receiving, maintenance and administrative employees. Unlimited access to a system of this type could allow an individual to establish fictitious vendors, purchase items for other than business use and

security of inputs can lead to wastage and pilferage, hence resulting in higher input costs. In addition, MGP's material weaknesses relating to the controls over the purchase and maintenance of materials and supplies can result in inputs not being procured at the lowest possible costs (hence increasing input costs) or inputs being procured at a more inferior quality (hence leading to lower sales), both of which result in lower operational efficiency for the firm.

Second, ineffective internal control can lead to erroneous internal management reports and thus lower firm operational efficiency. For example, material weaknesses relating to information technology can impair a firm's ability to capture, process and record raw transactional data corresponding to economic events, resulting in errors in internal management reports. Consistent with this notion, Feng et al. (2009) find that material weaknesses in internal control affect the financial inputs to management guidance and they document less accurate guidance among firms reporting ineffective internal control.[10] The authors further argue that "…..beyond issuing guidance, the internal management reports are also the basis for managers to make many day-to-day operational decisions. Hence, our findings on the effect of internal control quality on management guidance have potential implications for other management decisions based on internal reports."

These discussions suggest that erroneous internal management reports can have

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cover up errors that occur within the system. Invoices are not consistently reviewed and approved by someone other than individuals placing the order with the vendor. Further, our personnel have sometimes failed to use or maintain required requisition forms in the purchase of maintenance, electrical and chemical type items. These practices could result in unauthorized and undocumented purchases."

[10] To illustrate how ineffective internal controls can lead to erroneous internal reports, Feng et al. (2009) provide the example of a material weakness disclosed by Dana Corp. in the 10-K for the fiscal year ending December 31, 2005. Specifically, Dana Corp. disclosed that "Our financial and accounting organization was not adequate to support our financial accounting and reporting needs. Specifically, lines of communication between our operations and accounting and finance personnel were not adequate to raise issues to the appropriate level of accounting personnel and we did not maintain a sufficient complement of personnel with an appropriate level of accounting knowledge, experience and training in the application of GAAP commensurate with our financial reporting requirements. This control deficiency resulted in ineffective controls over the accurate and complete recording of certain customer contract pricing changes and asset sale contracts (both within and outside of the Commercial Vehicle business unit) to ensure they were accounted for in accordance with GAAP."

implications for firm operational efficiency. For example, ineffective internal control can adversely affect the firm's ability to forecast sales, which in turn can adversely affect managers' production decisions for the next period.[11] Over-forecasting of sales can result in overprovision of productive inputs and consequently increased costs in the form of inventory obsolescence, storage, idle capacity, redundant manpower, and wastage of resources. On the other hand, under-forecasting of sales can result in under-provision of productive inputs that may eventually lead to increased costs in the form of rushed overtime work to produce the inventory or last minute sourcing of potentially more expensive raw materials. In both cases, cost inefficiency arises because higher input costs are incurred for a given amount of outputs. Hence, ineffective internal control can result in operational inefficiency by impairing the quality of internal reports which lead to poorer decision making.

The above discussion leads to our first hypothesis (in alternative form):

H1: There is a negative association between firm operational efficiency and material weaknesses in internal control.

Notwithstanding the above arguments, there are two reasons why we may not find results consistent with H1. First, internal control cannot provide absolute assurance due to its inherent limitations. In its guidance to management regarding the evaluation and assessment of internal control over financial reporting, the SEC states that "internal control is a process that involves human diligence and compliance and is subject to lapses in judgment and breakdowns resulting from human failures. It also can be circumvented by collusion or improper management override (SEC 2007)." Furthermore, the American Institute of Certified Public Accountants (AICPA), in

[11] Feng et al. (2009) find that ineffective internal control leads to less accurate earnings forecast. Given that prior studies argue that sales and cost of goods sold are very important inputs to a manager's earnings forecast (e.g., Lundholm and Sloan 2006; Fairfield et al. 1996), it is reasonable to assume that ineffective internal control would lead to less accurate sales forecasts. Consistent with this notion, Cassar and Gibson (2008) find that small privately held firms that have effective internal accounting reporting and budgeting processes in place tend to make more accurate revenue forecasts.

its guidance to audit committees in addressing the risk of fraud through management override of internal control, notes that "even though internal control over financial reporting may appear to be well-designed and effective, controls that are otherwise effective can be overridden by management in every entity (AICPA 2005)." Management override is very difficult to detect because they are typically not documented or disclosed due to the intent to cover up the actions (AICPA 2005; COSO 2013).[12] Hence, to the extent that internal control has inherent limitations and managers are able to circumvent or override internal control to facilitate consumption of private benefits, internal control might not be able to constrain the misappropriation of corporate resources and improve operational efficiency.[13]

Second, because the intended objective of SOX 404 is to improve the reliability of the firm's *external* reports so as to enhance the decision making of external users (PCAOB 2004; Donaldson 2005), few have envisaged the importance or potential benefits of ICFR for internal users. Hence, it is possible that while managers understand the implications of ICFR for external reporting, they may not recognize the same for internal reporting. Consistent with this notion, based on a survey of 2,901 corporate insiders to assess the costs and benefits of complying with Section 404, Alexander et al. (2013) find that managers do not believe that this regulation can improve the efficiency of their firms' operations. If this is the case, the hypothesized benefits of effective internal control on operational efficiency may not materialize.

As a result, whether we can find results consistent with H1 is an empirical question.

[12] According to COSO (2013), management override refers to actions taken to override an entity's controls for illegitimate purposes, including personal gain or an enhanced presentation of an entity's financial condition or compliance status. For example, to allow a large shipment of goods to a customer with unacceptable credit in order to increase revenue, a manager might improperly override internal control by approving the sale transaction.

[13] It is possible that firms have material weaknesses in their internal control, but they are not reported either because management and the auditor do not detect the weakness, or they detect it but opt not to disclose it (Ashbaugh-Skaife et al. 2007; Rice and Weber 2012). This omission will bias against finding results consistent with H1.

2.3 Cross-sectional analyses: H2 and H3

In this section, we develop additional hypotheses to shed light on the mechanisms through which internal control effectiveness affects operational efficiency. In the hypothesis development above, we argue that effective internal control leads to greater operational efficiency through (1) reducing the likelihood of misappropriation of corporate resources and (2) enhancing the quality of internal reports, which in turn leads to better decision making. Thus, we identify circumstances where each of the two mechanisms is particularly relevant and important.

Related to the first channel, we hypothesize that for firms that have more opportunities for asset misappropriation, effective internal control should play a more important role in preventing the diversion of resources by managers or employees. Consequently, we should observe a stronger negative association between operational efficiency and material weaknesses in internal control for these firms. Prior research suggests two conditions under which the misappropriation of corporate resources is more likely to occur. First, Myers and Rajan (1998) argue that liquid assets are more difficult to trace and are easier to divert for private consumption than other assets, making them more vulnerable to extraction. Consistent with this notion, Caprio et al. (2013) find that in countries where the threat of political extraction is higher, firms hold a lower fraction of their assets in liquid form. Second, Bushman et al. (2004) argue that firms competing in multiple geographic regions face more complex operational and informational environments, and therefore require more monitoring activities to alleviate moral hazard problems. Bodnar et al. (1999) also contend that coordinating activities of different parts of the firm and delegating resources and authority to geographically diverse locations can increase agency costs and make monitoring more difficult and costly. Hence, we expect the opportunities for misappropriation of resources to be greater for firms with more liquid assets and multiple geographic regions.

The above discussion leads to our second hypothesis:

H2: The negative association between firm operational efficiency and material weaknesses in internal control, as hypothesized in H1, is stronger for firms with more liquid assets and for firms with greater geographical diversification.

For the second channel, we exploit settings in which there is a greater demand for higher quality internal reports for decision making. We conjecture that for firms that operate in more volatile business environments or in poorer information environments, the managers can benefit more from accurate internal reports for budgeting, resource allocation, and capital investments. Supporting this notion, prior studies find that greater uncertainty creates a need for more information and hence the use of management accounting systems (e.g., Gordon and Narayanan 1984; Davila and Foster 2005). For example, Cassar and Gibson (2008) document a significant positive association between internal accounting report preparation and revenue forecast accuracy and this effect is driven mainly by firms with high information uncertainty. Hence, we should observe a stronger negative association between operational efficiency and internal control material weaknesses for firms with more uncertain business environments or poorer information environments.

The above discussion leads to our third hypothesis:

H3: The negative association between firm operational efficiency and material weaknesses in internal control, as hypothesized in H1, is stronger for firms with more uncertain business environments and poorer information environments.

3 Research design

3.1 Sample selection

Panel A of Table 1 summarizes the sample selection procedure. From *Audit Analytics*, we first identify a sample of 32,897 firm-year observations (6,593 unique firms) with a SOX 404 disclosure in the period 2004-2011. We exclude 13,158 firm-year observations that are from financial industries, 180 firm-year observations with missing data to measure firm efficiency,

and 2,138 firm-year observations with missing data on other variables used in the analyses. The final sample consists of 17,421 firm-year observations representing 3,907 unique firms.

Panel B of Table 1 shows the sample distribution of firm-year observations with ineffective ICFR over time. Over the period 2004 to 2011, 8.10% of the observations have ineffective ICFR. However, there is a declining trend in the proportion of firm-year observations with ineffective ICFR, dropping from 17.77% in 2004 to 4.08% in 2011.

3.2 Measuring operational efficiency

As mentioned earlier, we use DEA to create a measure of firm operational efficiency (*EFFICIENCY*). It measures operational efficiency by creating an efficient frontier of production based on an optimization programming to maximize a ratio of outputs to inputs. This approach produces an ordinal ranking by measuring the relative efficiency of a firm compared to those firms located on the efficient frontier (i.e., the firms that produce the maximum level of outputs given the level of inputs or use the minimum level of inputs given the level of outputs). After solving an optimization programming for each firm within an estimation group, DEA analysis standardizes efficiency scores so that the most (least) efficient firms are assigned a value of one (zero). The advantage of the DEA approach is that it is a nonparametric method and one does not need to impose a specific functional form for the relationship between outputs and inputs or assign a priori factor weightings on inputs since the optimal weightings are derived from the data. See Cooper et al. (2000) for detailed discussion of the DEA method.

In this study, we follow Demerjian et al. (2012) and other related studies in estimating operational efficiency. Because efficiency measures are derived based on the relation between inputs and outputs, it is critical to choose inputs and outputs that adequately describe a firm's production function. Prior research uses sales revenue as the output variable because it is a

primary source of earnings and cash flows generated from firms' operating activities (Verma 1993; Thore et al. 1994; Demerjian et al. 2012). As in Demerjian et al. (2012), we use seven input variables: (i) net property, plant and equipment (PP&E), (ii) cost of goods sold (COGS), and (iii) selling, general, and administrative costs (SG&A), (iv) capitalized operating leases, (v) capitalized research and development (R&D) costs, (vi) purchased goodwill, and (vii) other intangibles. These seven inputs capture, to a large degree, the choices managers make in generating revenue. The five stock variables (PP&E, capitalized operating leases, capitalized R&D costs, purchased goodwill, and other intangibles) are measured at the beginning of the year, and the two flow variables (COGS and SG&A) are measured over the year. Following Demerjian et al. (2012), we estimate *EFFICIENCY* by industry (Fama and French (1997) industry classification) to increase the comparability of business models and cost structures among peer firms.[14] Appendix A provides details of the estimation process.

3.3 Regression model

To test the relation between internal control effectiveness and firm operational efficiency, we estimate the following regression:

$$EFFICIENCY_{it} = \alpha + \beta ICMW_{it} + \varphi EFFICIENCY\_CONTROLS_{it} + \gamma IC\_CONTROLS_{it} + \varepsilon_{it} \quad , (1)$$

where $EFFICIENCY_{it}$ refers to our measure of operational efficiency, $ICMW_{it}$ is an indicator variable that equals one if firm *i* discloses internal control material weaknesses in year *t*, and zero otherwise. H1 predicts the coefficient on $ICMW_{it}$ to be negative.

EFFICIENCY_CONTROLS refers to the determinants of operational efficiency. We follow

[14] Demerjian et al. (2012) note that one limitation of using the Fama and French (1997) industries is that most firms operate in several industries. Even within the same industry, the relation between the accounting inputs and outputs can vary substantially depending on firms' asset and operations mix. We acknowledge that this estimation procedure does not allow us to control for differences in accounting policies among firms within the same industry. However, as argued in Demerjian et al. (2012), this limitation likely introduces noises to the operational efficiency measure, and we do not have strong reason to believe that it will introduce systematic bias to our analyses.

Demerjian et al. (2012) in selecting determinants of firm operational efficiency. First, larger firms and firms with higher market share are usually more effective than others in negotiating terms with suppliers and customers. Hence, we include the log of total assets (*LOG_TA*) and the percentage of revenues earned by a firm within its Fama and French (1997) industry (*MKTSHARE*). Second, we control for free cash flow (*FCF*) because managers in firms with greater positive free cash flows are able to pursue positive net present value projects more effectively. Third, we include firm age (*LOG_AGE*) because the life cycle of a firm can affect management's opportunity set of possible projects as well as the required start-up costs of investments. Finally, operating in multiple industries and/or countries requires a broader knowledge set and reduces the amount of attention management pays to any single industry, hence reducing managers' ability to efficiently allocate capital. We control for firm diversification using the Herfindahl index for business segment concentration (*CONCENTRATION*) and an indicator variable signifying foreign operations (*FOREIGN*).

Prior studies suggest that firms with material weaknesses systematically differ from firms with effective internal control (e.g., Ashbaugh-Skaife et al. 2007; Doyle et al. 2007b). Thus, we include the determinants of internal control effectiveness *(IC_CONTROLS)* to control for their effect on operational efficiency. Specifically, firms with ineffective internal control tend to be smaller, poorly performing, subject to greater accounting measurement application risks, more complex, involved in mergers and acquisitions or restructuring, operating in a more litigious industry, audited by Big N auditors, and involved in an auditor change. Hence, *IC_CONTROLS* includes an indicator variables for loss firms (*LOSS*), the amount of inventory relative to total assets (*INVENTORY*),[15] the number of reported business and geographic segments

[15] According to Ashbaugh-Skaife et al. (2007), rapidly growing firms and firms with higher inventory levels are subject to greater accounting measurement application risks. Specifically, rapidly growing firms are more likely to

(*SEGMENTS*), firms involved in mergers and acquisitions (*MERGER*) or restructuring (*RESTRUCTURE*), firms operating in a litigious industry (*LITIGATION*), an indicator variable for rapid sales growth (*EXTREME_GROWTH*), firms audited by a Big 4 auditor (*BIG4*), and firms that have changed auditors in the fiscal year (*AUD_CHANGE*).

Appendix B includes the detailed definition of all variables. All p-values are based on the standard errors adjusted for firm- and year-clustering (Petersen 2009).

3.4 Descriptive statistics

Panel A of Table 2 reports the distribution of *EFFICIENCY* for the full sample and then by industry. The average efficiency score is 0.374.[16] As in previous studies (e.g., Demerjian et al. 2012), we observe a substantial variation in efficiency across industries; the mean ranges from 0.012 to 0.855.[17] Hence, we include industry fixed effects in all our analyses to control for inter-industry differences in operational efficiency. Panel B of Table 2 reports the mean firm efficiency and the number and percentage of firms that are on the efficient frontier by year. While there is some year-to-year variation in the efficiency score over the sample period, the variation is relatively small.[18]

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have systems that fail to keep pace with increases in customer demand or entry into new markets. They are also more likely to encounter staffing issues as the scope and complexity of their operations expand. Firms with more inventory face increased internal control risks related to the proper measurement and recording of inventory, misreporting due to theft, and timely recognition of inventory obsolescence.

[16] This average efficiency score is lower than that of 0.57 in Demerjian et al. (2012) and that of 0.79 in Baik et al. (2013). However, these studies use the data from a much longer period than our study and thus are not directly comparable.

[17] We also observe that the percentage of firms that are on or close to the efficient frontier differs across industries. For example, 0.3% (6.0%) of firms have an efficiency score greater than or equal to 0.9 in 'Drugs' ('Paper') industry (untabulated). Prior studies suggest that such inter-industry variation could be due to the competitiveness of the industry and the number of observations available for the estimation of the efficiency frontier. In our sample, small industries generally have a higher concentration of firms on or close to the efficient frontier. We address the inter-industry variation by including industry fixed effects in the main analysis and by estimating the regression by industry in a sensitivity test.

[18] The first-order autocorrelation of the DEA score is 0.88 (untabulated), comparable to that of 0.84 documented in Baik et al. (2013). Although this suggests that operational efficiency is sticky over time, we argue that material weaknesses in internal control can result in significant changes in operational efficiency. To the extent that our DEA measure is sticky over time, this should bias against finding significant result. In addition, in Section 5.1, we conduct

Panel C of Table 2 presents the descriptive statistics on *EFFICIENCY* and firm characteristics, separately for firm-years with internal control material weakness and those without. The mean *EFFICIENCY* is significantly lower for firm-year observations with ineffective internal control (0.350) than for those with effective internal control (0.377). This result provides preliminary evidence on the negative association between internal control material weaknesses and operational efficiency. Among the determinants of operational efficiency, we find that firms with ineffective internal control are smaller, younger, have lower market share, lower free cash flows, and are less likely to have foreign operations. For the determinants of internal control effectiveness, we find that firms with ineffective internal control are more likely to be experiencing losses, undergoing restructuring, operating in a litigious industry, experiencing extreme sales growth, audited by a Big 4 auditor, and involved in an auditor change. These results are generally consistent with prior studies.

Panel D of Table 2 presents correlations among firm operational efficiency, internal control material weaknesses, and control variables. As predicted, the correlation between *EFFICIENCY* and *ICMW* is significantly negative. Most of the control variables are significantly correlated with *EFFICIENCY*. An analysis of variance inflation factors (untabulated) suggests that our multivariate analyses are not subject to multicollinearity concerns.

4 Empirical results

4.1 Internal control material weaknesses and firm operational efficiency

Table 3 presents the regression results on the association between internal control material weaknesses and firm operational efficiency. The model in Column (1) only controls for the determinants of operational efficiency. We find that the coefficient on *ICMW* is negative and

a change analysis to examine whether the changes in internal control effectiveness are associated with the changes in operational efficiency.

significant (p = 0.001), indicating that operational efficiency is lower for firm-years with ineffective internal control. The coefficients on the operational efficiency determinants suggest that operational efficiency is higher for larger firms, older firms, firms with more free cash flows, and firms with higher business segment concentration, but lower for firms with higher market share.

Column (2) of Table 3 presents the result after further including the determinants of internal control effectiveness. The coefficient on *ICMW* continues to be significantly negative (p = 0.003). Column (2) also indicates that operational efficiency is lower for firms that have poorer performance and firms that undergo restructuring, but higher for firms that have more inventories, firms that are involved in mergers and acquisitions, and firms that experience high sales growth.

We conduct a series of robustness checks and do not tabulate the results for brevity reasons. The inferences based on these analyses remain the same. First, it is possible that firms with lower operational efficiency have poorer financial performance (Baik et al. 2013), which in turn increases the likelihood of internal control problems (Ashbaugh-Skaife et al. 2007; Doyle et al. 2007b). To control for this reverse causality, we employ the Heckman (1979) two-stage procedure. In the first stage, we estimate a probit regression of the likelihood of having an *ICMW* on the determinants (i.e., *IC_CONTROLS*). From this regression, we calculate the inverse Mills ratio *LAMBDA* and include it in Equation (1) when conducting the second-stage analysis. Second, we re-estimate Equation (1) by controlling for lagged return on assets and operational efficiency. Third, to make the efficiency score more comparable over time and across industries and to mitigate the influence of extreme observations, we re-estimate Equation (1) using the decile rank of *EFFICIENCY* by year and industry. Fourth, in an alternative approach to control

for industry fixed effects, we use the Fama and Macbeth (1973) approach to estimate our regression by industry. Fifth, we follow Baik et al. (2013) and measure operational efficiency using only three input variables: (i) net property, plant and equipment, (ii) cost of goods sold, and (iii) selling, general, and administrative costs. Finally, we use an alternative measure of operational efficiency derived from Stochastic Frontier Analysis (SFA), which is a parametric approach to model the relationship between outputs and inputs.[19] We use the same seven inputs used in the DEA measure and estimate a SFA model for each industry group (see Appendix A for details).

4.2 Cross-sectional analyses: Tests of H2 and H3

We use the following regression model to test H2 and H3:

$$EFFICIENCY_{it} = \alpha + \beta ICMW_{it} + \lambda ICMW \times Appropriation_{it} + \delta Appropriation_{it} + \varphi EFFICIENCY\_CONTROLS_{it} + \gamma IC\_CONTROLS_{it} + \varepsilon_{it} \quad (2')$$

$$EFFICIENCY_{it} = \alpha + \beta ICMW_{it} + \lambda ICMW \times Information_{it} + \delta Information_{it} + \varphi EFFICIENCY\_CONTROLS_{it} + \gamma IC\_CONTROLS_{it} + \varepsilon_{it} \quad (2'')$$

where *Appropriation* are proxies for the ease of misappropriation of corporate resources, *Information* are proxies for the demand for higher quality internal reports for decision making, and all other variables are defined as before.

To test H2, we use two proxies to capture the ease of asset misappropriation. Our first proxy is the amount of the liquid assets (*LIQUID*), defined as current assets divided by total assets. Our second proxy is the number of geographical segments reported by the firm (*GEO_SEGMENTS*). To mitigate the effect of extreme values and to facilitate result interpretation, we use standardized decile ranks of the variables by industry. Panel A of Table 4

[19] The advantage of using a parametric method such as SFA is to allow random shocks in the production process in measuring efficiency. However, unlike DEA, to use the SFA model, one has to specify a specific functional form for the relation between inputs and outputs and distributional assumption on the random error term, which could be arbitrary (e.g., Stone 2002).

presents the regression results. As reported in the table, the coefficient on *ICMW* × *LIQUID* is negative and marginally significant (p = 0.141), implying that the operational inefficiency associated with material weaknesses is more pronounced for firms with more liquid assets. Similarly, the coefficient on *ICMW* × *GEO_SEGMENTS* is negative and significant (p = 0.060). This result indicates that when firms have more geographical segments, it becomes more difficult to monitor the misappropriation of resources, exacerbating the adverse effects of material weaknesses on operational efficiency. Overall, these cross-sectional results show that in settings where the managers and other employees have more opportunities for misappropriation of corporate resources, the effect of internal control on firm operational efficiency is stronger. This finding is consistent with our conjecture that effective internal control leads to greater operational efficiency by reducing the likelihood of misappropriation of corporate resources.

To test H3, we use three proxies to capture the business environment uncertainty and the quality of the firm's information environment, and hence the demand for higher quality internal reports for decision making. Our first proxy is operating cash flow volatility (*OCFVOL*). Unstable market conditions likely affect a firm's cash flow generating abilities and lead to greater volatility in operating cash flow (Gong et al. 2009). *OCFVOL* is measured as the standard deviation of operating cash flow divided by total assets in the past five years. Our second proxy is analyst forecast error (*AF_ERROR*). Much of the information that the analysts use comes from the firm, and the accuracy of the analyst forecast reflects the quality of the firm's information environment (Lang and Lundholm 1996). Furthermore, analysts are likely to face greater difficulty in forecasting earnings of firms that operate in more volatile and uncertain business environments, which can lead to greater forecast errors. *AF_ERROR* is measured as the absolute difference between the analyst consensus forecast and actual earnings per share, divided by the

stock price at beginning of the year. Our third proxy is the corporate opacity index (*OPACITY*), as developed in Anderson et al. (2009), which is based on the number of analysts following, analyst forecast error, trading volume, and bid-ask spread.[20] We use standardized decile ranks of each of these variables by industry to mitigate the effect of extreme values.

Panel B of Table 4 reports the regression results. We find that the coefficients on *ICMW* × *OCFVOL*, *ICMW* × *AF_ERROR*, and *ICMW* × *OPACITY* are all significantly negative (p = 0.043, 0.010, and 0.077, respectively). These results indicate that the negative effect of material weaknesses on operational efficiency is greater for firms with higher operating cash flow volatility, greater analyst forecast error, and higher corporate opacity. To the extent that these proxies capture managers' demand for higher quality information for decision making, our result is consistent with effective internal control resulting in greater operational efficiency through enhancing the quality of internal reports.

Overall, the above results indicate that the effectiveness of internal control is particularly important for firms that are subject to more severe asset misappropriation and for firms with higher information uncertainty. These results suggest that effective internal control leads to greater operational efficiency through reducing the likelihood of misappropriation of corporate resources and through enhancing the quality of internal reports for decision making.

5 Additional analyses

5.1 Change analysis using the sample of firms with material weaknesses

To provide further evidence on the link between internal control effectiveness and operational efficiency, we conduct a change analysis using the sample of firms with material

[20] Specifically, Anderson et al. rank or categorize these four individual variables into deciles with the most opaque firms taking a value of ten and the least opaque firms assuming a value of one. The four rankings are then summed and scaled by a factor of 40 (total possible points) to provide an index that ranges from 0 to 1. Lower values denote more transparent firms and higher values denote more opaque firms.

weaknesses in the sample period. The advantage of a change analysis is that it uses the same firm as its own control and thus mitigates the omitted correlated variable concern by controlling for time-invariant firm characteristics. Specifically, we examine whether the changes in internal control effectiveness are associated with the changes in operational efficiency in a way consistent with the levels regression results documented earlier:

$$\Delta EFFICIENCY_{it} = \alpha + \beta_1 \Delta ICMW_{it} + \varphi \Delta EFFICIENCY\_CONTROLS_{it} + \varepsilon_{it} \quad (3')$$

$$\Delta EFFICIENCY_{it} = \alpha + \gamma_1 IC\_WORSE_{it} + \gamma_2 IC\_BETTER_{it} + \varphi \Delta EFFICIENCY\_CONTROLS_{it} + \varepsilon_{it} \quad (3'')$$

where $\Delta EFFICIENCY_{it}$ refers to the change in operational efficiency from year t-1 to t, $\Delta ICMW_{it}$ refers to the change in internal control material weakness dummy from year t-1 to t,[21] IC_WORSE_{it} is an indicator variable that equals 1 if the firm reports no material weaknesses in year t-1 but reports material weaknesses in year t, and zero otherwise, IC_BETTER_{it} is an indicator variable that equals 1 if the firm reports material weaknesses in year t-1 but reports no material weaknesses in year t, and zero otherwise, $\Delta EFFICIENCY\_CONTROLS_{it}$ refers to the changes in the determinants of operational efficiency from year t-1 to t, except for firm age and the indicator variable for foreign operations in which the changes are constants and are thus excluded from the analyses.

Columns (1) and (2) of Table 5 present the regression results of estimating Equations (3') and (3"), respectively. Despite the small sample, the inferences are similar to those based on Table 3. In Column (1), we find that the coefficient on $\Delta ICMW$ is significantly negative (p = 0.008), indicating that the improvement in internal control effectiveness is positively associated with the change in operational efficiency and/or the deterioration in internal control effectiveness

[21] That is, $\Delta ICMW$ equals 1 if the firm reports no material weaknesses in year t-1 but reports material weaknesses in year t, 0 if the firm does not experience any changes in the effectiveness in internal control, and -1 if the firm reports material weaknesses in year t-1 but reports no material weaknesses in year t.

is negatively associated with the change in operational efficiency. In Column (2), we find that the coefficient on *IC_WORSE* is significantly negative (p = 0.023), while the coefficient on *IC_BETTER* is significantly positive (p = 0.007). These results indicate that a deterioration (improvement) in the effectiveness of internal control is associated with a decrease (increase) in operational efficiency. Taken together, the change analyses results are consistent with those reported in Section 4.1 and provide further evidence on the negative association between ineffective internal control and operational efficiency.

5.2 Is the effect of internal control effectiveness on operational efficiency larger for small firms?

As mentioned in the introduction, it has been widely documented that smaller firms experience a disproportional amount of costs for implementing SOX. However, there is little evidence on the differential benefits of SOX 404 for these firms. Because small firms tend to have less well-defined internal control processes and less clear segregation of duties (Ashbaugh-Skaife et al. 2007; Doyle et al. 2007b; Gao et al. 2009), they are more susceptible to agency problems and managerial rent seeking behaviour. In this subsection, we examine whether smaller firms disproportionally gain from having effective internal control in terms of operational efficiency.

We re-estimate Equation (2') by replacing *Appropriation* with *MVE*, which is the firm's market capitalization at the end of the second quarter in the year of SOX 404 disclosure (Gao et al. 2009). Again, we use the standardized decile ranks in the industry to facilitate result interpretation and to mitigate the effect of extreme values. Column (1) of Table 6 reports the regression results. The coefficient on *ICMW* × *MVE* is significantly positive (p = 0.072). This finding suggests that the problem of material weakness is particularly severe for small firms, or in other words, the positive effect of effective internal control on operational efficiency is

stronger for smaller firms.

Because firms with market capitalization under $75m are permanently exempt from SOX 404 compliance under the Dodd-Frank Act and regulators are contemplating extending the exemption to all firms with market capitalization below $250 million, we further examine the differential effect of internal control on operational efficiency for these two sets of firms. For this purpose, we replace *MVE* with either *D_75million* or *D_250million*, which are indicator variables that equal 1 for firms with market capitalization below $75 million and below $250 million, respectively, and 0 otherwise. Column (2) of Table 6 shows that the coefficient on *ICMW* × *D_75million* is negative, although insignificant (p = 0.166), while Column (3) shows that the coefficient on *ICMW* × *D_250million* is significantly negative (p = 0.078). Finally, we re-run the regression by replacing *MVE* with *D_75million* and *D_75-250million*, the latter of which is an indicator variable that equals 1 for firms with market capitalization between $75 million and $250 million. The results presented in Column (4) show that the coefficient on *ICMW* × *D_75million* is negative and insignificant (p = 0.138), but the coefficient on *ICMW* × *D_75-250million* is negative and significant (p = 0.097).

Overall, these results suggest that small firms, especially those with market capitalization between $75million and $250 million likely benefit more in terms of improved operational efficiency from effective internal control. We believe that these findings can be potentially informative to the SEC, managers, and investors and are relevant to the Congress as further exemptions from SOX 404 are debated.

5.3 Does the market understand the implications of ineffective internal control on operational efficiency

Prior studies document that investors react negatively to the disclosure of material weaknesses and usually attribute the negative market reaction to the firm's lower financial

reporting quality (Hammersley et al. 2008; Beniesh et al. 2008). Given the above-mentioned results, it is possible that the negative market reaction is partly due to investors' concerns that material weaknesses would harm the firm's operational efficiency and hence future profitability. To provide evidence on whether the market understands the implications of ineffective internal control on the firm's operational efficiency, we estimate the following regression:

$$EFFICIENCY_{it} = \alpha + \beta ICMW_{it} + \lambda ICMW \times CAR_{it} + \\ + \varphi EFFICIENCY\_CONTROLS_{it} + \gamma IC\_CONTROLS_{it} + \varepsilon_{it} \quad , \qquad (4)$$

where *CAR* is the three day size-adjusted (*CAR_1*) or market-adjusted abnormal returns (*CAR_2*) surrounding the date of disclosure of material weaknesses, and all other variables are defined as before. We use the standardized decile ranks of *CAR* by industry to mitigate the effect of extreme values.

Table 7 presents the regression results. We find that the coefficients on *ICMW*×*CAR* are significantly positive ($p < 0.05$), implying that within firms with internal control material weakness, those with more negative market reaction experience a larger deterioration in operational efficiency. This result is consistent with the disclosure of material weaknesses under SOX 404 conveying information about the firm's operational efficiency to investors, and investors react negatively to the disclosure due to concerns that material weaknesses would harm the firm's operational efficiency and hence future profitability. Hence, the market appears to understand the implications of ineffective internal control on operational efficiency.

5.4 Analysis of future firm performance and stock returns

Although our results thus far suggest that firms with more effective internal control have greater operational efficiency, it is not clear how this benefit translates into real monetary terms. Focusing on the sample of material weakness firms, we examine in this section whether the improvement in internal control is accompanied by a subsequent improvement in the operating

performance, measured by return on assets (*ROA*). We define *ROA* as income before extraordinary items scaled by average total assets and calculate abnormal *ROA* using a matched-firm approach, as suggested by Barber and Lyon (1996). For each material weakness firm-year, we select a firm in the same industry (Fama-French industry classification) that has the closest *ROA* in the same year.[22]

Table 8 presents the findings of our tests of the relation between changes in internal control effectiveness and abnormal *ROA* in years t+1 and t+2. In Panel A, we provide results for firms that remediate their weaknesses in year t+1 (remediating firms) and those that do not (non-remediating firms). We find that future *ROA* for the non-remediating firms is significantly lower than that for their corresponding matched firms. In the first and second year after the disclosure of material weakness, non-remediating firms significantly underperform their matched firms in *ROA* by a mean of 3.2 and 8.6 percent, respectively. In contrast, the remediating firms have similar ROA after the remediation as their corresponding matched firms.

To investigate whether an improvement in operational efficiency leads to better *ROA* for the remediating firms, we further split the sample of remediating firms into those that have positive or negative changes in their operational efficiency from year t to t+1 (t+2). Panel B shows that remediating firms with positive changes in operational efficiency significantly outperform their matched firms in *ROA* by a mean of 2.4 percent (5.0 percent) in year t+1 (t+2). On the other hand, remediating firms with negative changes in operational efficiency significantly underperform their matched firms in *ROA* by a mean of 4.1 percent (3.1 percent) in year t+1 (t+2). Taken together, the results in Table 8 indicate that the improvement in internal control leads to better subsequent operating performance and this is mainly attributable to the

[22] For material weakness firm-years that we are unable to find a match using this approach, we choose a firm with the closest *ROA* in the same year without restrictions on industry membership, as suggested by Barber and Lyon (1996). The results are quantitatively similar if we do not include these additional observations.

improvement in operational efficiency.

We obtain qualitatively similar results when we examine whether the improvement in internal control effectiveness is associated with future stock returns. Using a similar methodology, we obtain the abnormal returns (*RETURNS*) for the first and second year after the disclosure of the material weakness. Panel A of Table 9 reports the abnormal returns for the remediating and non-remediating firms. We find that in the first and second year after the disclosure of material weaknesses, non-remediating firms significantly underperform their matched firms in stock returns by a mean of 10.0 and 12.5 percent, respectively. In contrast, the returns for the remediating firms experience similar stock returns as their corresponding matched firms. In Panel B, we examine abnormal returns for the remediating firms by whether they experience positive or negative changes in operational efficiency from year t to t+1 (or t+2). We find that remediating firms with positive changes in operational efficiency from year t to t+1 (t+2) significantly outperform their matched firms in stock returns by a mean of 8.5 percent (7.4 percent) in year t+1 (t+2). On the other hand, remediating firms with negative changes in operational efficiency significantly underperform their matched firms in stock returns by a mean of 14.6 percent in year t+1.

Overall, the results in Tables 8 and 9 indicate that maintaining effective internal control helps firms achieve better operating performance and stock returns by improving their operational efficiency.

6 Conclusion

In this paper, we examine whether effective internal control has implications on firm operational efficiency. Using a sample of firms that reported internal control opinions under SOX 404 during the period 2004-2011 and the frontier analysis method to measure operational

efficiency, we find that operational efficiency is significantly lower in firms disclosing material weaknesses in internal control than in other firms. This finding holds after controlling for factors associated with operational efficiency and determinants of material weaknesses. The result is robust to a battery of sensitivity checks.

We also conduct additional analyses, which provide several important insights. First, the cross-sectional analyses suggest that effective internal control leads to greater operational efficiency through (1) reducing the likelihood of misappropriation of corporate resources and (2) enhancing the quality of internal reports, which leads to better operational decisions. Second, we find some evidence that smaller firms (particularly those with market capitalization between $75 million and $250 million) benefit more from having effective internal control in terms of operational efficiency. Third, we find that within firms with material weaknesses, those with more negative market reaction experience a larger deterioration in operational efficiency. This finding indicates that the negative market reaction to the disclosure of material weaknesses is partly due to investors' concerns that internal control weaknesses can harm the firm's operational efficiency. Finally, we find that among the firms with material weaknesses, the remediation of material weaknesses is followed by an improvement in operating performance and stock returns, and this effect is mainly driven by the improvement in operational efficiency.

Overall, our study documents that effective internal control not only helps external users make more informed decision but also enhances firms' internal operations. This finding complements an emerging literature that examines the implications of internal control beyond financial reporting (e.g., Cheng et al. 2013; Feng et al. 2013; Bauer 2013). It also informs the debate on the costs versus benefits of SOX 404 reporting, which is relevant and timely given that regulators have recently grant non-accelerated filers permanent exemption from SOX 404 under

the Dodd-Frank Act on grounds of high compliance cost and are currently contemplating to extend the exemption to firms with market capitalization between $75 million and $250 million. The greater operational efficiency achieved from having effective internal control can partially offset the compliance costs of SOX 404.

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Appendix A Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) approaches for measuring operational efficiency

The DEA approach is a nonparametric method to evaluate the relative efficiency of decision-making units (DMUs) which produce outputs such as sales revenue using some inputs such as capital and labor. DEA efficiency is derived from the following optimization programming to maximize a ratio of outputs to inputs:

$$\frac{\sum_{i=1}^{n} \alpha_i y_{ik}}{\sum_{j=1}^{m} \beta_j x_{jk}} \quad for\ k = 1, 2, \ldots., p \qquad (1)$$

$$\text{s.t.} \alpha_i \geq 0 \text{ and } \beta_j \geq 0$$

where k represents k-th DMU which belong to a group consisting of p DMUs, y_{ik} is i-th output, and x_{jk} is to the j-th input for k-th DMU. Each input and output are assigned a weight, denoted by β_j and α_i, respectively. Note that these weights are constrained to be non-negative as both inputs and outputs are non-negative.

The DEA approach attempts to solve the above equation (1) by deriving the optimal weights on inputs and outputs, α and β, for each DMU in an estimation group. One should form estimation groups to ensure that all DMUs within each group are comparable in terms of the relationship between inputs and outputs. In solving the maximization problem, DEA method uses all DMUs in the same group. Then, the derived optimal weights are used to calculate a ratio-based efficiency score for each DMU and to estimate an efficient frontier which represents the best performing DMUs. Lastly, the DEA method standardizes the efficiency scores by scaling the scores by the highest score within the group to produce an ordinal ranking so that the most efficient DMUs are assigned a value of one while the least efficient DMUs are assigned a value of zero.

The SFA approach is a parametric method to estimate the relative efficiency. However, unlike DEA, SFA attempts to measure efficiency relative to a stochastic frontier of production by

allowing random shocks to the production process. In other words, SFA assumes that a unit can deviate from an efficient frontier for two reasons: (i) a random shock and (ii) technical inefficiency. Furthermore, the SFA approach requires a specific form for the relationship between outputs and inputs. Following Coelli et al. (2005) and Baik et al. (2013), we use the following translog stochastic production frontier for an estimation group:

$$ln\, y_{kt} = \gamma_0 + \sum_{j=1}^{m} \gamma_j\, ln\, x_{jkt} + \frac{1}{2}\sum_{j=1}^{m}\sum_{l=1}^{m} \gamma_{jl}\, ln\, x_{jkt}\, ln\, x_{lkt} + \sum_{j=1}^{m} \gamma_q\, \mathrm{t}\, ln\, x_{jkt} + \gamma_t \mathrm{t} + \frac{1}{2}\gamma_{tt}\mathrm{t}^2 + v_{kt} - u_{kt} \quad for\ k = 1,..,p\ \ and\ \ t = 1,....T \qquad (2)$$

where *k* refers to *k*-th unit which belong to a group consisting of *p* units, and *t* refers to *t*-th year representing a time trend. y_{kt} is the output level, and x_{jkt} is the *j*-th input for *k*-th unit in year *t*-th year. Note that each input and each combination of inputs are assigned a weight, γ. More importantly, v_{kt} are random errors accounting for random effects and assumed to be i.i.d with a distribution $N(0, \sigma_v^2)$, while u_{kt} are non-negative random variables representing technical ineffieincy and assumed to be i.i.d with $N^+(0, \sigma_u^2)$. In addition, the two error terms, *v* and *u*, are assumed to be independent of each other.

SFA attempts to maximize the output by estimating the parameters on inputs (i.e., γ). Then, using the estimated parameters, SFA produces a measure of operational efficiency by estimating $\mathrm{E}(\exp(-u_{kt} \mid \mathrm{e}_{kt})$, the conditional expectation of the negative of error term related to technical inefficiency given the value of total error term. Similar to DEA, SFA produces an ordinal ranking of efficiency such that the most efficient units are assigned a value of one while the least efficient units are assigned a value of zero.

Appendix B Variable definitions

Variable	Definition
EFFICIENCY	A measure of firm efficiency for fiscal year t based on Data Envelopment Analysis (DEA). Following Demerjian et al. (2012), we measure this variable by using one output of revenue (SALE) and seven inputs: net PP&E (PPENT), cost of goods sold (COGS), and selling, general, and administrative expenses (XSGA), capitalized operating leases (MRC1 – MRC5), capitalized research and development (R&D) costs (XRD), purchased goodwill (GDWL), and other intangibles (INTAN minus GDWL);
ICMW	An indicator variable for ineffective internal control that takes a value of one if a firm reports a material weakness in internal control over financial reporting for fiscal year t, and zero otherwise;
LOG_TA	The natural logarithm of total assets (AT);
MKTSHARE	The percentage of revenues (SALE) earned by a firm within its Fama and French (1997) industry for fiscal year t;
FCF	An indicator variable that takes a value of one if a firm's free cash flow scaled by total assets is in the top quintile of the sample distribution for fiscal year t, and zero otherwise; free cash flow is measured as earnings before depreciation and amortization (OIBDP) minus the change in working capital (RECT + INVT + ACO – LCO – AP) and capital expenditure (CAPX);
LOG_AGE	The natural logarithm of one plus the number of years a firm has appeared in the Compustat database at the end of fiscal year t;
CONCENTRATION	The Herfindahl index for business segment concentration, measured as the square of the ratio of individual business segment sales to total sales, summed across all business segment for fiscal year t;
FOREIGN	An indicator variable that takes a value of one if a firm reports a non-zero value for foreign currency adjustment (FCA) in fiscal year t, and zero otherwise;
LOSS	An indicator variable that takes a value of one if a firm reported a loss (IB) in any of the last two years, and zero otherwise;
INVENTORY	The ratio of inventory (INVT) to total assets (AT);
SEGMENTS	The number of reported business and geographic segments for fiscal year t in the Compustat segment file;
MERGER	An indicator variable that takes a value of one if a firm reports sales from merger and acquisition (AQC) for fiscal year t, and zero otherwise;
RESTRUCTURE	An indicator variable that equals one if a firm was involved in a restructuring, and zero otherwise; this variable is set to one if any of the following Compustat data items (RCP, RCA, RCEPS, and RCD) is non-

	zero;
LITIGATION	An indicator variable that takes a value of one if a firm is in a litigious industry (SIC codes 2833-2836, 3570 -3577, 3600–3674, 5200-5961, and 7370), and zero otherwise;
EXTREME_GROWTH	An indicator variable that takes a value of one if a firm's industry adjusted sales growth (SALE) belongs to the top quintile for fiscal year t, and zero otherwise;
BIG4	An indicator variable that takes a value of one when a firm's auditor is a Big 4 audit firm for fiscal year t, and zero otherwise;
AUD_CHANGE	An indicator variable that takes a value of one if a firm changed auditors in fiscal year t, and zero otherwise;
LIQUID	Current Assets (ACT) divided by total assets (AT);
GEO_SEGMENTS	The number of reported geographic segments in the Compustat segment file;
OCFVOL	Standard deviation of operating cash flow divided by total assets (OANCF / AT) in the past five years;
AF_ERROR	Analyst forecast error, calculated as the absolute difference between analyst consensus forecast and actual reported EPS for the fiscal year t, divided by the stock price at beginning of the year; analyst annual earnings forecasts are obtained from IBES and the consensus is measured as the mean forecast, measured three quarters prior to the end of the fiscal year t;
OPACITY	A measure of firm opacity adopted from Anderson et al. (2009), which is measured as the sum of the decile ranks of four individual proxies, divided by 40: (i) trading volume (inverse ranking), (ii) bid-ask spread, (iii) the number of analysts following (inverse ranking), and (iv) analyst forecast error;
MVE	Market value of equity at the end of second quarter of fiscal year t (PRCCQ*CSHOQ);
CAR_1	Size-adjusted cumulative abnormal returns over the three-day window centered on the filing date of 10-K that reports a material weakness in internal control over financial reporting by using the equally weighted market return for firms in the same market capitalization decile;
CAR_2	Market-adjusted cumulative abnormal returns over a three-day window centered on the filing date of 10-K that reports a material weakness in internal control over financial reporting by using the return of value weighted market portfolio;
ROA	Return on assets, calculated as income before extraordinary items (IB) divided by average total assets (AT) for fiscal year t;
RETURNS	Buy-and-hold return for fiscal year t.

Table 1 Sample selection and internal control effectiveness over time

Panel A: Sample selection

Description	Firm-years	Firms
Firms on Audit Analytics with an internal control disclosure for years 2004-2011	32,897	6,593
Less: firms in the financial industries	13,158	2,166
Less: observations with missing value on firm efficiency	180	58
Less: observations with missing value on firm characteristics	2,138	462
Final Sample	17,421	3,907

Panel B: Internal control effectiveness over time

	2004	2005	2006	2007	2008	2009	2010	2011	Total
Total number of firms	1,761	2,241	2,313	2,372	2,392	2,200	2,109	2,033	17,421
Number of firms with ineffective internal control	313	303	239	217	120	72	64	83	1,411
Percentage of firms with ineffective internal control (%)	17.77	13.52	10.33	9.15	5.02	3.27	3.03	4.08	8.10

This table presents the sample selection process and the number and percentage of firm-years with ineffective internal control over the period from 2004 to 2011 as reported in Audit Analytics.

Table 2 Descriptive statistics

Panel A: Firm efficiency by industry

	# of obs	Mean	STD	Q1	Median	Q3
All firms	17,421	0.374	0.246	0.152	0.353	0.570
Agriculture	66	0.372	0.147	0.245	0.367	0.485
Food	227	0.664	0.098	0.592	0.634	0.717
Soda	27	0.818	0.127	0.765	0.817	0.947
Beer and Liquor	36	0.854	0.089	0.759	0.878	0.947
Smoking	43	0.690	0.258	0.653	0.760	0.834
Toys	98	0.623	0.082	0.575	0.623	0.674
Fun	287	0.125	0.089	0.091	0.107	0.126
Books	138	0.494	0.175	0.377	0.459	0.544
Household Products	262	0.531	0.116	0.450	0.519	0.582
Clothing	179	0.750	0.077	0.701	0.736	0.798
Health	437	0.481	0.127	0.364	0.468	0.564
Medical Equipment	684	0.470	0.144	0.420	0.474	0.539
Drugs	1,655	0.160	0.139	0.034	0.131	0.265
Chemicals	517	0.493	0.110	0.421	0.472	0.544
Rubber	106	0.809	0.058	0.772	0.803	0.831
Textiles	28	0.855	0.049	0.821	0.845	0.878
Building Materials	289	0.650	0.105	0.608	0.662	0.704
Construction	286	0.604	0.120	0.541	0.616	0.675
Steel	335	0.608	0.094	0.546	0.589	0.653
Fabricated Products	49	0.873	0.067	0.837	0.868	0.942
Machinery	662	0.548	0.083	0.504	0.537	0.585
Electrical Equipment	336	0.509	0.159	0.464	0.554	0.607
Utilities	143	0.407	0.126	0.376	0.421	0.467
Automobiles	328	0.788	0.113	0.747	0.793	0.842
Aerospace	106	0.782	0.068	0.735	0.766	0.806
Ships	56	0.878	0.075	0.844	0.889	0.940
Guns	57	0.837	0.121	0.750	0.875	0.947
Gold	101	0.107	0.043	0.088	0.102	0.129
Mining	129	0.178	0.082	0.128	0.176	0.220
Coal	95	0.670	0.143	0.604	0.662	0.740
Energy	1,152	0.183	0.105	0.113	0.162	0.239
Telecom	824	0.495	0.119	0.444	0.493	0.550
Personal Services	270	0.577	0.149	0.488	0.571	0.650
Business Services	2,667	0.156	0.069	0.131	0.144	0.168
Computers	757	0.372	0.125	0.304	0.360	0.435
Chips	1,190	0.313	0.159	0.194	0.277	0.415
Laboratory Equipment	405	0.577	0.110	0.536	0.584	0.633
Paper	249	0.741	0.067	0.698	0.732	0.778
Boxes	75	0.852	0.091	0.820	0.859	0.892
Transportation	785	0.269	0.113	0.207	0.230	0.283
Wholesale	575	0.012	0.025	0.003	0.006	0.011
Retail	559	0.663	0.081	0.606	0.657	0.715
Restaurants	151	0.103	0.012	0.096	0.102	0.108

Table 2 (Cont'd)

Panel B: Firm efficiency over time

	2004	2005	2006	2007	2008	2009	2010	2011	Total
Total number of firm-years	1,761	2,241	2,313	2,372	2,392	2,200	2,109	2,033	17,421
Mean Efficiency	0.357	0.378	0.371	0.371	0.379	0.364	0.385	0.390	0.374
# of firms with Efficiency = 1	5	12	10	12	13	8	11	15	86
Percentage of firms with Efficiency = 1 (%)	0.284	0.535	0.432	0.506	0.543	0.364	0.522	0.738	0.494

Table 2 (Cont'd)

Panel C: Firm efficiency and control variables by internal control effectiveness

	Mean	STD	Q1	Median	Q3
Firm-years with ineffective internal control (n= 1,411)					
EFFICIENCY	**0.350**	0.236	0.143	**0.299**	0.538
LOG_TA	**5.985**	1.541	4.971	**5.841**	6.914
MRTSHARE	**0.381**	1.138	0.017	**0.061**	0.266
FCF	**0.147**	0.355	0.000	**0.000**	0.000
LOG_AGE	**2.721**	0.606	2.303	**2.639**	3.091
CONCENTRATION	0.835	0.285	0.574	1.000	1.000
FOREIGN	**0.381**	0.486	0.000	**0.000**	1.000
LOSS	**0.543**	0.498	0.000	**1.000**	1.000
INVENTORY	0.089	0.113	0.000	0.041	0.142
SEGMENTS	4.079	2.932	2.000	3.000	5.000
MERGER	0.437	0.496	0.000	0.000	1.000
RESTRUCTURE	**0.369**	0.483	0.000	**0.000**	1.000
LITIGATION	**0.374**	0.484	0.000	**0.000**	1.000
EXTREME_GROWTH	**0.196**	0.397	0.000	**0.000**	0.000
BIG4	**0.717**	0.451	0.000	**1.000**	1.000
AUD_CHANGE	**0.135**	0.342	0.000	**0.000**	0.000
Firm-years with effective internal control (n= 16,010)					
EFFICIENCY	0.377	0.247	0.153	0.355	0.572
LOG_TA	6.678	1.764	5.396	6.560	7.837
MRTSHARE	0.971	2.447	0.026	0.121	0.575
FCF	0.243	0.429	0.000	0.000	0.000
LOG_AGE	2.862	0.637	2.398	2.773	3.296
CONCENTRATION	0.837	0.281	0.604	1.000	1.000
FOREIGN	0.354	0.478	0.000	0.000	1.000
LOSS	0.396	0.489	0.000	0.000	1.000
INVENTORY	0.088	0.112	0.001	0.047	0.136
SEGMENTS	4.044	2.872	2.000	3.000	5.000
MERGER	0.457	0.498	0.000	0.000	1.000
RESTRUCTURE	0.326	0.469	0.000	0.000	1.000
LITIGATION	0.344	0.475	0.000	0.000	1.000
EXTREME_GROWTH	0.161	0.368	0.000	0.000	0.000
BIG4	0.850	0.357	1.000	1.000	1.000
AUD_CHANGE	0.045	0.206	0.000	0.000	0.000

Table 2 (Cont'd)

Panel D: Pairwise correlations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	*EFFICIENCY*		**-0.03**	**0.20**	**0.25**	**0.11**	**0.19**	**-0.13**	**0.04**	**-0.24**	**0.37**	**0.14**	**0.07**	**0.07**	**-0.31**	0.02	**0.05**	-0.01
2	*ICMW*	**-0.03**		**-0.11**	**-0.07**	**-0.06**	**-0.06**	0.00	**0.02**	**0.08**	0.00	0.00	-0.01	**0.02**	**0.02**	**0.03**	**-0.10**	**0.11**
3	*LOG_TA*	**0.21**	**-0.11**		**0.52**	**0.11**	**0.36**	**-0.23**	**0.15**	**-0.31**	0.01	**0.30**	**0.25**	**0.22**	**-0.26**	**-0.12**	**0.37**	**-0.08**
4	*MKTSHARE*	**0.45**	**-0.08**	**0.76**		**0.08**	**0.29**	**-0.17**	**0.06**	**-0.16**	**0.06**	**0.22**	**0.13**	**0.15**	**-0.18**	**-0.07**	**0.15**	**-0.04**
5	*FCF*	**0.12**	**-0.06**	**0.10**	**0.16**		**0.09**	-0.01	**0.03**	**-0.22**	0.01	**0.07**	**0.03**	**-0.01**	0.00	**-0.06**	**0.04**	**-0.03**
6	*LOG_AGE*	**0.19**	**-0.06**	**0.32**	**0.39**	**0.09**		**-0.24**	**0.06**	**-0.18**	**0.21**	**0.22**	**0.07**	**0.17**	**-0.19**	**-0.20**	**0.07**	**-0.03**
7	*CONCENTRATION*	**-0.16**	0.00	**-0.24**	**-0.28**	-0.01	**-0.24**		**-0.07**	**0.11**	**-0.06**	**-0.08**	**-0.16**	**-0.13**	**0.14**	**0.07**	**-0.07**	0.01
8	*FOREIGN*	**0.05**	**0.02**	**0.15**	**0.15**	**0.03**	**0.06**	**-0.06**		**-0.04**	**0.04**	**0.36**	**0.08**	**0.16**	**0.02**	**-0.03**	**0.08**	0.00
9	*LOSS*	**-0.25**	**0.08**	**-0.31**	**-0.35**	**-0.22**	**-0.18**	**0.13**	**-0.04**		**-0.11**	**-0.09**	**-0.22**	**0.08**	**0.17**	**0.08**	**-0.10**	**0.03**
10	*INVENTORY*	**0.46**	0.00	**0.09**	**0.35**	**0.05**	**0.29**	**-0.15**	**0.12**	**-0.13**		**0.14**	**-0.02**	**0.04**	**-0.12**	**-0.03**	**-0.01**	**0.02**
11	*SEGMENTS*	**0.18**	0.00	**0.30**	**0.34**	**0.08**	**0.23**	**-0.10**	**0.42**	**-0.11**	**0.26**		**0.11**	**0.19**	**-0.05**	**-0.08**	**0.12**	-0.01
12	*MERGER*	**0.08**	-0.01	**0.26**	**0.25**	**0.03**	**0.06**	**-0.18**	**0.08**	**-0.22**	0.01	**0.15**		**0.10**	**-0.04**	**0.02**	**0.09**	**-0.02**
13	*RESTRUCTURE*	**0.07**	**0.02**	**0.22**	**0.24**	-0.01	**0.16**	**-0.12**	**0.16**	**0.08**	**0.10**	**0.23**	**0.10**		**0.03**	**-0.13**	**0.13**	-0.01
14	*LITIGATION*	**-0.30**	**0.02**	**-0.27**	**-0.39**	0.00	**-0.18**	**0.16**	**0.02**	**0.17**	**-0.16**	**-0.03**	**-0.04**	**0.03**		**0.03**	**-0.03**	0.00
15	*EXTREME_GROWTH*	**0.01**	**0.03**	**-0.12**	**-0.14**	**-0.06**	**-0.20**	**0.07**	**-0.03**	**0.08**	**-0.05**	**-0.10**	**0.02**	**-0.13**	**0.03**		**-0.08**	**0.02**
16	*BIG4*	**0.06**	**-0.10**	**0.38**	**0.31**	**0.04**	**0.05**	**-0.06**	**0.08**	**-0.10**	0.01	**0.15**	**0.09**	**0.13**	**-0.03**	**-0.08**		**-0.16**
17	*AUD_CHANGE*	-0.01	**0.11**	**-0.08**	**-0.06**	**-0.03**	**-0.03**	0.00	0.00	**0.03**	0.01	-0.01	**-0.02**	-0.01	0.00	**0.02**	**-0.16**	

This table reports descriptive statistics and pair-wise correlation coefficients for variables used in the study. See Appendix B for variable definitions. All continuous variables are winsorized at the 1% and 99% levels. Panel A reports the operational efficiency by the Fama and French (1997) industry classification. Panel B reports the mean firm efficiency, and the number and percentage of firms on the efficient frontier by year. Panel C presents descriptive statistics on firm efficiency and control variables for firm-years with internal control material weaknesses (*ICMW*=1) and those without (*ICMW*=0). The variables for which the group of ineffective internal control is different from the group of effective internal control at 5% significant level are presented in boldface. Differences in means (medians) are tests using a t-test (Wilcoxon rank-sum test). Panel D presents Pearson (Spearman) correlations above (below) the diagonal. The correlation coefficients significant at the 5% level are presented in boldface.

Table 3 Internal control effectiveness and firm operational efficiency

	(1)		(2)	
	Coeff.	p-val.	Coeff.	p-val.
ICMW (H1: −)	-0.011	0.001	-0.007	0.003
LOG_TA	0.015	0.000	0.014	0.000
MKTSHARE	-0.003	0.002	-0.003	0.003
FCF	0.076	0.000	0.064	0.000
LOG_AGE	-0.011	0.001	-0.011	0.000
CONCENTRATION	0.008	0.066	0.008	0.038
FOREIGN	0.004	0.195	0.004	0.169
LOSS			-0.049	0.000
INVENTORY			0.095	0.000
SEGMENTS			0.000	0.489
MERGER			0.005	0.012
RESTRUCTURE			-0.017	0.000
LITIGATION			0.007	0.141
EXTREME_GROWTH			0.021	0.000
BIG4			-0.007	0.160
AUD_CHANGE			-0.002	0.607
INDUSTRY FIXED EFFECTS	Yes		Yes	
N	17,421		17,421	
Adjusted R^2	0.8185		0.8304	

This table reports the results from OLS regressions of firm operational efficiency on *ICMW* and control variables. See Appendix B for variable definitions. All continuous variables are winsorized at the 1% and 99% levels. All p-values are computed using the standard errors adjusted for firm and year clustering, and are based on two-tailed tests except for *ICMW*, which is based on one-tailed tests.

Table 4 Cross-sectional analyses on the relation between internal control effectiveness and firm operational efficiency

Panel A: Ease of misappropriation of corporate resources

	LIQUID (1)		GEO_SEGMENTS (2)	
	Coeff.	p-val.	Coeff.	p-val.
ICMW	0.004	0.690	0.002	0.773
ICMW × LIQUID (H2: −)	-0.020	0.141		
ICMW × GEO_SEGMENTS (H2: −)			-0.019	0.060
LIQUID	0.018	0.001		
GEO_SEGMENTS			0.014	0.005
LOG_TA	0.015	0.000	0.013	0.000
MKTSHARE	-0.003	0.001	-0.003	0.004
FCF	0.063	0.000	0.064	0.000
LOG_AGE	-0.012	0.000	-0.012	0.000
CONCENTRATION	0.008	0.052	0.009	0.018
FOREIGN	0.003	0.282	0.003	0.392
LOSS	-0.049	0.000	-0.049	0.000
INVENTORY	0.083	0.000	0.094	0.000
SEGMENTS	0.000	0.597		
MERGER	0.006	0.002	0.005	0.017
RESTRUCTURE	-0.017	0.000	-0.017	0.000
LITIGATION	0.006	0.226	0.006	0.226
EXTREME_GROWTH	0.020	0.000	0.021	0.000
BIG4	-0.009	0.101	-0.007	0.160
AUD_CHANGE	-0.001	0.615	-0.002	0.595
INDUSTRY FIXED EFFECTS	Yes		Yes	
N	17,421		17,421	
Adjusted R^2	0.8307		0.8306	

Table 4 (Cont'd)

Panel B: Demand for higher quality internal reports for decision making

	OCFVOL (1)		AF_ERROR (2)		OPACITY (3)	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
ICMW	0.007	0.376	0.011	0.173	0.008	0.409
ICMW × OCFVOL (H3: −)	-0.025	0.043				
ICMW × AF_ERROR (H3: −)			-0.026	0.010		
ICMW × OPACITY (H3: −)					-0.018	0.077
OCFVOL	0.005	0.319				
AF_ERROR			-0.010	0.005		
OPACITY					0.000	0.982
LOG_TA	0.014	0.000	0.013	0.000	0.012	0.000
MKTSHARE	-0.003	0.004	-0.003	0.003	-0.002	0.006
FCF	0.064	0.000	0.064	0.000	0.061	0.000
LOG_AGE	-0.011	0.000	-0.011	0.000	-0.011	0.000
CONCENTRATION	0.008	0.036	0.008	0.043	0.006	0.167
FOREIGN	0.004	0.195	0.005	0.129	0.005	0.147
LOSS	-0.049	0.000	-0.048	0.000	-0.047	0.000
INVENTORY	0.093	0.000	0.099	0.000	0.083	0.000
SEGMENTS	0.000	0.472	0.000	0.484	0.000	0.590
MERGER	0.005	0.008	0.005	0.021	0.004	0.082
RESTRUCTURE	-0.017	0.000	-0.016	0.000	-0.017	0.000
LITIGATION	0.007	0.148	0.007	0.180	0.005	0.309
EXTREME_GROWTH	0.020	0.000	0.021	0.000	0.019	0.000
BIG4	-0.008	0.132	-0.008	0.114	-0.015	0.001
AUD_CHANGE	-0.002	0.549	-0.001	0.731	-0.001	0.829
INDUSTRY FIXED EFFECTS	Yes		Yes		Yes	
N	17,332		17,421		14,854	
Adjusted R^2	0.8307		0.8307		0.8431	

This table reports the OLS regression results from cross-sectional analyses of the relation between internal control effectiveness and operational efficiency. Panels A and B present the results in which the cross-sectional variables proxy for the ease of misappropriation of corporate resources and the demand for higher quality internal reports for decision making, respectively. See Appendix B for variable definitions. All continuous variables are winsorized at the 1% and 99% levels, except for the cross-sectional variables, which are the standardized decile ranks within industries. All p-values are computed using the standard errors adjusted for clustering by firm and year, and are based on two-tailed tests except for the interaction terms, which are based on one-tailed tests.

Table 5 Internal control effectiveness and firm operational efficiency – Change analysis

	(1)		(2)	
	Coeff.	p-val.	Coeff.	p-val.
INTERCEPT	-0.004	0.110	-0.003	0.194
Δ*ICMW (H1: −)*	-0.006	0.008		
IC_WORSE (H1: −)			-0.009	0.023
IC_BETTER (H1: +)			0.003	0.007
Δ*LOG_TA*	0.027	0.000	0.028	0.000
Δ*MKTSHARE*	0.022	0.148	0.022	0.149
Δ*FCF*	0.012	0.036	0.012	0.035
Δ*CONCENTRATION*	0.003	0.892	0.003	0.891
INDUSTRY FIXED EFFECTS	No		No	
N	3,675		3,675	
Adjusted R^2	0.0300		0.0301	

This table reports the OLS regression results of the changes in firm operational efficiency on changes in internal control effectiveness. *ΔICMW* is the change in internal control material weakness dummy from year t-1 to t. *IC_WORSE* is an indicator variable that equals one if the firm reports no material weaknesses in year t-1 but reports material weaknesses in year t, zero otherwise. *IC_BETTER* is an indicator variable that equals one if the firm reports material weakness in year t-1 but reports no material weaknesses in year t, zero otherwise. The dependent variable *ΔEFFICIENCY* refers to the changes in operational efficiency from t-1 to t. The other explanatory variables are also measured as the changes from year t-1 to year t. See Appendix B for variable definitions. All continuous variables are winsorized at the 1% and 99% levels. All p-values are computed using the standard errors adjusted for clustering by firm and year, and are based on two-tailed tests except for Δ*ICMW*, *IC_WORSE*, and *IC_BETTER*, which are based on one-tailed tests.

Table 6 Internal control effectiveness and firm operational efficiency by firm size

	MVE (1)		D_75million (2)		D_250million (3)		D_75-250million (4)	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
ICMW	-0.014	0.022	-0.006	0.031	-0.002	0.477	-0.002	0.451
ICMW × MVE	0.019	0.072						
ICMW × D_75million			-0.023	0.166			-0.027	0.138
ICMW × D_250million					-0.010	0.078		
ICMW × D_75-250million							-0.009	0.097
MVE	0.041	0.000						
D_75million			-0.027	0.000			-0.032	0.000
D_250million					-0.010	0.002		
D_75-250million							-0.007	0.032
LOG_TA			0.013	0.000	0.012	0.000	0.012	0.000
MKTSHARE	-0.001	0.586	-0.003	0.009	-0.002	0.016	-0.002	0.019
FCF	0.062	0.000	0.064	0.000	0.063	0.000	0.063	0.000
LOG_AGE	-0.009	0.002	-0.011	0.000	-0.011	0.000	-0.011	0.000
CONCENTRATION	0.005	0.252	0.008	0.038	0.008	0.047	0.008	0.043
FOREIGN	0.006	0.070	0.004	0.205	0.004	0.200	0.004	0.201
LOSS	-0.049	0.000	-0.048	0.000	-0.048	0.000	-0.047	0.000
INVENTORY	0.098	0.000	0.096	0.000	0.096	0.000	0.097	0.000
SEGMENTS	0.001	0.135	0.001	0.424	0.001	0.407	0.001	0.410
MERGER	0.008	0.000	0.005	0.008	0.006	0.006	0.005	0.009
RESTRUCTURE	-0.012	0.000	-0.016	0.000	-0.016	0.000	-0.016	0.000
LITIGATION	0.002	0.643	0.006	0.213	0.006	0.221	0.006	0.226
EXTREME_GROWTH	0.018	0.000	0.019	0.000	0.019	0.000	0.019	0.000
BIG4	-0.002	0.724	-0.008	0.118	-0.009	0.088	-0.009	0.077
AUD_CHANGE	-0.001	0.665	-0.001	0.650	-0.001	0.702	-0.001	0.708
INDUSTRY FIXED EFFECTS	Yes		Yes		Yes		Yes	
N	17,164		17,164		17,164		17,164	
Adjusted R^2	0.8297		0.8320		0.8317		0.8321	

This table reports the cross-sectional results on the effect of internal control effectiveness on operational efficiency by firm size. In Column (1), *MVE* is the market value of equity. In Columns (2) and (3), *D_75million* and *D_250million* are indicator variables for small firms, where *D_75million* and *D_250million* are set to one for firms whose market capitalization is below $75 million and below $250 million, respectively, and zero otherwise. In Column (4), *D_75-250million* is an indicator variable that equals one for firms with market capitalization between $75 million and $250 million. See Appendix B for the definition of other variables. All continuous variables are winsorized at the 1% and 99% levels except for *MVE,* which is the standardized decile ranks within industries. All p-values are computed using

the standard errors adjusted for clustering by firm and year, and are based on two-tailed tests except for the interaction terms, which are based on one-tailed tests.

Table 7 Market reaction to the disclosure of material weaknesses

	CAR_1 (Size-adjusted return)		CAR_2 (Market-adjusted return)	
	Coeff.	p-val.	Coeff.	p-val.
ICMW	-0.017	0.022	-0.016	0.027
ICMW × *CAR*	0.024	0.013	0.023	0.016
LOG_TA	0.013	0.000	0.013	0.000
MKTSHARE	-0.003	0.004	-0.003	0.004
FCF	0.064	0.000	0.064	0.000
LOG_AGE	-0.012	0.000	-0.012	0.000
CONCENTRATION	0.008	0.039	0.008	0.038
FOREIGN	0.004	0.166	0.004	0.165
LOSS	-0.049	0.000	-0.049	0.000
INVENTORY	0.093	0.000	0.093	0.000
SEGMENTS	0.000	0.509	0.000	0.512
MERGER	0.005	0.012	0.005	0.012
RESTRUCTURE	-0.016	0.000	-0.016	0.000
LITIGATION	0.007	0.167	0.007	0.169
EXTREME_GROWTH	0.020	0.000	0.020	0.000
BIG4	-0.009	0.075	-0.009	0.075
AUD_CHANGE	-0.002	0.550	-0.002	0.545
INDUSTRY FIXED EFFECTS	Yes		Yes	
N	17,256		17,256	
Adjusted R^2	0.8314		0.8314	

This table reports the cross-sectional results on the effect of internal control effectiveness on operational efficiency by the market reaction to the disclosure of material weaknesses. Specifically, we regress operation efficiency in year t on the cumulative abnormal returns (*CAR*) over a three-day window centered on the filing date of 10-K that reports an ineffective internal control and other control variables, where *CAR_1* is the sized-adjusted returns and *CAR_2* is the market-adjusted returns. See Appendix B for variable definitions. All continuous variables are winsorized at the 1% and 99% levels. All p-values are computed using the standard errors adjusted for clustering by firm and year, and are based on two-tailed tests except for the interaction terms, which are based on one-tailed tests.

Table 8 Operating performance subsequent to the disclosure of material weaknesses

Panel A: Firms with material weaknesses in year t

	t+1	t+2
No remediation in year t+1		
Mean	-3.2%	-8.6%
(p-value)	(0.005)	(0.003)
Median	-0.1%	-5.0%
(p-value)	(0.006)	(0.000)
N	325	124
Remediation in year t+1		
Mean	-0.6%	1.4%
(p-value)	(0.431)	(0.199)
Median	-0.1%	-0.4%
(p-value)	(0.156)	(0.802)
N	635	485

Panel B: Firms that remediate their material weaknesses in year t+1

	t+1	t+2
With improvement in operational efficiency		
Mean	2.4%	5.0%
(p-value)	(0.010)	(0.000)
Median	0.8%	1.3%
(p-value)	(0.005)	(0.001)
N	341	266
Without improvement in operational efficiency		
Mean	-4.1%	-3.1%
(p-value)	(0.001)	(0.068)
Median	-3.0%	-1.8%
(p-value)	(0.000)	(0.004)
N	294	219

This table reports the abnormal operating performance for firms with material weaknesses in year t for subsequent years t+1 and t+2, where year t is the year of disclosure of material weaknesses. Abnormal return on assets (*ROA*) is calculated based on a matched-firm approach, as suggested by Barber and Lyon (1996), where the matched firm is the firm in the same industry (Fama-French industry classification) with *ROA* closest to that of a firm with material weaknesses in year t. Panel A reports the future operating performance of firms with material weaknesses depending on whether or not firms remediate their material weaknesses in year t+1. Panel B shows the future operating performance for firms that remediate their material weaknesses in year t+1 depending on whether they improve their operational efficiency from t to t+1 (or from t to t+2). Two-sided p-values are based on t-statistics for the differences in means and Wilcoxon signed tests for the differences in medians.

Table 9 Stock performance subsequent to the disclosure of material weaknesses

Panel A: Firms with material weaknesses in year t

	t+1	t+2
No remediation in year t+1		
Mean	-10.0%	-12.5%
(p-value)	(0.007)	(0.145)
Median	-11.4%	-20.2%
(p-value)	(0.001)	(0.008)
N	316	103
Remediation in year t+1		
Mean	-2.3%	5.7%
(p-value)	(0.382)	(0.136)
Median	-4.6%	4.3%
(p-value)	(0.045)	(0.317)
N	648	492

Panel B: Firms that remediate their material weaknesses in year t+1

	t+1	t+2
With improvement in operational efficiency		
Mean	8.5%	7.4%
(p-value)	(0.021)	(0.139)
Median	4.5%	6.3%
(p-value)	(0.130)	(0.405)
N	346	270
Without improvement in operational efficiency		
Mean	-14.6%	3.6%
(p-value)	(<.0001)	(0.541)
Median	-14.7%	0.7%
(p-value)	(<.0001)	(0.601)
N	302	222

This table reports the abnormal stock performance for firms with material weaknesses in year t for subsequent years t+1 and t+2 where year t is the year of disclosure of material weaknesses. Abnormal stock return are calculated based on a matched-firm approach, as suggested by Barber and Lyon (1996), where the matched firm is the firm in the same industry (Fama-French industry classification) with the buy-and-hold return closest to that of a firm with material weaknesses in year t. Panel A reports the future stock performance of firms with material weaknesses depending on whether or not firms remediate their material weaknesses in year t+1. Panel B shows the future stock performance for firms that remediate their material weaknesses in year t+1 depending on whether they improve their operational efficiency from t to t+1 (or from t to t+2). Two-sided p-values are based on t-statistics for the differences in means and Wilcoxon signed tests for the differences in medians.