# Does Ineffective Internal Control over Financial Reporting affect a Firm's Operations? Evidence from Firms' Inventory Management

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**ABSTRACT:** We investigate whether ineffective internal control over financial reporting has implications for firm operations by examining the association between inventory-related material weaknesses in internal control over financial reporting and firms' inventory management. We find that firms with inventory-related material weaknesses have systematically lower inventory turnover ratios and are more likely to report inventory impairments relative to firms with effective internal control over financial reporting. We also find that inventory turnover rates increase for firms that remediate material weaknesses related to inventory tracking. Remediating firms also experience increases in sales, gross profit, and operating cash flows. Finally, we assess the generalizability of our findings by examining all material weaknesses in internal control over financial reporting, regardless of type, and provide evidence that firms' returns on assets are associated with both their existence and remediation. Collectively, our findings support the general hypothesis that internal control over financial reporting has an economically significant effect on firm operations.

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**Keywords:** *internal control over financial reporting; inventory management; firm operations.*

# I. INTRODUCTION

For the past decade, managers and regulators have debated the costs and benefits of Section 404 of the Sarbanes-Oxley Act (U.S. House of Representatives 2002), which requires disclosure of the effectiveness of internal control over financial reporting (ICFR). A number of research studies document negative consequences of maintaining ineffective ICFR, such as lower earnings quality, higher cost of equity and debt, higher management and analyst forecast errors, and inefficient investments.[1] Following the disclosure of ineffective ICFR, firms tend to remediate material weaknesses, and prior research documents economically significant improvements in some areas, such as financial reporting quality (Ashbaugh-Skaife, Collins, Kinney, and LaFond 2008). Consistent with these improvements, a recent survey reveals that most managers believe that Section 404 has improved the quality of their financial reporting. However, the average manager does not believe that the regulation has improved the efficiency of their firms' operations (Alexander, Bauguess, Bernile, Lee, and Marietta-Westberg 2013). In other words, managers appear to recognize that they provide higher-quality information as a result of effective ICFR, but they do not appear to recognize that they may also be *using* higher-quality information to make better operational decisions when they maintain effective ICFR because some controls play both operational and financial reporting roles. The purpose of our study is to assess the implications of ICFR for firm operations.[2]

We explore the effect of inventory-related material weaknesses in internal control (MWIC) on firm operations because inventory is a critical component of firm strategy. Having inventory available the moment it is demanded by the customer or required for production, with the proper specifications, and at the best cost for the desired quality, sustains firm operations. When a firm lacks consistent policies related to the accounting for routine inventory transactions, there can be greater variation in unit costs, invoice payment dates, and shipping fees, thereby increasing inventory costs. Moreover, lax policies and procedures related to inventory tracking and valuation can result in substantial lost sales due to inventory shortages, as well as increased capital charges and risk of obsolescence due to inventory surpluses. In summary, when a firm fails to have adequate systems to control inventory purchase, tracking, and valuation, there is a greater likelihood of a mismatch between inventory supply and demand, leading to poorer operating performance.[3]

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[1] Examples include Doyle, Ge, and McVay (2007a); Ashbaugh-Skaife, Collins, Kinney, and LaFond (2009); Feng, Li, and McVay (2009); Chen, Lai, and Liu (2011); Costello and Wittenberg-Moerman (2011); Dhaliwal, Hogan, Trezevant, and Wilkins (2011); Li, Peters, Richardson, and Watson (2012); Cheng, Dhaliwal, and Zhang (2013); and Clinton, Pinello, and Skaife (2014).

[2] The Committee of Sponsoring Organization's (COSO) *Internal Control—Integrated Framework* defines internal control as a process that is designed to provide reasonable assurance that a firm can achieve its objectives (COSO 1992). The COSO *Framework* distinguishes between reporting objectives and operating objectives, and describes elements of internal control that enhance the reliability of financial reporting versus the effectiveness and efficiency of operations, respectively. Many of the same policies, procedures, and controls that lead to effective ICFR related to inventory, however, also affect the proper accounting for inventory acquisition, sale, storage, and returns, leading to more effective inventory management. Thus, we expect there to be mutually beneficial effects on financial reporting quality (Doyle, Ge, and McVay 2007b) and firms' inventory management as a result of having effective ICFR.

[3] This is distinct from prior research that provides evidence that poor operating performance is a *determinant* of ineffective ICFR. We conjecture that poor performance is also a possible *consequence* of having ineffective ICFR conditional on current performance. We control for firms' contemporaneous operating profitability in our analyses and conduct change analyses to further distinguish causality. We also conduct a within-performance-levels analysis as a robustness check in Section IV.

We use inventory turnover and inventory impairments, two commonly cited accounting-based measures, to assess the relation between inventory-related MWIC and inventory management. Inventory turnover is often used to assess managerial performance and is a common component of any industry competitive analysis (Easton 2009). Holding profit margins constant, lower inventory turnover ratios, defined as cost of goods sold divided by average inventory, are associated with less profitable operations (Huson and Nanda 1995). Firms having inventory-related MWIC potentially lack the proper policies and procedures to handle and record inventory transactions, thereby placing suboptimal order quantities that culminate in higher cost of goods sold via higher holding or stock-out costs. As a result, we expect firms with inventory-related MWIC to have lower inventory turnover ratios relative to firms with effective ICFR. Likewise, if inaccurate inventory tracking and errors in the internal valuation process result in firms not managing their inventory properly, then we expect firms with inventory-related MWIC to have larger and more frequent inventory impairments as out-of-date or obsolete product loses market value.[4] Finding no relation between inventory-related MWIC and inventory turnover or impairments would be consistent with either (1) managers relying on internal data from a different system to make operational decisions, or (2) the errors introduced to the system as a result of inventory-related MWIC not being economically significant. As such, documenting that inventory-related MWIC affect inventory management would provide an important link between ICFR and firm operations that has not been documented to date.

Among our sample firms that report MWIC, more than 25 percent (161/640) report MWIC that relate to inventory.[5] Descriptive statistics indicate that inventory turnover is significantly lower, on average, for inventory-related MWIC firms (8.37 or 43 days) relative to the inventory turnover of firms with effective ICFR (14.03 or 26 days) and of firms with other types of MWIC (14.34 or 25 days). The significantly slower inventory turnover for firms with inventory-related MWIC is substantiated in our multivariate analysis, where we control for revenue-related and other types of material weaknesses, as well as factors related to inventory turnover and determinants of MWIC. Using the information from the Section 404 reports, we also partition inventory-related MWIC into tracking- and valuation-related issues, where the former are those weaknesses that could affect the recorded existence or quantity of inventory and the latter are those weaknesses that could affect the recorded value of inventory; we provide examples in Section IV. We find significantly lower inventory turnover ratios for both. Examining post-remediation performance, we find evidence that inventory turnover ratios increase after firms remediate their inventory-tracking MWIC. Importantly, we do not find an increase in inventory turnover ratios following the remediation of other types of MWIC.

Our second analysis focuses on inventory impairments. Inventory impairments are an attractive measure to assess inventory management because the link to firm performance is direct and immediate, as inventory write-offs increase current-period expenses, resulting in lower earnings. We find that firms with inventory-related MWIC are (1) more likely to report inventory

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[4] As we discuss below, inventory values reported in firms' 10-Ks should not be unduly affected by the ineffective ICFR because they have been corrected with a physical count and costing of the ending inventory units via substantive audit procedures. U.S. Generally Accepted Accounting Principles (GAAP) require inventory to be reported at the lower of cost or market, which drives the recognition of inventory impairments and increases the reliability of the ending inventory value reported on the balance sheet. Moreover, none of the firms in the sample reporting inventory-related MWIC received qualified audit opinions from their auditors due to the inability of the auditor to opine on the inventory value reported on the balance sheet. We expect the day-to-day inventory quantities and values to be less reliable when firms have inventory-related MWIC. Less reliable inventory quantities and values for internal reporting purposes hamper day-to-day decision making, thereby leading to poorer inventory management and less profitable operations.

[5] We focus on accelerated filers because this group of firms has been subject to both Section 404(a) and 404(b) since 2004. See Section III for more details.

impairments, and (2) report significantly larger inventory impairments. These findings hold for both inventory tracking- and valuation-related MWIC. The results of the inventory turnover and inventory impairment tests provide evidence that ineffective ICFR related to inventory has adverse consequences for inventory management, leading to less profitable operations.

To corroborate this conclusion, we investigate changes in firms' operating performance following the remediation of inventory-related MWIC. If effective inventory-related ICFR leads to better inventory management, then we expect operating performance to improve once firms remediate their inventory-related MWIC. We find that firms that correct their inventory-related MWIC report significant increases in sales, gross margin, and operating cash flows after remediation. Moreover, once firms remediate their inventory-related MWIC, we find that their gross profit and operating income are no longer significantly different from firms with effective ICFR.

We conclude our study with a broader examination of the association between all MWIC and a firm's return on assets (ROA). We document that the average return on assets is lower for firms with MWIC and that the remediation of MWIC is associated with higher future return on assets. These findings, combined with the results of our inventory-related MWIC analyses, support our general hypothesis that ICFR has an economically significant effect on firm operations.

Our study makes several contributions to the literature. First, our study extends the literature on the consequences of having ineffective ICFR. A number of research studies provide evidence that information disseminated from firms disclosing ineffective ICFR is of lower quality than information from other firms. Examples include reported earnings or forecasted earnings (Doyle et al. 2007a; Ashbaugh-Skaife et al. 2008; Feng et al. 2009; Altamuro and Beatty 2010; Li et al. 2012). Our study focuses on whether management *acts on* lower-quality information produced from a system with ineffective ICFR when making operational decisions, thereby affecting firm performance. We document an explicit link between inventory-related MWIC and poor inventory management, as well as substantiate that inventory management improves once inventory-related MWIC are remediated. Further, we provide evidence on the generalizability of our results by examining all material weaknesses, regardless of type, and provide evidence that firms' returns on assets are associated with both their existence and remediation. We are the first paper to examine the broad effect of ineffective ICFR on firm operations, and to establish a more direct link between MWIC over inventory and managers' inventory management decisions. These results provide strong evidence that despite being largely unremarked upon as a potential benefit by managers or regulators, maintaining effective ICFR can provide an economically meaningful benefit to their firms' operations. To the extent that there is a disconnect between actual and perceived benefits to maintaining effective ICFR, the recent regulatory move to exempt certain firms from internal control disclosure regulation may be premature.

Our study also contributes to the literature on inventory management and firm operations. Most of the prior literature on inventory management relies on insights obtained via case studies, surveys, and questionnaires to document the consequences of inventory mismanagement (e.g., Anderson, Fitzsimons, and Simester 2006). For a large sample of publicly traded firms, we provide evidence that the lack of proper inventory acquisition, tracking, or valuation systems has a direct impact on firms' operating performance.

## II. HYPOTHESIS DEVELOPMENT

Internal control is a process that is designed to provide reasonable assurance that a firm can achieve its objectives, where differing aspects of internal control can be partitioned into operating objectives, reporting objectives, and compliance objectives (COSO 1992). Internal control over operations is comprised of policies, procedures, and personnel intended to enhance the effectiveness and efficiency of firm operations and safeguard assets (COSO 2013; Lawrence, Minutti-Meza, and Vyas 2014). Internal control over financial reporting (ICFR) encompasses the processes and procedures established by

management to maintain records that accurately reflect the firm's transactions (Deloitte & Touche, Ernst & Young, KPMG, and PricewaterhouseCoopers 2004). The development of policies and procedures related to effective ICFR is a strategic choice by management and boards of directors, who weigh the costs and benefits of establishing and maintaining effective ICFR (COSO 2013), as well as the costs of disclosing ineffective ICFR (Government Accountability Office [GAO] 2013).

ICFR became a well-known component of internal control as a result of Section 404 of the Sarbanes-Oxley Act (SOX) of 2002, which requires both managers and auditors to assess and publicly disclose the effectiveness of ICFR. Accelerated filers began complying with the rule in 2004, whereas the compliance date for non-accelerated filers was delayed until 2007 and, under the Dodd-Frank Act (U.S. House of Representatives 2010), only requires management's assessment.

Since the implementation of Section 404, a vast literature on ICFR has emerged. Much of this literature focuses on how ineffective ICFR affects investors' resource allocation decisions (Beneish, Billings, and Hodder 2008; Costello and Wittenberg-Moerman 2011; Skaife and Wangerin 2013), firms' cost of capital (Ashbaugh-Skaife et al. 2009; Dhaliwal et al. 2011), or analysts' behavior (Clinton et al. 2014). A number of research studies document negative consequences to maintaining ineffective ICFR; for example, diminished quality of external financial reporting (Doyle et al. 2007a; Ashbaugh-Skaife et al. 2008; Altamuro and Beatty 2010) and internal financial reports (Feng et al. 2009; Li et al. 2012). These studies provide evidence that information, such as reported earnings or forecasted earnings, disseminated from firms disclosing ineffective ICFR is of lower quality than information from other firms. The focus of our study is whether management *acts on* lower-quality information when making operational decisions, thereby affecting firm performance.

Recent studies have begun to explore the extent to which managers act on faulty information as a result of ineffective ICFR. Bauer (2014) posits that tax-related MWIC reflect management's capability or discretion for tax planning and finds evidence that firms with tax-related MWIC have higher effective tax rates than firms without tax-related MWIC. More broadly, Cheng et al. (2013) investigate the efficiency of firm investments, such as property, plant, and equipment (PP&E) and research and development (R&D), in the presence of ineffective ICFR, concluding that managers of firms with ineffective ICFR make poorer investments.[6] However, they do not examine the resulting performance, such as return on assets, and they do not conduct cross-sectional tests examining investment-specific weaknesses related to PP&E and R&D. Thus, their evidence is indirect.

Further, no studies examine the effect of MWIC on crucial day-to-day operating decisions made by management. A recent survey reveals that although the majority of managers believe that Section 404 has improved the quality of their internal control structure and improved the quality of their financial reporting, only 29 percent of managers believe that having effective internal control will have a positive impact on their operations (Alexander et al. 2013). One possible reason for such beliefs is that managers may rely on other information to make operating decisions, including inventory management decisions.[7] As a result, material weaknesses in ICFR may not have a spillover effect on the quality of the information that managers use for operational decisions.

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[6] Lawrence et al. (2014) examine privacy breaches, which are an indication of operational control risk. They document a positive leading relation between operational control risk and financial reporting control risk and, in turn, total audit risk. They suggest that known control risks, such as privacy breaches, are important for risk assessments and should be a required disclosure to regulators and external market participants. They also suggest that concerns about control risk have been overshadowed by Section 404's focus on ICFR. Our study suggests that some ICFR also have implications for control risk.

[7] For example, Procter & Gamble uses SAP for the company's financial reporting. However, many divisions and processes rely on legacy systems for daily operations. Procter & Gamble translates financial data from different divisions to the central SAP periodically. It is possible that those data are mistranslated as they are rolled up into the financial reporting system (S. Wright and A. Wright 2002). Therefore, even though the quality of the financial data is significantly diminished during this integration process, the data in the operational legacy systems that managers rely on to make business decisions are sound.

However, we expect that, often, the same systems are used for internal management and financial reporting and, thus, the additional disclosure regulation over ICFR will have positive spillover effects on managers' operational decisions. In particular, because Section 404 requires the formal assessment and disclosure of ICFR, these controls are brought to the attention of management when they might not otherwise have been discovered and, in addition, identified MWIC are often remediated. Prior research has documented an improvement in financial reporting quality following this remediation; we investigate whether MWIC and the related disclosure regulation also affect operational performance.

We examine whether an explicit link exists between the effectiveness of ICFR and operating performance by looking at the association between inventory-related MWIC and inventory management. The objective of inventory management is to provide sufficient inventory quantities to serve customers' or production needs while minimizing the sum of total variable inventory costs. Inventory-related MWIC would also affect inventory management if the same policies and procedures that contribute to effective inventory-related ICFR also affect inventory management decisions in the form of procurement, tracking, and pricing of inventory. For example, many retailers and manufacturers use automated inventory ordering systems that rely on recorded inventory quantities to trigger purchase orders. If inventory quantity is mistakenly under- (over-) reported because inventory is not tracked properly, then too many (too few) goods will be ordered, resulting in an overstock (stock-out) and additional holding (stock-out) costs (Nachtmann, Waller, and Rieske 2010). Having policies and procedures that lead to more accurate and timely inventory data, including quantity, location, and cost, helps firms manage their inventory more efficiently (Croson and Donohue 2006) and allow automated inventory systems to function properly (Chen 1999). In contrast, when a firm has inventory-related MWIC, inventory data for inventory management will be inaccurate, leading to suboptimal inventory management decisions. As an example of an inventory-related MWIC, consider the following excerpt from IPIX Corp.'s 2004 10-K:

> As of December 31, 2004, the Company did not maintain effective internal control over inventory . . . These deficiencies were considered to be material weaknesses:
>
> - Controls to ensure inventory receipts are properly received and accounted for were not adequately documented or tested.
> - Controls relating to inventory counts and the reconciliations between accounting records and inventory counts were not adequately documented or tested. Specifically, the Company did not maintain documented inventory count instructions, and there was a lack of sufficient evidence that inventory reconciliations were performed and reviewed by appropriate personnel.
> - Controls relating to the proper costing and valuation of inventory were not adequately documented or tested.

This example illustrates that inventory-related MWIC affect information about the quantity and costing of inventory—important inputs to inventory management decisions such as purchasing and pricing (DeHoratius and Raman 2008).

When inventory is not properly tracked, larger deviations are likely between the inventory levels reported in the company's internal documents and the actual inventory quantities on hand.[8] Operating decisions based on these potentially faulty internal management reports will lead to

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[8] Raman, DeHoratius, and Zeynep (2001) note that inventory error, defined as the difference between physical and system inventory levels, often enters automated inventory systems through human action, e.g., failing to properly record customer returns, misplacing inventory on the sales floor, or improper storage of inventory. For example, inventory errors can occur during the return process when a customer exchanges a garment for a different size and the retailer does not have standardized procedures for recording the exchange.

mismatches between demand and supply (Hendricks and Singhal 2005). Hence, firms with inaccurate inventory records are more likely to hold excess inventory or incur inventory shortages.[9] Inventory shortages resulting from inaccurate records will result in lost sales, because sales are constrained by available inventory (Iglehart and Morey 1972; Anderson et al. 2006; Lai, Debo, and Nan 2011). Lost sales result in adverse consequences for budgeted sales and future inventory acquisitions because accounting records will not appropriately reflect customers' demand for products. Alternatively, inadvertently carrying inventory levels that are too high is also costly, as it ties up capital, increases holding costs, and increases the risk of obsolescence (Sheppard and Brown 1993; DeHoratius and Raman 2008). When obsolete inventory is identified and written off as a current-period expense, it reduces operating income.

Importantly, we expect inventory-related MWIC to affect inventory transactions throughout the year more than they affect the year-end inventory balances reported on financial statements filed with the Securities and Exchange Commission (SEC). Financial statement errors resulting from inventory-related MWIC should be corrected by auditors' substantive testing during the external audit (Doss and Jonas 2004; Doyle et al. 2007a). Thus, end-of-year inventory balances reported on firms' balance sheets are likely to be reliable for financial reporting. In contrast, to the extent that inventory reports are generated from the same system that generates financial reports, errors in internal management reports, which are not corrected by auditors, will lead to errors in inventory management. As previously noted, automated inventory orders will affect inventory quantities and costs throughout the year, leading to suboptimal inventory management.

Taken together, although effective ICFR is intended to provide assurance about the reliability of a firm's financial statements, not about its operating performance (Deloitte & Touche et al. 2004), our general hypothesis is that the implications of ineffective ICFR go beyond financial reporting quality. Specifically, we posit that ineffective inventory-related ICFR is associated with poor inventory management. It is important to concretely document that the most fundamental aspects of firm operations, such as inventory management, are affected by ICFR. To the extent that managers and regulators are not aware that effective inventory-related ICFR enables management to make better inventory management decisions, the perceived benefits of effective ICFR will be underestimated. The disconnect between perceived and actual benefits of maintaining effective ICFR potentially influences the ongoing deliberations to exempt even more firms from the auditor assessment of ICFR.

## III. SAMPLE AND DESCRIPTIVE STATISTICS

### Sample and Data

Our initial sample is comprised of 15,485 accelerated filer firm-years with available data on internal control effectiveness from 2004 to 2009 from the WRDS-based Audit Analytics database. Audit Analytics includes both the evaluation of ICFR as effective or ineffective, as well as the underlying reason(s) for any material weaknesses in internal control, where, by definition, the existence of at least one material weakness in internal control implies ineffective ICFR. Our analysis period begins in 2004 and focuses on accelerated filers because this group of firms has been subject to both Section 404(a) and 404(b) since 2004, whereas non-accelerated filers are only subject to Section 404(a), and only since 2007. We end the analysis period in 2009 in order to have

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[9] The safeguarding of assets is a key objective of internal control (COSO 1992). To the extent that a firm does not restrict access to inventory warehouses or protect inventory from misappropriation, inventory shrinkage will be higher. Normal inventory shrinkage will increase cost of goods sold and decrease ending inventory values, thereby increasing inventory turnover. Thus, the problems of inventory shrinkage biases against finding lower inventory turnover for firms with MWIC related to inventory.

## TABLE 1

### Sample Selection

**Panel A: Sample Selection**

| | Obs. |
|---|---|
| Firm-year observations for accelerated filers from Audit Analytics and Compustat for fiscal years 2004–2009 | 15,485 |
| Less: | |
| Firm-year observations without inventory information | 4,733 |
| Firm-years missing necessary financial data from Compustat to conduct empirical tests | 1,799 |
| Sample for inventory turnover tests | 8,953 |
| Firm-years with effective internal control over financial reporting | 8,313 |
| Firm-years with material weaknesses in internal control over financial reporting (MWIC) other than inventory, but no inventory-related MWIC | 479 |
| Firm-years with inventory-related MWIC over financial reporting | 161 |

**Panel B: Additional Detail**

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | Total |
|---|---|---|---|---|---|---|---|
| Inventory-related MWIC in Audit Analytics | 70 | 63 | 40 | 53 | 34 | 15 | 275 |
| Inventory-related MWIC with Compustat data | 42 | 45 | 29 | 38 | 23 | 10 | 187 |
| Less MWIC that are removed after manual screen | −5 | −8 | −4 | −2 | −3 | −4 | −26 |
| Inventory-related MWIC used in our tests | 37 | 37 | 25 | 36 | 20 | 6 | 161 |
| Remediated inventory-related MWIC | 26 | 31 | 17 | 28 | 18 | 4 | 124 |
| Unremediated inventory-related MWIC in year $t+1$ | 11 | 6 | 8 | 8 | 2 | 2 | 37 |
| Any unremediated MWIC in year $t+1$ | 27 | 33 | 34 | 18 | 14 | 22 | 148 |

the same sample for the levels and changes analyses, where the change analyses require two years of future data: the year of remediation and the full year following the remediation.

From the initial sample, we eliminate firm-years missing inventory values (n = 4,733) and the necessary financial data from Compustat to conduct our empirical tests (n = 1,799), resulting in a sample of 8,953 firm-year observations. With the exception of banks, the industry representation is similar to the Compustat population. Untabulated results show that the retail and computer industries are the most represented in our sample, whereas Compustat has the highest representation in banks, then retail and computers, respectively. Of the 8,953 observations, 8,313 firm-year observations relate to firms with effective ICFR. Of the 7.15 percent (640 firm-years) reporting ineffective ICFR, 25.16 percent (161 firm-years) disclosed inventory-related MWIC. We summarize the sample selection process in Table 1, Panel A.

Table 1, Panel B displays the composition of the inventory-related MWIC subsample over time, after reading firms' audit opinions and deleting observations coded in Audit Analytics as having inventory-related MWIC that actually relate to other accounts. Specifically, we exclude 26 observations that were identified as "Inventory, vendor and cost of sales issues" by Audit Analytics, but that we concluded did not actually reflect inventory-related MWIC. In particular, 16 of these directly followed from the inappropriate timing of revenue recognition and related

to the corresponding cost of goods sold entry; five related to "vendors," but not inventory; two related to financial statement classification issues, such as current versus non-current inventory; and three appear to be Audit Analytics coding errors.[10] Table 1, Panel B also displays the number of firms that remediated or reported inventory-related MWIC by year.

**Descriptive Statistics**

Table 2 shows that the inventory turnover ratios of *Inventory-MWIC* firms (mean = 8.370; median = 4.227) are significantly lower than firms with effective ICFR (mean = 14.032; median = 5.955) and *Other-MWIC* firms (mean = 14.336; median = 5.301). This difference is economically significant, with firms reporting inventory-related MWIC holding inventory, on average, for over 40 days versus less than 27 days for the other firms.

Turning to the control variables, among *Inventory-MWIC* firms, revenue recognition internal control problems are present in over 44 percent of the observations, and *Inventory-MWIC* firms tend to have one other MWIC. By construction, the "Effective IC" sample has no MWIC, inventory-related or otherwise. Firms with inventory-related MWIC report lower gross profit and are less capital-intensive relative to firms with effective ICFR and firms with other MWIC. The descriptive statistics indicate that inventory-related MWIC firms have significantly higher sales volatility and sales growth relative to other firms in our sample. Consistent with prior research on ICFR, the descriptive statistics indicate that firms with ineffective ICFR tend to be younger, less likely to employ high-quality auditors, less profitable, and smaller than firms with effective ICFR (Ge and McVay 2005; Ashbaugh-Skaife, Collins, and Kinney 2007; Doyle et al. 2007b).

Table 3 presents Pearson correlations between variables used in our empirical tests. The correlation between *Inventory-MWIC* and *Revenue-MWIC* (correlation = 0.56) highlights how problems with key operating functions can be inter-related, and the correlation between *ROA* and *Loss* (correlation = −0.67) reflects that these are alternative measures of firm performance.

## IV. TEST DESIGN AND RESULTS

**Inventory Turnover**

We begin our empirical analysis by testing the relation between inventory turnover and inventory-related MWIC using the following OLS regression:

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\begin{aligned}
InventoryTurnover_t = {} & \alpha_0 + \alpha_1 Inventory\text{-}MWIC_t + \alpha_2 Revenue\text{-}MWIC_t + \alpha_3 Other\text{-}MWIC_t \\
& + \alpha_4 GrossMargin_t + \alpha_5 CapitalIntensity_{t-1} + \alpha_6 SalesVolatility_{t-1} \\
& + \alpha_7 SalesGrowth_{t-1} + \alpha_8 Segments_{t-1} + \alpha_9 ForeignSales_{t-1} \\
& + \alpha_{10} FirmAge_{t-1} + \alpha_{11} Auditor_{t-1} + \alpha_{12} ROA_{t-1} + \alpha_{13} Loss_{t-1} \\
& + \alpha_{14} Size_{t-1} + IndustryDummies + YearDummies + \varepsilon,
\end{aligned}
\tag{1}
$$

where *InventoryTurnover* is equal to a firm's cost of goods sold in year *t* divided by average inventory over year *t*.[11] We also present an industry-adjusted inventory turnover measure as a

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[10] Table 1, Panel B shows that the number of inventory-related material weaknesses in internal control appearing in the Audit Analytics database declined over our sample period, from 70 (63) in 2004 (2005) to 15 in 2009. Because the economic recession may have impacted inventory turnover and internal controls, in untabulated results, we also replicate our analyses excluding 2007–2009; results are similar.

[11] We adjust all LIFO (last in, first out) inventory figures to be on a FIFO (first in, first out) basis using the required disclosure of LIFO reserves. Our primary analysis defines inventory turnover based on the cost of goods sold. Prior research occasionally defines inventory turnover based on sales to assess the consequences of inventory shortages (Gaur, Fisher, and Raman 2005). As an untabulated robustness check, when we calculate inventory turnover based on sales to capture the effect of inventory shortages due to ineffective ICFR over inventory, results are similar.

## TABLE 2
## Descriptive Statistics

| | Effective IC n = 8,313 | | | Other-MWIC n = 479 | | | Inventory-MWIC n = 161 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | Std. Dev. | Mean | Median | Std. Dev. | Mean | Median | Std. Dev. |
| InventoryTurnover | 14.032 | 5.955 | 19.32 | 14.336 | 5.301 | 20.23 | 8.370*** | 4.227*** | 13.45 |
| AverageInventory (in millions) | 649.9 | 114.1 | 1,634.34 | 505.9* | 59.1*** | 1,686.26 | 170.5*** | 60.3*** | 300.69 |
| CostofSales (in millions) | 4,248.6 | 777.7 | 10,776.24 | 3,349.3* | 419.7*** | 11,690.38 | 933.1*** | 253.1*** | 1,812.70 |
| Revenue-MWIC | 0 | 0 | 0 | 0.063*** | 0.000*** | 0.24 | 0.447*** | 0.000*** | 0.50 |
| Other-MWIC | 0 | 0 | 0 | 1.399*** | 1.000*** | 1.18 | 1.398*** | 1.000*** | 1.31 |
| GrossMargin | 0.372 | 0.351 | 0.22 | 0.38 | 0.357 | 0.24 | 0.345 | 0.333 | 0.18 |
| CapitalIntensity | 5.691 | 5.669 | 2.23 | 4.962*** | 4.947*** | 2.23 | 4.414*** | 4.175*** | 1.71 |
| SalesVolatility | 0.177 | 0.129 | 0.15 | 0.206*** | 0.165*** | 0.17 | 0.232*** | 0.194*** | 0.16 |
| SalesGrowth | 0.124 | 0.09 | 0.29 | 0.168*** | 0.1 | 0.33 | 0.203*** | 0.11 | 0.34 |
| Segment | 1.695 | 1.792 | 0.75 | 1.583*** | 1.609** | 0.73 | 1.642 | 1.792 | 0.65 |
| ForeignSales | 0.132 | 0 | 0.34 | 0.088*** | 0.000*** | 0.28 | 0.093 | 0 | 0.29 |
| FirmAge | 2.687 | 2.708 | 0.96 | 2.492*** | 2.565*** | 0.97 | 2.336*** | 2.485** | 1.04 |
| Auditor | 0.947 | 1 | 0.22 | 0.930* | 1.000* | 0.26 | 0.926* | 1 | 0.26 |
| ROA | 0.049 | 0.055 | 0.12 | 0.012*** | 0.030*** | 0.14 | 0.004*** | 0.024*** | 0.13 |
| Loss | 0.176 | 0 | 0.38 | 0.301*** | 0.000*** | 0.46 | 0.348*** | 0.000*** | 0.48 |
| Size | 7.374 | 7.192 | 1.73 | 6.718*** | 6.518*** | 1.62 | 6.272*** | 6.095*** | 1.19 |

*, **, *** Denote two-tailed p-values of less than 0.10, 0.05, and 0.01, respectively, and are testing the difference from the effective internal control sample.
The Effective IC columns relate to firm-year observations with effective internal control over financial reporting. Other-MWIC columns represent the firm-year observations with material weaknesses in internal control other than inventory. Inventory-MWIC columns represent the firm-year observations with inventory-related MWIC. Variable definitions appear in Appendix A. All variables except indicators and *FirmAge* are winsorized at the extreme 1 percent and 99 percent.

**TABLE 3**

**Correlation Matrix**

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 InventoryTurnover | −0.04 | −0.02 | −0.02 | −0.21 | 0.12 | −0.03 | 0.03 | −0.18 | −0.10 | −0.11 | 0.01 | −0.01 | −0.02 | −0.01 |
| 2 Inventory-MWIC | | 0.56 | 0.36 | −0.02 | −0.07 | 0.05 | 0.04 | −0.01 | −0.01 | −0.05 | −0.01 | −0.05 | 0.06 | −0.08 |
| 3 Revenue-MWIC | | | 0.37 | 0.00 | −0.06 | 0.02 | 0.00 | 0.01 | 0.00 | −0.02 | 0.00 | −0.04 | 0.06 | −0.07 |
| 4 Other-MWIC | | | | 0.01 | −0.07 | 0.03 | 0.02 | 0.00 | −0.01 | −0.04 | −0.02 | −0.06 | 0.08 | −0.08 |
| 5 GrossMargin | | | | | −0.11 | −0.09 | 0.10 | 0.02 | 0.01 | −0.09 | 0.00 | 0.21 | −0.08 | 0.11 |
| 6 CapitalIntensity | | | | | | −0.29 | −0.12 | 0.23 | 0.01 | 0.30 | 0.23 | 0.19 | −0.23 | 0.76 |
| 7 SalesVolatility | | | | | | | 0.09 | −0.14 | −0.02 | −0.23 | −0.07 | 0.04 | 0.06 | −0.22 |
| 8 SalesGrowth | | | | | | | | −0.15 | −0.17 | −0.17 | 0.01 | 0.10 | −0.09 | 0.00 |
| 9 Segments | | | | | | | | | 0.27 | 0.20 | 0.07 | 0.07 | −0.03 | 0.26 |
| 10 ForeignSales | | | | | | | | | | 0.05 | −0.03 | −0.03 | 0.05 | 0.01 |
| 11 FirmAge | | | | | | | | | | | 0.03 | 0.06 | −0.12 | 0.25 |
| 12 Auditor | | | | | | | | | | | | 0.08 | −0.08 | 0.24 |
| 13 ROA | | | | | | | | | | | | | −0.67 | 0.27 |
| 14 Loss | | | | | | | | | | | | | | −0.29 |
| 15 Size | | | | | | | | | | | | | | |

Statistically significant correlations (p-values < 0.10, two-tailed) are in bold.
Variable definitions appear in Appendix A.

second dependent variable, where *IndAdj-InventoryTurnover* is defined as the firm's inventory turnover less the median inventory turnover for the firm's industry, based on two-digit SIC codes. We expect a negative coefficient on *Inventory-MWIC,* which is an indicator variable identifying firms that disclose inventory-related MWIC.

Our model of inventory turnover includes three sets of control variables. The first set of controls contains indicator variables capturing whether the firm discloses an MWIC related to an area other than inventory. Specifically, we control for MWIC related to revenue recognition (*Revenue-MWIC*) because sales and inventory are related via cost of goods sold, but they are not perfectly aligned because of inventory holdings across accounting periods. We also control for other MWIC (*Other-MWIC*) to reduce the concern that a correlated omitted variable drives both ineffective ICFR and inventory turnover.[12]

The second set of control variables in Equation (1) contains measures that prior research documents influence firms' inventory turnover, namely, *GrossMargin, CapitalIntensity, Sales-Volatility,* and *SalesGrowth*. We include contemporaneous gross profit margin (*GrossMargin*) as a control in Equation (1) because the trade-off between gross margin and inventory turnover is strategically determined. Specifically, firms that are able to sustain high gross margins tend to report lower inventory turnover, and *vice versa* (Gaur et al. 2005). The remainder of our variables are measured in year $t-1$. *CapitalIntensity,* defined as the natural logarithm of gross property, plant, and equipment, is included as a determinant of inventory turnover because firms that invest in more fixed assets, such as warehouses, stores, or leasehold improvements, are likely to have higher inventory turnover to generate margins to cover their overhead costs (Balakrishnan, Linsmeier, and Venkatachalam 1996). Firms with more volatile sales (*SalesVolatility*) are expected to have lower inventory turnover because the uncertainty in the demand for products will increase the likelihood of holding costs or stock-outs. We expect firms with greater sales growth (*SalesGrowth*) to have higher inventory turnover because the greater demand for products would result in greater inventory turnover.[13]

The third set of control variables includes other determinants of ineffective ICFR as reported in Ashbaugh-Skaife et al. (2007) and Doyle et al. (2007b). These determinants include firm complexity (*Segments* and *ForeignSales*), firm age (*FirmAge*), audit quality (*Auditor*), limited resources (*ROA* and *Loss*), and firm size (*Size*). Firms with more complex operations are more likely to have ineffective ICFR because the more diverse a firm's operations, the greater the chance there are inconsistent policies and procedures across operating or geographic segments. The natural log of the number of geographic and operating segments (*Segments*) and the presence of foreign sales (*ForeignSales*) are used to proxy for firm complexity. *FirmAge,* proxied by the natural log of the number of years that a company is covered by CRSP, is included in Equation (1) because smaller, younger firms are less likely to invest in sophisticated information systems, thereby increasing the likelihood of having ineffective ICFR. The quality of the external auditor is known to affect the likelihood of detecting and reporting firms' material weaknesses in ICFR. *Auditor* is set equal to 1 if the firm hires one of the six largest U.S. audit firms during our period of analysis (Deloitte, Ernst & Young, KPMG, PricewaterhouseCoopers, BDO Seidman, or Grant Thornton), and 0 otherwise. The effectiveness of ICFR is also a function of resources, as firms with limited resources are more likely to underinvest in systems and controls and to have staffing problems that

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[12] *Other-MWIC* would include material weaknesses due to the lack of separation of duties that arguably also affect the efficiency and effectiveness of operations, but are less directly traced to fundamental operating performance measures such as inventory turnover or inventory impairments.

[13] Firms having greater *SalesVolatility* and higher *SalesGrowth* are also more likely to have internal control problems because of the difficultly in planning, implementing, and maintaining adequate policies and procedures over periods of rapid expansion or contraction (Ashbaugh-Skaife et al. 2007; Doyle et al. 2007b).

lead to ineffective ICFR. We include the prior year's return on assets (*ROA*) and the existence of a loss in the prior year (*Loss*) to proxy for firm resources. We include the natural log of market value of assets to proxy for firm size (*Size*) because larger firms are more likely to have effective ICFR. We control for ineffective ICFR determinants to reduce concerns of correlated omitted variables. However, we do not make signed predictions on the set of ICFR control variables, as it is unclear how they are systematically related to inventory turnover. Equation (1) also includes industry and year indicator variables. We cluster standard errors by firm and provide variable definitions in Appendix A.

The results of the inventory turnover analysis are presented in the first column of results in Table 4. We begin by discussing the estimation of Equation (1) using *InventoryTurnover,* the unadjusted measure of inventory turnover. Consistent with our expectations, we find a significantly negative coefficient on *Inventory-MWIC* (coefficient = −6.104; t-statistic = −3.91), indicating inventory-related internal control problems are associated with lower inventory turnover. In contrast, the coefficients on *Revenue-MWIC* (coefficient = 1.322; t-statistic = 0.59) and *Other-MWIC* (coefficient = 0.291; t-statistic = 0.62) are both insignificant, indicating that material weaknesses in ICFR that are not specifically related to inventory are not associated with inventory turnover. This result is important because finding no association between other types of material weaknesses and inventory turnover alleviates the natural concern that a correlated omitted variable, such as poor management, could drive both the inventory-related ineffective ICFR and the low turnover ratio.

Turning to the factors posited to be related to inventory turnover, we find in Table 4 that *GrossMargin* is negatively associated with *InventoryTurnover,* consistent with the strategic association of high margins and low inventory turnover, and *vice versa* (Nissim and Penman 2001; Gaur et al. 2005). We find a significantly positive coefficient on *CapitalIntensity,* supporting the notion that inventory turnover is higher in firms that face higher fixed costs. We find a significantly negative coefficient on *SalesVolatility,* suggesting that the uncertainty in the demand for products results in managers being less able to predict efficient inventory levels. Finally, as predicted, we find a significantly positive coefficient on *SalesGrowth,* as more sales drives higher inventory turnover.

Turning to the MWIC determinants included in Equation (1), for which we did not have sign predictions, we find significantly negative coefficients on *Segments, ForeignSales,* and *FirmAge* in Table 4, indicating that firms with more diverse operations, competing in foreign product markets, and older firms have lower inventory turnovers. We find a positive association between turnover and *ROA,* which is consistent with a higher turnover increasing *ROA* after controlling for gross margin. Finally, *Size* is negatively associated with turnover.

The second column in Table 4 reports the results using *IndAdj-InventoryTurnover* as the dependent variable. The sign and significance level on *Inventory-MWIC* are quantitatively and qualitatively similar to the original analysis (coefficient = −8.218; t-statistic = −3.25). Likewise, the coefficients on the other MWIC variables (*Revenue-MWIC* and *Other-MWIC*) are insignificant, similar to the analysis using the unadjusted inventory turnover measure as the dependent variable. With the exception of the insignificant coefficient on *SalesVolatility* and the positive and marginally significant coefficient on *Size,* the results on the control variables are similar to those of the unadjusted inventory turnover analysis.[14]

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[14] Gaur et al. (2005) suggest that inventory turnover is better evaluated on a quarterly basis because of seasonality in inventory supply and demand. Although SOX Section 302 disclosures are less accurate in capturing the effectiveness of ICFR and quarterly ending inventory balances are not audited, we reestimate Equation (1) using quarterly data and inventory-related internal control deficiencies disclosed under Section 302. Untabulated results show that inventory-related SOX Section 302 disclosures are negatively associated with inventory turnover (p-value = 0.017) and are marginally negatively associated with industry-adjusted inventory turnover (p-value = 0.110).

## TABLE 4
### Regression Analysis of Inventory Turnover Ratio

| | Pred. Sign | Dependent Variable = | | | |
|---|---|---|---|---|---|
| | | *Inventory Turnover* | *IndAdj-Inventory Turnover* | *Inventory Turnover* | *IndAdj-Inventory Turnover* |
| Intercept | | 32.659*** | 26.169*** | 32.672*** | 26.185*** |
| | | (12.80) | (4.36) | (12.80) | (4.36) |
| *Inventory-MWIC* | − | −6.014*** | −8.218*** | | |
| | | (−3.91) | (−3.25) | | |
| *Inventory-Tracking-MWIC* | − | | | −4.308*** | −7.354*** |
| | | | | (−2.32) | (−2.70) |
| *Inventory-Valuation-MWIC* | − | | | −4.104*** | −3.439* |
| | | | | (−2.67) | (−1.50) |
| *Revenue-MWIC* | | 1.322 | −1.596 | 1.082 | −2.218 |
| | | (0.59) | (−0.42) | (0.51) | (−0.62) |
| *Other-MWIC* | | 0.291 | −0.212 | 0.291 | −0.242 |
| | | (0.62) | (−0.18) | (0.61) | (−0.20) |
| *GrossMargin* | − | −18.332*** | −38.271*** | −18.338*** | −38.285*** |
| | | (−9.33) | (−6.45) | (−9.33) | (−6.46) |
| *CapitalIntensity* | + | 1.781*** | 1.713** | 1.779*** | 1.716** |
| | | (5.74) | (2.30) | (5.73) | (2.31) |
| *SalesVolatility* | − | −6.391** | −6.367 | −6.413** | −6.444 |
| | | (−2.17) | (−0.83) | (−2.17) | (−0.84) |
| *SalesGrowth* | + | 3.087*** | 4.612** | 3.075*** | 4.581** |
| | | (3.16) | (2.07) | (3.15) | (2.06) |
| *Segments* | | −4.468*** | −3.902*** | −4.472*** | −3.911*** |
| | | (−7.49) | (−2.72) | (−7.50) | (−2.73) |
| *ForeignSales* | | −4.367*** | −3.035** | −4.353*** | −3.019** |
| | | (−7.66) | (−2.49) | (−7.63) | (−2.47) |
| *FirmAge* | | −2.502*** | −3.493*** | −2.505*** | −3.501*** |
| | | (−5.93) | (−3.90) | (−5.94) | (−3.91) |
| *Auditor* | | 0.287 | 1.283 | 0.258 | 1.255 |
| | | (0.22) | (0.43) | (0.20) | (0.42) |
| *ROA* | | 5.909* | 14.670** | 5.918* | 14.709** |
| | | (1.88) | (2.17) | (1.88) | (2.17) |
| *Loss* | | −0.605 | 1.668 | −0.597 | 1.690 |
| | | (−0.73) | (1.01) | (−0.72) | (1.03) |
| *Size* | | −1.003*** | 1.599* | −0.997*** | 1.609* |
| | | (−2.67) | (1.83) | (−2.66) | (1.84) |
| Year Indicators | | Included | Included | Included | Included |
| Industry Indicators | | Included | Not Included | Included | Not Included |
| Firm-Year Observations | | 8,953 | 8,953 | 8,953 | 8,953 |
| Inventory-MWIC | | 161 | 161 | | |
| Inventory-Tracking MWIC | | | | 99 | 99 |
| Inventory-Valuation MWIC | | | | 115 | 115 |
| F-statistic | | 48.67 | 20.59 | 47.35 | 20.06 |
| Adjusted $R^2$ | | 0.161 | 0.073 | 0.161 | 0.073 |

*(continued on next page)*

**TABLE 4 (continued)**

**Type of Inventory Weakness Analysis**

We next explore whether the relation between inventory turnover and inventory-related MWIC is driven by inventory tracking, inventory valuation, or both types of inventory-related weaknesses. For example, consider the disclosure made by 99 Cents Only Stores (excerpted from their 2006 10-K) in its internal control report:

> There was an internal control weakness surrounding the Company's inventory accounts. The Company *did not maintain accurate records of specific item quantity and location of its inventory* and therefore relied primarily on physical counting of inventory and its existing transactional controls. (emphasis added)

Similarly, Dana Holding Corp's (excerpted from their 2004 10-K) internal control report states:

> The Company *did not maintain effective control over the valuation of certain inventory and the related cost of goods sold accounts*. Specifically, the Company did not maintain effective controls over the computation and review of its LIFO inventory calculation to ensure that appropriate components, such as the impact of steel surcharges, were properly reflected in the calculation. (emphasis added)

Although we expect both tracking and valuation issues to affect inventory management, tracking issues are likely to have a larger economic effect. If inventory quantity is mistakenly under- (over-) reported because inventory is not tracked properly, then too many (too few) goods will be ordered, resulting in an overstock (stock-out) and additional holding (stock-out) costs (Nachtmann et al. 2010).

We read each of the 161 adverse inventory-related MWIC disclosures to classify each as "tracking" or "valuation," and reestimate Equation (1).[15] The final two columns in Table 4 display the results. We find lower inventory turnover ratios for both types of inventory-related MWIC; for example, in the third column of results, the coefficient on inventory-tracking (valuation) is −4.308 (−4.104). Untabulated results show that the coefficients on *Inventory-Tracking-MWIC* and *Inventory-Valuation-MWIC* are not statistically different under an F-test in either specification. The signs and significance levels of the coefficients on the control variables are quantitatively the same as in our main analysis reported in the first two columns of Table 4.

**Remediation Analysis**

If the lower inventory turnover is a result of inventory-related MWIC, then remediation of these problems should produce an increase in inventory turnover. As an illustration of remediation

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[15] Note that 53 of the observations have both tracking and valuation issues. We also note that 37 of the 161 firm-years with inventory-related MWIC also recognized an information technology (IT)-related MWIC, with 20 of these affecting inventory to some extent. In untabulated analyses, we insert indicator variables for IT-related MWIC and co-mingled inventory-IT MWIC, but neither variable is significant at conventional levels.

of inventory-related MWIC, JDS Uniphase Corporation disclosed the following in their 10-K for the year ended June 30, 2007:[16]

> As of July 1, 2006, the Company determined that it did not maintain effective controls … over the accounting for the completeness, existence, accuracy and valuation of inventory and cost of goods sold. Specifically, adequate controls were not designed over (1) the existence and accuracy of the perpetual inventory balance, (2) the accuracy of the standard costs and analysis of variances (3) the valuation of excess and obsolete inventory. In addressing this material weakness, the Company implemented the following changes to our internal control over financial reporting:
>
> • Implementation of Oracle for CommTest U.S. locations
> • Adoption of JDSU Corporate ("Classic") controls and procedures in CommTest U.S.
> • Addition of Manufacturing Site Controller and multiple cost accounting analysts
>
> As of June 30, 2007, we have determined that the new controls are effectively designed and have demonstrated effective operation for a sufficient period of time to enable management to conclude that this material weakness has been remediated.

To investigate whether firms that remediate their inventory-related MWIC experience an increase in their inventory turnover, we estimate the following change regression:

$$\Delta TurnoverRatio_{t,t+2} = \alpha_0 + \alpha_1 Remediation\text{-}Inventory\text{-}MWIC_{t,t+1}$$
$$+ \alpha_2 Remediation\text{-}Revenue\text{-}MWIC_{t,t+1}$$
$$+ \alpha_3 Remediation\text{-}Other\text{-}MWIC_{t,t+1} + \Delta Controls + \varepsilon. \qquad (2)$$

The sample used in our remediation analysis is comprised of 124 firms in the original sample that remediated their inventory-related MWIC in year $t+1$ (see Table 1, Panel B), compared to 148 firms that reported any MWIC in year $t$, and continue to report any MWIC in year $t+1$. This results in a total of 272 observations; of the 124 firms that remediated their inventory-related MWIC, 85 also remediated their revenue-related or other MWIC, which we control for in the remediation model.[17]

*Remediation-Inventory-MWIC* is equal to 1 if the problem was remediated, as evidenced by there being an inventory-related material weakness in year $t$, but not year $t+1$, and 0 otherwise. We expect a positive coefficient on *Remediation-Inventory-MWIC* if the implementation of effective policies and procedures over inventory acquisition, tracking, and valuation improve inventory management. *Remediation-Revenue-MWIC* is equal to 1 if there was a revenue recognition-related material weakness in year $t$, but not year $t+1$, and 0 otherwise. *Remediation-Other-MWIC* is equal to 1 if there were other MWIC in year $t$, but not year $t+1$, and 0 otherwise. We include other types of remediation in the model to assess whether remediating other material weaknesses in internal control over financial reporting is associated with the change in inventory turnover. Finding insignificant

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[16] Firms often make more general statements regarding the remediation of inventory-related MWICs. For example, in its 2008 10-K, Navistar International Corp. stated that "Management will implement stronger inventory procedures and systems and augment our resources to address the inventory accounting material weakness. Specifically, we are changing our procedures for cost accounting, conducting physical inventory counts, establishing accruals for inventory receipts, and establishing our provisions for inventory obsolescence." Despite the lack of greater specificity in such disclosures, the lack of an inventory-related MWIC subsequent to having an inventory-related MWIC is consistent with the firm implementing effective inventory tracking and valuation systems.

[17] We do not compare the 124 inventory-MWIC remediators to the firms that continue to report inventory-related MWIC because of the small sample of firms that continue to report inventory-related MWIC (n = 37; see Table 1, Panel B). In untabulated analyses, the difference in the change in inventory turnover between the two subsamples is 0.481, but this difference is not statistically different from zero (t-statistic = 1.22).

coefficients on *Remediation-Revenue-MWIC* and *Remediation-Other-MWIC* would provide further support for the effect of the remediation of inventory MWIC on the change in inventory turnover.

We measure inventory turnover changes from year $t$ to year $t+2$, where year $t+1$ is the remediation year. We do not examine one-year changes because it is not clear when in year $t+1$ the inventory-related material weakness was remediated.[18] Thus, we require the weakness to have been remediated for *at least* one full year (all of year $t+2$) in order to better capture the benefits to remediation. As such, all control variables are also measured as two-year changes defined as $(t+2) - t$.

The first column of results in Table 5 displays the results of estimating Equation (2). We find an insignificant coefficient on *Remediation-Inventory-MWIC* (coefficient = 1.262; t-statistic = 0.48) and no significant relation between remediation of other types of internal control problems and changes in inventory turnover. However, when we partition remediating firms by the nature of their inventory-related MWIC, presented in the final column of results in Table 5, we discover that firms that remediate their inventory-tracking MWIC experience significant increases in their inventory turnover rates (coefficient = 4.253; t-statistic = 1.65). Because inventory tracking relates to having the necessary policies and procedures to properly record the buying, selling, storage, and returns of inventory, this finding is consistent with the notion that the day-to-day inventory management decisions are affected by MWIC related to inventory tracking. Importantly, the coefficients on *Remediation-Revenue-MWIC* and *Remediation-Other-MWIC* are insignificant in both regressions, diminishing the concern that the remediation of other types of MWIC drives the change in inventory turnover. The results of the remediation analysis also indicate that as gross margin increases, inventory turnover falls, as theory predicts.

## Inventory Impairments

As stated earlier, surplus inventory can be an indication of inventory management problems. Firms holding surplus or obsolete inventory with market values declining below cost are required to record inventory impairments in order to value the inventory at the lower of cost or market in accordance with U.S. GAAP. According to U.S. GAAP, inventory impairments must be written off in the period in which they are identified. The write-off is recorded as a loss and reduces operating income, thereby having a negative effect on operating performance and bottom-line net income. We use both the existence and the magnitude of inventory impairments (*Impairment Indicator* and *Impairment Magnitude,* respectively) as indications of poor inventory management and deterioration of operating performance as a result of inventory-related MWIC.

Because the presence and magnitude of inventory impairments is hand-collected from firms' financial statements, we construct a matched sample, based on year, two-digit SIC code, total assets, and inventory level, to investigate our conjecture that inventory-related MWIC will increase the likelihood of an inventory impairment, as well as the magnitude of inventory impairments. Of the 161 inventory-related MWIC firm-years we examine in Table 4, we are able to match 139 with control firms that report effective internal control.[19] In untabulated analyses, we confirm that total

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[18] Although we require that the MWIC related to inventory be remediated by the end of year $t+1$, the day-to-day operations throughout year $t+1$ could still be affected by the inventory-related internal control problems, especially given the time and effort involved in implementing inventory control systems (Bedard, R. Hoitash, U. Hoitash, and Westermann 2012).

[19] Specifically, within year and two-digit SIC code, we first consider all match firms with total assets within 30 percent of the material weakness firm, and then identify the matched firm as the one with the closest inventory level. It is important to note that many of the control variables in the inventory impairment models are also determinants of MWIC, thereby diminishing endogeneity concerns and the need for a propensity matched sample. Untabulated results, however, are robust to estimating a propensity score match using the following model: *Inventory-MWIC* = $\beta_0$ + $\beta_1 Size$ + $\beta_2 CapitalIntensity$ + $\beta_3 SalesVolatility$ + $\beta_4 SalesGrowth$ + $\beta_5 ROA$ + $\beta_6 Loss$ + $\beta_7 Segments$ + $\beta_8 ForeignSales$ + $\beta_9 FirmAge$ + $\beta_{10} Auditor$ + *Year Fixed Effects* + *Firm Fixed Effects*.

### TABLE 5

### Regression Analysis of Changes in Inventory Turnover Ratio on Remediation of Inventory-Related Material Weaknesses

| | Pred. Sign | Dependent Variable = $\Delta InventoryTurnover$ | |
|---|---|---|---|
| Intercept | | 0.769 | 0.266 |
| | | (0.33) | (0.11) |
| *Remediation-Inventory-MWIC* | + | 1.262 | |
| | | (0.48) | |
| *Remediation-Inventory-Tracking* | + | | 4.253** |
| | | | (1.65) |
| *Remediation-Inventory-Valuation* | + | | −0.382 |
| | | | (−0.15) |
| *Remediation-Revenue-MWIC* | | 1.157 | 0.715 |
| | | (0.43) | (0.27) |
| *Remediation-Other-MWIC* | | 3.937 | 3.309 |
| | | (1.38) | (1.19) |
| *ΔGrossMargin* | | −10.653** | −10.892** |
| | | (−2.05) | (−2.11) |
| *ΔCapitalIntensity* | | −2.581 | −2.750 |
| | | (−1.43) | (−1.52) |
| *ΔSalesVolatility* | | 4.653 | 4.574 |
| | | (0.46) | (0.45) |
| *ΔSalesGrowth* | | 1.110 | 1.261 |
| | | (0.43) | (0.95) |
| *ΔSegment* | | 1.798 | 2.170 |
| | | (0.79) | (0.95) |
| *ΔForeignSales* | | −3.122 | −2.669 |
| | | (−1.17) | (−1.00) |
| *ΔAuditor* | | −5.799* | −6.016* |
| | | (−1.78) | (−1.84) |
| *ΔROA* | | 4.305 | 4.371 |
| | | (0.45) | (0.46) |
| *ΔLoss* | | −0.185 | 0.079 |
| | | (−0.09) | (0.04) |
| *ΔSize* | | −0.199 | −0.201 |
| | | (−0.14) | (−0.14) |
| *PriorPeriodInventoryTurnover* | | −0.126** | −0.122** |
| | | (−2.11) | (−2.04) |
| Year Indicators | | Included | Included |
| Inventory-Related MWIC Remediators | | 124 | 124 |
| All MWIC Non-Remediators | | 148 | 148 |
| Total Firm-Year Observations | | 272 | 272 |
| F-statistic | | 1.54 | 1.60 |
| Adjusted $R^2$ | | 0.04 | 0.04 |

*, ** Denote p-values of less than 0.10 and 0.05, respectively (one-tailed if there is a sign prediction, two-tailed otherwise).

**TABLE 5 (continued)**

The sample used in this analysis is comprised of 124 firms in the original sample described in Table 1 that remediated their inventory-related MWIC in year $t+1$, compared to 148 firms that had any MWIC in year $t$ and did not remediate their MWIC in year $t+1$; both must have the necessary data to calculate change variables. The change variables are defined as $(t+2) - t$, where $t$ is the last year the firm reported an MWIC. Variables are winsorized at the 1 percent level. Standard errors are clustered by firm, and t-statistics are in parentheses.
Variable definitions not shown below appear in Appendix A.

Variable Definitions:
*Remediation-Inventory-MWIC* $= 1$ if the firm corrected its inventory-related internal control problem, and 0 otherwise;
*Remediation-Revenue-MWIC* $= 1$ if the firm corrected its revenue recognition internal control problem, and 0 otherwise;
*Remediation-Other-MWIC* $= 1$ if the firm corrected its other internal control problems, and 0 otherwise; and
*PriorPeriodInventoryTurnover* $=$ the inventory turnover from year $t-1$.

assets, inventory, and cost of goods sold are not statistically different across the treatment and control groups.

Untabulated descriptive statistics indicate that 43.8 percent of *Inventory-MWIC* firms report inventory impairments, whereas 22.3 percent of control firms incur inventory write-offs, and the difference is significant (p-value $= 0.001$). To test the association between inventory-related internal control problems and inventory impairments (i.e., write-offs) in a multivariate setting, we estimate the following equations:

$$
\begin{aligned}
\textit{Impairment Indicator}_t = {} & \alpha_0 + \alpha_1 \textit{Inventory-MWIC}_t + \alpha_2 \textit{Revenue-MWIC}_t + \alpha_3 \textit{Other-MWIC}_t \\
& + \alpha_4 \textit{GrossMargin}_t + \alpha_5 \textit{CapitalIntensity}_{t-1} + \alpha_6 \textit{SalesVolatility}_{t-1} \\
& + \alpha_7 \textit{SalesGrowth}_{t-1} + \alpha_8 \textit{Segments}_{t-1} + \alpha_9 \textit{ForeignSales}_{t-1} \\
& + \alpha_{10} \textit{FirmAge}_{t-1} + \alpha_{11} \textit{Auditor}_{t-1} + \alpha_{12} \textit{ROA}_{t-1} + \alpha_{13} \textit{Loss}_{t-1} \\
& + \alpha_{14} \textit{Size}_{t-1} + \varepsilon.
\end{aligned}
$$

(3)

$$
\begin{aligned}
\textit{Impairment Magnitude}_t = {} & \alpha_0 + \alpha_1 \textit{Inventory-MWIC}_t + \alpha_2 \textit{Revenue-MWIC}_t + \alpha_3 \textit{Other-MWIC}_t \\
& + \alpha_4 \textit{GrossMargin}_t + \alpha_5 \textit{CapitalIntensity}_{t-1} + \alpha_6 \textit{SalesVolatility}_{t-1} \\
& + \alpha_7 \textit{SalesGrowth}_{t-1} + \alpha_8 \textit{Segments}_{t-1} + \alpha_9 \textit{ForeignSales}_{t-1} \\
& + \alpha_{10} \textit{FirmAge}_{t-1} + \alpha_{11} \textit{Auditor}_{t-1} + \alpha_{12} \textit{ROA}_{t-1} + \alpha_{13} \textit{Loss}_{t-1} \\
& + \alpha_{14} \textit{Size}_{t-1} + \varepsilon.
\end{aligned}
$$

(4)

We expect positive coefficients on *Inventory-MWIC*. We estimate Equation (3) using a logistic regression and estimate Equation (4) using a tobit regression because impairment magnitude cannot be less than zero and, thus, is left censored. We do not include year or industry indicators in Equations (3) or (4) because, as previously discussed, we use a matched sample in conducting our inventory impairment analysis. Otherwise, Equations (3) and (4) include the same control variables as in Equation (1) and standard errors are clustered by firm.

The first two columns of results in Table 6 display the results of our inventory impairment tests, with the likelihood of inventory impairment analysis (Equation (3)) being reported in the first column, labeled "*Impairment*," and the magnitude of impairment analysis (Equation (4)) in the second column. Consistent with our expectations, we find firms with inventory-related MWIC are more likely to record inventory impairments (coefficient $= 0.717$; $\chi^2 = 3.45$). The untabulated economic effect of *Inventory-MWIC* suggests that having an inventory-related MWIC increases the likelihood of writing off inventory by 15.9 percent. The results also indicate that firms with higher sales growth and larger auditors are more likely to report

## TABLE 6

### Logistic (Tobit) Regression Analysis of the Existence (Magnitude) of Inventory Impairments on MWIC

| | Pred. Sign | Dependent Variable = | | | |
|---|---|---|---|---|---|
| | | *Impairment* | *Impairment Magnitude* | *Impairment* | *Impairment Magnitude* |
| Intercept | | −3.569*** | −0.033** | −3.547*** | −0.032** |
| | | (9.14) | (5.78) | (9.19) | (5.02) |
| *Inventory-MWIC* | + | 0.717** | 0.011*** | | |
| | | (3.45) | (5.90) | | |
| *Inventory-Tracking-MWIC* | | | | 0.442* | 0.005* |
| | | | | (1.75) | (1.70) |
| *Inventory-Valuation-MWIC* | | | | 0.568** | 0.007** |
| | | | | (2.67) | (3.22) |
| *Revenue-MWIC* | | 0.200 | 0.001 | 0.213 | 0.002 |
| | | (0.27) | (0.04) | (0.31) | (0.14) |
| *Other-MWIC* | | 0.104 | 0.001 | 0.089 | 0.002 |
| | | (0.46) | (0.53) | (0.33) | (0.67) |
| *GrossMargin* | | −0.301 | −0.004 | −0.271 | −0.004 |
| | | (0.15) | (0.19) | (0.12) | (0.15) |
| *CapitalIntensity* | | −0.083 | −0.003** | −0.069 | −0.003** |
| | | (0.44) | (4.87) | (0.31) | (4.34) |
| *SalesVolatility* | | 1.068 | 0.006 | 1.072 | 0.006 |
| | | (1.40) | (0.28) | (1.41) | (0.28) |
| *SalesGrowth* | | 1.057** | 0.008 | 1.106** | 0.009 |
| | | (4.79) | (2.16) | (5.20) | (2.48) |
| *Segments* | | 0.281 | 0.004 | 0.297 | 0.004 |
| | | (1.63) | (1.80) | (1.79) | (1.99) |
| *ForeignSales* | | 0.335 | 0.001 | 0.280 | 0.001 |
| | | (0.46) | (0.01) | (0.31) | (0.01) |
| *FirmAge* | | −0.183 | −0.003 | −0.189 | −0.003 |
| | | (1.39) | (1.86) | (1.47) | (1.90) |
| *Auditor* | | 1.395* | 0.004 | 1.444** | 0.005 |
| | | (3.75) | (0.35) | (4.00) | (0.50) |
| *ROA* | | −0.582 | 0.005 | −0.651 | 0.004 |
| | | (0.12) | (0.08) | (0.15) | (0.03) |
| *Loss* | | 0.203 | 0.003 | 0.168 | 0.003 |
| | | (0.23) | (0.46) | (0.16) | (0.38) |
| *Size* | | 0.206 | 0.004* | 0.186 | 0.004* |
| | | (1.54) | (3.56) | (1.28) | (3.25) |
| Year Indicators | | Included | Included | Included | Included |
| Firm-Year Observations | | 278 | 278 | 278 | 278 |
| *Inventory-Tracking-MWIC* | | | | 86 | 86 |
| *Inventory-Valuation-MWIC* | | | | 99 | 99 |
| $\chi^2$ | | 39.21 | 277.02 | 39.90 | 275.45 |
| Pseudo $R^2$ | | 0.183 | NA | 0.186 | NA |

*, **, *** Denote p-values of less than 0.10, 0.05, and 0.01, respectively (one-tailed if there is a sign prediction, two-tailed otherwise).

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**TABLE 6 (continued)**

The sample used in this analysis is comprised of 139 unique firms described in Table 1 that reported inventory-related material weaknesses in internal control that could be matched to 139 firms with effective internal control based on two-digit SIC code, year, total assets, and inventory value. Standard errors are clustered by firm, and $\chi^2$ statistics are in parentheses. Note that the coefficients on *Inventory-Tracking-MWIC* and *Inventory-Valuation-MWIC* are not statistically different under an F-test at conventional levels.

Variable definitions appear in Appendix A.

inventory impairments. Other types of MWIC are not associated with the existence of inventory impairments.

Turning to the impairment magnitudes in Table 6, we find a positive and significant coefficient on *Inventory-MWIC* (coefficient = 0.011; $\chi^2 = 5.90$), indicating that firms with ineffective ICFR over inventory report larger inventory impairments relative to the control sample of effective ICFR firms. The results also indicate that firms with higher capital intensity report lower magnitudes of inventory impairments, whereas larger firms tend to report larger inventory impairments. Neither the *Revenue-MWIC* nor the *Other-MWIC* coefficient is significant.

The final two columns of Table 6 display the results of estimating Equations (3) and (4) when partitioning *Inventory-MWIC* into *Inventory-Tracking-MWIC* and *Inventory-Valuation-MWIC*. Regardless of the type of MWIC over inventory, we find firms are more likely to have inventory impairments and report larger inventory impairments when they have ineffective ICFR related to inventory. In untabulated tests, the differences in the coefficients between *Inventory-Tracking-MWIC* and *Inventory-Valuation-MWIC* are not statistically different in either analysis.

Collectively, the results of the inventory turnover analysis and inventory impairment tests are consistent with our general hypothesis that ineffective ICFR related to inventory has implications for firm operations and, ultimately, operating performance.

### Change in Additional Operating Performance Measures

Previously, we provided some evidence that firms that remediated their inventory-related MWIC saw improvements in their core operations via greater inventory turns (see Table 5), but this remediation analysis does not shed light on whether the improvements in inventory-related ICFR affect other measures of operating performance. If the effect of the remediation of inventory-related MWIC is substantial, then we expect sales, gross margin, operating income, and cash flows from operations to improve after their remediation. We investigate whether there is a significant increase in sales and gross margin after firms remediate their inventory-related MWIC because these two accounting measures are directly impacted by inventory management and are often reported in the financial press. Likewise, we examine whether there is a significant increase in operating income and operating cash flows because these measures are often cited when discussing firms' operating performance.

We test whether remediating firms' changes in sales, gross margin, operating income, and operating cash flows are greater than zero, and also test whether the changes for firms remediating inventory-related MWIC (124 firm-year observations) are greater than the changes for firms that continue to report any type of MWIC (148 firm-year observations). Table 7, Panel A reports the results. As in Table 5, we calculate changes from year $t$ to year $t+2$, where year $t+1$ is the year of remediation.

In Table 7, Panel A, we find that firm-specific changes in sales, gross margin, and cash flow from operations are statistically greater than zero after firms remediate their inventory-related MWIC, suggesting that the remediation of inventory-related MWIC improved firms' operating decisions. For example, among the 124 firm-years remediating their inventory-related MWIC, there

## TABLE 7

## Operational Performance after Remediation of Inventory-Related Material Weaknesses

**Panel A: The Comparison of Changes in Performance between Firms that Remediated Inventory-Related Material Weaknesses and Firms that Did Not Remediate Material Weaknesses**

| | Firms that Remediated Their Inventory-Related MWIC n = 124 | Firms that Did Not Remediate Their MWIC (Any Area) n = 148 | t-stat. |
|---|---|---|---|
| | **Mean** | | |
| Change in log of sales | 0.076** | 0.146 | −1.25 |
| Change in gross profit/net sales | 0.021*** | −0.007 | 1.46 |
| Change in operating income/sales | 0.026 | −0.110 | 1.37 |
| Change in cash flows from operations/assets | 0.027*** | −0.009 | 2.11 |

**, *** Denote two-tailed p-values of less than 0.05 and 0.01, respectively, testing for a value greater than 0.
The sample used in this analysis is comprised of 124 firms in the original sample described in Table 1 that remediate their inventory-related MWIC in year $t+1$ compared to 148 firms that did not remediate their MWIC in year $t+1$; both must have the necessary data to calculate the performance measures pre- and post-remediation. The change variables are defined as $(t+2) − t$, where $t$ is the last year the firm reported an MWIC. Variables are winsorized at the 1 percent level.

**Panel B: The Comparison of Post-Remediation Performance between Firms that Remediated Inventory-Related Material Weaknesses and Firms that Did Not Have Material Weaknesses**

| | Firms that Remediated Their Inventory-Related MWIC n = 124 | Firms that Consistently Maintained Effective Internal Control n = 7,945 | t-stat. |
|---|---|---|---|
| | **Mean** | | |
| Inventory turnover | 10.688 | 14.230 | −1.59 |
| Log of sales | 6.272 | 7.365 | −8.41 |
| Gross profit/net sales | 0.359 | 0.371 | −0.66 |
| Operating income/sales | −0.004 | −0.065 | 1.07 |
| Cash flows from operations/assets | 0.078 | 0.095 | −1.59 |

The sample used in this analysis is comprised of 124 firms in the original sample described in Table 1 that remediated their inventory-related MWIC in year $t+1$ compared to 7,945 firm-years in the original sample that disclosed effective internal controls in year $t$ and $t+1$; both groups must have the necessary data to calculate the performance measures. The variables are measured at $t+2$, where $t$ is the last year the firm reported an MWIC. Variables are winsorized at the 1 percent level.

is an increase in gross margin of 2.1 percent, on average, from year $t$ to year $t+2$. We also provide evidence that the increase in operating cash flows is significantly greater for remediating firms (0.027) relative to firms that continue to report MWIC (−0.009). Overall, the firm-specific improvements in these performance measures, as well as the improvement in inventory turnover, is consistent with our conjecture that inventory-related MWIC has adverse consequences for firm operations.

Table 7, Panel B reports the results of investigating whether firms that remediated their inventory-related MWIC (124 firm-year observations) are distinguishable from firms that

consistently maintained effective ICFR (7,945 firm-year observations). Once firms with inventory-related MWIC remediate these weaknesses, we do not expect the performance of these firms to be different from firms with effective internal control. We find that inventory turnover ratios are lower among the newly remediated firms (10.688) relative to effective ICFR firms (14.230), but the difference is not significant at conventional levels (t-statistic = 1.59; two-tailed p-value = 0.115). Sales are significantly higher (t-statistic = 8.41) among effective ICFR firms (7.365) relative to remediated firms (6.272). In contrast, gross margin and operating margin are not statistically different between firms that remediate their inventory-related MWIC and firms with consistently effective ICFR. Finally, operating cash flows of remediated firms (0.078) are lower than firms consistently maintaining effective internal control (0.095), but the difference is not significant at conventional levels (t-statistic = 1.59; two-tailed p-value = 0.112). Overall, the results of our operational performance analysis provide some evidence that firms opting to remediate their inventory-related MWIC see improvements in their operating performance and become more comparable, in terms of operating performance measures, to firms that have maintained effective ICFR.

### Generalizability of the Results

A strength of our research design is the clear link between inventory-related MWIC and inventory management outcome variables: inventory turnover and inventory impairments. However, we expect that our results have broader implications for firm operations. In particular, we expect MWIC to have a negative impact on firm operations in a multitude of ways. For example, ineffective ICFR over accounts receivable can result in a company failing to follow up on outstanding receivables, leading to a greater proportion of uncollectible accounts or failing to recognize the riskiness of potential customers, resulting in higher bad debt expense and lower net income.[20] Similarly, ineffective ICFR over sales-related liabilities such as warranties can lead to inefficient pricing. To provide evidence on this broader association between ineffective ICFR and operations, we examine the relation between *MWIC* and return on assets (*ROA*). The results are reported in Table 8.

We consider three sets of analyses. In the first column of results (Table 8, Column A), we replicate our main analysis, extending it to a broader setting, regressing contemporaneous *ROA* on *MWIC*. The coefficient on *MWIC* is negative and economically significant with a coefficient of −0.01 (t-statistic = −2.19), suggesting that *ROA* is an average of 1 percent lower for firms with ineffective internal controls after controlling for prior performance and other determinants of operating performance, such as growth.

In our second analysis (Table 8, Column B), we explore whether, among firms with ineffective ICFR in year *t,* those that remediate their ineffective ICFR in year *t*+1 experience an improvement in *ROA* (measured from year *t* to *t*+2, consistent with our prior analyses). We find a positive coefficient on *Remediation-MWIC* (coefficient = 0.026), indicating that following the remediation of ineffective internal controls, firms experience, on average, a significant improvement of 2.6 percent in *ROA* from year *t* to *t*+2 (t-statistic = 1.56; one-tailed p-value = 0.060).

Finally, in Table 8, Column C, we examine whether future ROA for firms that remediate MWIC in year *t* (n = 435) and firms that do not remediate MWIC in year *t* (n = 625 − 435 = 190) is statistically different from firms that report effective ICFR in year *t* (n = 8,852 − 625 = 8,227). We find that the 190 firms that disclose ineffective ICFR in year *t* have ROA that is 3.3 percent lower than the full sample (one-tailed p-value < 0.05).

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[20] As with our inventory-related MWIC, these weaknesses are flagged under Section 404, indicating that they violate the assumptions of effective ICFR, but can also threaten more general internal control effectiveness.

## TABLE 8

### The Association between Operating Performance and Material Weaknesses in Internal Control over Financial Reporting

| | | Dependent Variable = | | | | |
|---|---|---|---|---|---|---|
| | Column A | | Column B | | Column C | |
| | Pred. Sign | $ROA_t$ | Pred. Sign | $\Delta ROA_{t,t+2}$ | Pred. Sign | $ROA_{t+2}$ |
| Intercept | | −0.105*** | | −0.006 | | −0.065*** |
| | | (−12.95) | | (−0.17) | | (−4.11) |
| MWIC | − | −0.010** | | | | |
| | | (−2.19) | | | | |
| Remediation-MWIC | | | + | 0.026* | ? | 0.009 |
| | | | | (1.56) | | (1.55) |
| NoRemediation-MWIC | | | | | − | −0.033** |
| | | | | | | (−1.68) |
| CapitalIntensity | | −0.003*** | | −0.022 | | 0.001 |
| | | (−3.26) | | (−1.55) | | (0.27) |
| SalesVolatility | | −0.004 | | 0.008 | | −0.037 |
| | | (−0.53) | | (0.08) | | (−1.52) |
| Growth | | −0.013** | | 0.041** | | −0.018 |
| | | (−2.44) | | (2.56) | | (−1.51) |
| Complexity | | −0.001 | | −0.013 | | 0.003 |
| | | (−0.93) | | (−0.76) | | (1.20) |
| ForeignOperations | | 0.000 | | 0.012 | | 0.002 |
| | | (0.18) | | (0.49) | | (0.55) |
| Age | | 0.003** | | | | 0.004* |
| | | (2.56) | | | | (1.77) |
| Auditor | | −0.007 | | 0.049 | | 0.017 |
| | | (−1.23) | | (1.23) | | (0.91) |
| PriorROA | | 0.706*** | | −0.154** | | 0.692*** |
| | | (27.07) | | (−2.11) | | (10.14) |
| Loss | | −0.005 | | −0.019** | | 0.017* |
| | | (−1.17) | | (−1.97) | | (1.85) |
| Size | | 0.012*** | | 0.111*** | | 0.007*** |
| | | (10.80) | | (4.21) | | (2.93) |
| Year Indicators | | Included | | Included | | Included |
| Industry Indicators | | Included | | Included | | Included |
| Firm-Year Observations | | 8,953 | | 625 | | 8,852 |
| MWIC Observations | | 640 | | 625 | | 625 |
| Remediation-MWIC | | | | 435 | | 435 |
| F-value | | 683.1 | | 12.81 | | 155.28 |
| Adjusted $R^2$ | | 0.549 | | 0.221 | | 0.229 |

*, **, *** Denote p-values of less than 0.10, 0.05, and 0.01, respectively (one-tailed if there is a sign prediction, two-tailed otherwise).

Columns A and C include all firm-year observations with available data; Column B includes only firm-year observations of firms with MWIC in year $t$. *ROA* is return on assets, defined as earnings before extraordinary items scaled by total assets. $\Delta ROA_{t,t+2}$ is the difference between $ROA_{t+2} - ROA_t$, where $t$ is the last year the firm reported an MWIC. Control variables in Column A are measured at $t-1$. Control variables in Column B except *PriorROA* are change variables, defined as $(t+2) - t$. Control variables in Column C are measured at $t+1$. Standard errors are clustered by firm, and t-statistics are in parentheses. Other variable definitions appear in Appendix A.

Overall, the results of the more general analysis assessing the relation between MWIC and firm operating performance as proxied by ROA are consistent with our main analysis examining the relation between inventory-related MWIC and indicators of inventory management known to affect operating performance. We conclude that firms that maintain ineffective ICFR have weaker operating performance, both concurrently and prospectively, and firms that remediate their ineffective ICFR experience improvements in their operating performance.

## Sensitivity Tests

### *Accuracy of Inventory Transactions versus Reported Ending Inventory Value*

Our inventory turnover ratios and inventory impairments are a product of the accounting system. The premise of our paper is that auditors can correct the inventory values reported in the annual financial statements via substantive testing (e.g., Hogan and Wilkins 2008; Doyle et al. 2007b), but that the daily, weekly, and monthly inventory transactions will be affected by inventory-related MWIC. It is possible, however, that inventory values reported in firms' financial statements are erroneous, and that it is the misstated ending value of inventory that is affecting the association between inventory management and inventory-related MWIC. To explore the sensitivity of our results to this issue, we exclude all firm-years that restated as of December 31, 2012, and reestimate Equation (1). Specifically, in untabulated results, we exclude 520 firm-years with misstatements, of which 41 relate to ineffective ICFR over inventory; results are quantitatively similar.

### *Performance: Determinant versus Consequence*

A number of studies have provided evidence that poorly performing firms are more likely to maintain ineffective ICFR (i.e., performance is a determinant of material weaknesses in ICFR). In our study, we posit that poor operating performance is also a *consequence* of inventory-related MWIC. In our main analyses, we investigate our hypothesized effect by controlling for non-inventory-related MWIC and also by conducting a change analysis. In this section, we explore this further by reestimating Table 4 solely among loss firms, and also by ROA quartile. Untabulated results are similar in each of these subsets of observations, further corroborating that the lower inventory turnover ratios we document are not simply a function of poor prior performance. Instead, we find additional evidence that poor operating performance is a consequence of inventory-related MWIC.[21]

### *Ending versus Average Inventory*

Our inventory turnover ratios are scaled by average inventory. However, the results of our impairment tests suggest that the beginning balance of inventory may contain some soon-to-be-impaired inventory for firms reporting inventory-related MWIC, which would result in systematically lower inventory turnover ratios. This possibility biases in favor of finding a negative coefficient on *Inventory-MWIC* in the inventory turnover ratio test. As another untabulated robustness check, we repeat our analyses using firms' ending inventory balance. Results are qualitatively and quantitatively similar.

### *Alternate Samples*

Although we used a matched sample for our impairment analysis because inventory impairments must be hand-collected from firms' financial statements, our main control sample for

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[21] Our change analysis also helps to address this concern, suggesting that it is ICFR affecting performance, not *vice versa*.

the inventory turnover analysis includes all firms on Compustat having the necessary data to conduct our empirical tests. When we replicate our inventory turnover test (Equation (1)) using the matched sample of 139 inventory-related MWIC firms and 139 effective ICFR firms used in our impairment analysis, the untabulated coefficient on inventory-related MWIC remains negative and significant, albeit weaker than that presented in Table 3.

We also conduct a sensitivity test using an alternative sample for our inventory impairment analysis. Specifically, we estimate Equations (2) and (3) using the impairment data of Allen, Larson, and Sloan (2013), who collect inventory impairments for the 2004 population of firms covered by Compustat. The untabulated results are qualitatively and quantitatively similar.

## V. CONCLUSION

We examine the association between inventory-related material weaknesses in internal control (MWIC) and accounting-based measures of inventory management to draw inferences on whether internal control over financial reporting (ICFR) has spillover effects on firm operations. We hypothesize that firms with inventory-related MWIC are more likely to experience the real effects of stock shortages, excess inventory, and greater inventory obsolescence as a consequence of maintaining ineffective inventory-related ICFR, leading to lower inventory turnover and more inventory impairments. Consistent with these expectations, we document that firms with inventory-related MWIC, as identified in firms' required internal control reports, have systematically slower inventory turnover and have a higher likelihood and magnitude of inventory impairments. We also find evidence that inventory turnover ratios, sales, gross margin, and cash flows from operations improve when the weaknesses are remediated. Because firms with higher inventory turnover ratios and fewer inventory impairments are viewed to be operating more effectively, our findings suggest that an unintended benefit of maintaining effective ICFR is better operating performance.

The debate over the required public disclosure of MWIC continues. COSO issued a revised internal control framework in December 2011 emphasizing the importance of communicating internal control effectiveness to external stakeholders. Nevertheless, in October 2011 the U.S. Jobs Council recommended amending SOX to allow public companies with market valuations below $1 billion to opt out of Section 404 compliance (Miller 2011). Moreover, the average manager perceives no operational benefit from maintaining effective ICFR (Alexander et al. 2013). Proposal legislation may also be introduced in the House of Representatives to adjust the definition of accelerated filers such that firms with market capitalization of less than $250 million or annual revenues of less than $100 million will no longer be required to disclose MWIC (*Strategic Finance* 2012). These policy issues would benefit from evidence on the effect of ICFR on firm operations because managers responsible for both the decision to establish and maintain effective ICFR, as well as the daily operation of their firm, may underestimate the actual benefits from ICFR. We leave the issue of whether the costs of establishing and maintaining effective ICFR outweigh the combined reporting and operational benefits to future research.

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# APPENDIX A

## Variable Definitions

| Variable Name | Definition |
|---|---|
| *InventoryTurnover* | Inventory turnover ratio measured as cost of sales (Compustat COGS) in year $t$ divided by inventory (Compustat INVT) averaged over years $t-1$ and $t$ (on a FIFO basis). |
| *IndAdj-InventoryTurnover* | The firm-specific inventory turnover ratio less the median inventory turnover ratio for the firm's industry, where industry is defined by two-digit SIC. |
| *Inventory-MWIC* | An indicator variable equal to 1 if the firm reports there is an inventory-related material weakness in internal control in year $t$, and 0 otherwise; (Audit Analytics NOTEFF_ACC_REAS_KEYS = 32, or NOTEFF_FINFRAUD_KEYS = 32, or NOTEFF_OTHER_REAS_KEYS = 32). |
| *Revenue-MWIC* | An indicator variable equal to 1 if the firm reports there is a material weakness in internal control over revenue recognition in year $t$, and 0 otherwise; (Audit Analytics NOTEFF_ACC_REAS_KEYS = 39, or NOTEFF_FINFRAUD_KEYS = 39, or NOTEFF_OTHER_REAS_KEYS = 39). |
| *Other-MWIC* | The number of material weaknesses in internal control in year $t$ excluding those over inventory or revenue recognition (Audit Analytics NOTEFF_ACC_REAS_KEYS $\neq$ 32 or 39, and NOTEFF_FINFRAUD_KEYS $\neq$ 32 or 39, and NOTEFF_OTHER_REAS_KEYS $\neq$ 32 or 39). |
| *GrossMargin* | The gross profit ratio measured as (sales (Compustat REVT) − cost of sales (Compustat COGS)) divided by sales (Compustat REVT) in year $t$. |
| *CapitalIntensity* | The natural logarithm of gross property, plant, and equipment (Compustat PPEGT) at the end of year $t$. |
| *SalesVolatility* | The standard deviation of annual sales (Compustat REVT) divided by average total assets (Compustat AT) in years $t$ and $t-1$ over the prior seven years (requiring at least three non-missing observations). |
| *SalesGrowth* | Sales growth from year $t-2$ to year $t-1$. |
| *Segments* | The natural logarithm of the total number of geographic and operating segments in year $t-1$. |
| *ForeignSales* | An indicator variable equal to 1 if the firm reports foreign sales (Compustat FCA) in year $t$, and 0 otherwise. |
| *FirmAge* | The natural logarithm of the number of years that a company is covered by CRSP at the end of year $t-1$. |
| *Auditor* | An indicator variable equal to 1 if the firm hires one of the six largest audit firms (Audit Analytics AUDITOR_FKEY $\leq$ 7), and 0 otherwise. |
| *ROA* | Earnings before extraordinary items (Compustat IB) in year $t-1$ divided by average total assets over year $t-1$ and year $t-2$. |
| *Loss* | An indicator variable equal to 1 if net income (Compustat NI) in year $t-1$ is less than zero, and 0 otherwise. |
| *Size* | The natural logarithm of market value of equity (Compustat PRCC_F $\times$ CSHO) at the end of year $t-1$. |

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