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Do Internal Control Weaknesses Affect Firms' Demand for Accounting Skills? Evidence from U.S. Job Postings

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ABSTRACT: In this study, we examine whether firms respond to internal control weaknesses (ICWs) by requiring accounting-specific skills when hiring rank-and-file employees. Using unique data containing an extensive collection of job postings, we document significant increases in firms' job postings that list accounting skills after the disclosure of an ICW. This effect is more pronounced for firms with better financial resources and when ICWs are more severe or personnel-related. In addition, our results extend to employees that are not specifically designated as accountants, suggesting a broader role for rank-and-file employees in influencing internal control quality. Finally, we find that increases in job postings with accounting skill requirements are associated with improvements in internal controls and a higher likelihood of ICW remediation. Overall, our findings shed new light on how firms respond to ineffective internal controls by increasing their emphasis on accounting skills in their workforce.

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I. INTRODUCTION

Implementing and executing high-quality accounting systems is essential in the production of financial reporting information. Deficiencies in these systems, manifested as internal control weaknesses (ICWs), are associated with greater regulatory scrutiny, negative market reactions, and increased cost of capital (e.g., Beneish, Billings, and Hodder 2008; Hammersley, Myers, and Shakespeare 2008; Ashbaugh-Skaife, Collins, Kinney, and LaFond 2009;

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Dhaliwal, Hogan, Trezevant, and Wilkins 2011; Kim, Song, and Zhang 2011).[1] In many cases, firms respond to ICWs by replacing executives responsible for the preparation of the financial statements. Such a response, however, may be incomplete as it ignores the role of rank-and-file personnel, a pivotal component of accounting systems and a common cause of ICWs (e.g., Ge and McVay 2005; Doyle, Ge, and McVay 2007; Ashbaugh-Skaife, Collins, Kinney, and LaFond 2008). Our study assesses whether ICWs prompt firms to increase their requirements for accounting-based skill sets when hiring rank-and-file employees and whether such efforts facilitate improvements in internal controls.

Our study is motivated by the argument that rank-and-file employees play a significant role in the implementation and execution of internal controls over financial reporting (e.g., J. Choi, S. Choi, Hogan, and Lee 2013; Guo, Huang, Zhang, and Zhou 2016; Call, Campbell, Dhaliwal, and Moon 2017). Thus, requiring more accounting skills can improve accounting systems and help remediate ICWs. We argue, however, that such a strategy (a "bottom-up" approach) is not an obvious response to ICWs. Modifying worker skill sets is a costly endeavor that requires firms to identify specific personnel issues, search and procure suitable job candidates with appropriate skill sets, and devise plans to integrate these skill sets into the accounting system.[2] Moreover, modifying employees' skill profiles likely takes time to generate benefits and is less visible to external stakeholders, limiting this strategy's ability to produce short-run reputation effects.

In addition, firms may not need to directly reshape rank-and-file employee skill sets if they instead choose to remove key personnel at the top of the firm who are responsible for the certification of the financial statements and the policies and procedures that guide the actions of rank-and-file employees. Indeed, regulations such as the Sarbanes-Oxley Act emphasize a "top-down" approach toward ICW remediation, highlighting the accountability of company executives, board members, and auditors. Prior studies predominantly focus on this approach and find that ICWs lead firms to replace CEOs, CFOs, audit committees, or auditors (Li, Sun, and Ettredge 2010; Johnstone, Li, and Rupley 2011; Newton, Persellin, Wang, and Wilkins 2016). Whereas such actions are easily observable to market participants and help firms quickly repair their capital market reputation, they do not always lead to ICW remediation (e.g., Johnstone et al. 2011), suggesting potential roles for remediation efforts at lower echelons of the firm.

We test our research question using granular data on job skill requirements listed in more than 20 million job postings issued between 2010 and 2017 from Burning Glass Technologies (BGT). The data contain detailed information on individual job postings, including the job's location, industry, standardized occupation codes, and specific skill sets required. The skill set descriptions provide precise information on the type of workers, skills, and knowledge that a firm seeks to hire at a given point in time. These data help us to better capture the skills firms are seeking to acquire, which overcomes a significant data limitation faced by prior studies.

We first identify skills that are relevant to accounting (e.g., billing and invoicing, budget management, financial analysis) and classify job postings listing at least one such skill as "accounting-relevant." We calculate the percentage of each firm-year's job postings that are accounting-relevant across *all* employees. Doing so allows us to assess whether ICWs lead firms to reshape worker skill sets broadly, including jobs that interface with accounting functions (e.g., accounts payable clerks, procurement officers, or corporate finance officers). In additional analyses, we also remove jobs specifically defined as accounting personnel to assess the degree to which these skill effects permeate the firm and impact peripheral job functions.

We test whether firms increase their accounting-relevant job postings after ICW disclosures by regressing the percentage of job postings requiring accounting skills in a given year on an indicator for whether the company revealed an internal control weakness during the prior year. We control for known determinants of internal control weaknesses, including size, complexity, and performance. We also control for factors related to general labor demand, including sales growth, research and development (R&D) growth, and capital expenditures, as well as for the quality of a firm's internal corporate governance. Our most stringent test includes *Firm Fixed Effects* and *Year Fixed Effects* to control for unobservable firm-level heterogeneity and general time trends.

Our main results are consistent with firms changing their accounting skill requirements after an ICW. In terms of magnitude, ICWs are associated with a 1.0–1.6-percentage point increase in the percentage of job postings listing accounting skills, which represents a 4.8–7.8-percent increase relative to the sample mean. We find that this response is concentrated in the periods *after* but not prior to the ICW disclosure, which alleviates concerns about simultaneity or reverse causality. In addition, we find no association between ICWs and general business skill requirements, suggesting that our results are not driven by a general increase in business skill needs.

[1] For purposes of this study, we define ICWs broadly as any internal control deficiencies that are publicly disclosed via a Section 302 management certification, 404(a) management assessment, and/or 404(b) audit report.

[2] This process is complex given information frictions within the firm and labor market mismatch (Handel 2003; Shimer 2007; Lazear and Spletzer 2012; Şahin, Song, Topa, and Violante 2014) and information asymmetries within firms (e.g., Waldman 1984; Stein 2002; Duchin and Sosyura 2013).

We also examine variation in our main results based on firm characteristics and ICW characteristics. We find that the association between ICWs and job postings listing accounting skills is more pronounced for firms with higher ROA, lower bankruptcy risk, and lower leverage, consistent with these firms having more resources to recruit workers with more accounting skills. We also find that the association between ICWs and accounting-related job postings is more pronounced when ICWs are more severe and provide evidence supporting the notion that our results are likely to be concentrated among personnel-related ICWs.

We next examine how ICWs relate to changes in labor skill demand across different occupations by redefining our accounting skill measure in three ways. First, we restrict the measure to only internal control skills. Second, we focus only on jobs specifically designated as accountants. Third, we focus on job postings that do not formally reference accountants, as these postings may still involve people who interface with accounting systems. We find evidence of a positive association between ICWs and accounting-relevant job posting across all three dimensions. Even among nonaccountants, our results suggest that an ICW still increases a firm's accounting skill requirements. This finding highlights the importance of promoting accounting skill sets across *employees* beyond just those specifically designated as accountants.

Having documented a robust relation between ICWs and accounting skill requirements, we next explore the role of top-down responses, as it is possible that our results are a byproduct of top-down responses that reflect a broader strategy to make personnel changes across the firm. We examine the extent to which ICWs lead to executive turnover in our sample. Our results generally confirm prior findings that ICWs lead to CFO, CEO, and auditor turnover. More importantly, we find that controlling for these types of turnover as well as the interaction of each type of turnover with ICWs does not affect our inferences. Overall, this analysis suggests that a firm's demand for rank-and-file skills after an ICW is a distinct response.

In our final analyses, we examine whether increasing accounting skill requirements improves internal controls and facilitates ICW remediation. First, we use the full sample and classify observations based on whether there were improvements, declines, or no changes in internal control. Using both multinomial logit analysis and OLS, we find that increases in the percentage of job postings requiring accounting skills are associated with significant improvements in internal control. In our second test, we conduct a remediation analysis based on the subset of firm-years that disclosed an ICW and examine whether these issues are subsequently remediated. We find that a one-standard-deviation increase in job postings listing accounting skills is associated with a 3.2-percentage point increase in the probability of remediation. Importantly, the above results are robust to controlling for employee training (as disclosed in firms' 10-Ks) as well as the various top-down responses discussed above. Overall, these analyses suggest that accounting-relevant job postings are associated with better internal controls.

We acknowledge several caveats to our study. First, the job posting data we utilize do not indicate whether job postings are filled. However, we expect that the labor market is sufficiently liquid for public corporations such that job postings are unlikely to remain vacant for long periods of time. Second, whereas our empirical proxy is based only on job postings, we expect that the requirement for accounting skills for new employees likely reflects a broader strategy that encompasses other actions, such as improving training procedures for existing employees. Although these channels are difficult to observe, we expect they complement skilled hiring. Third, our job posting data do not allow us to observe the number of employees hired and, thus, represent a lower-bound estimate of a firm's preference for accounting-based skill sets. Finally, our empirical analyses do not distinguish between firms replacing versus expanding their labor force.

Our results contribute to the literature across several dimensions. First, we extend prior studies examining how firms respond to and remediate ICWs (Goh 2009; Li et al. 2010; Johnstone et al. 2011; Bedard, R. Hoitash, U. Hoitash, and Westermann 2012). These studies focus primarily on responses at the executive level (i.e., a "top-down" response), and data limitations have precluded a large-scale examination of personnel responses outside of the C-suite. We focus on the less visible, and potentially more long-term and costly, actions firms take to remediate fundamental issues among rank-and-file employees (i.e., a "bottom-up" response). Incorporating novel data on firm-level job postings, we find that firms require more accounting skills at the rank-and-file level after an ICW. In addition, such initiatives appear to facilitate improvements in internal control, thus highlighting the importance of remediating personnel issues at all echelons of the firm.

Our findings also complement two related studies specifically examining the relation between human capital and internal control quality. First, Guo et al. (2016) use corporate social responsibility (CSR) data to show that firms with employee-friendly policies have fewer material weaknesses. Second, Choi et al. (2013) use data from South Korea to show that investments in full-time IC personnel are associated with fewer ICWs. We contribute to this literature by examining how a firm's demand for accounting skills changes after the public disclosure of an ICW. This represents an important addition to the internal control literature, as it is *ex ante* not clear that a firm will choose to remediate underlying personnel issues given such actions are costly and less observable to outsiders. In addition, our study also extends

the remediation results of Choi et al. (2013), which focus on IC personnel in South Korea. Internal control weakness disclosures appear to be more frequent in the U.S., thus making our setting amenable to an examination of the role of accounting-based skill labor. Our results demonstrate that increased requirements for accounting skills across *all* employees (including nonaccountants) can improve internal controls. Collectively, these studies enhance our understanding of how human capital impacts internal control quality.

More broadly, our findings enhance our understanding of skill demand and requirements in the accounting labor market. Recent economics research has documented how skill requirements are evolving in general labor markets (e.g., Hershbein and Kahn 2018; Deming and Kahn 2018; Babina, Fedyk, He, and Hodson 2020; Forsythe, Kahn, Lange, and Wiczer 2020). Three concurrent studies examine how skill sets are evolving among audit firms (Law and Shen 2021; Ham, Hann, Rabier, and Wang 2021; Hendricks, Landsman, and Peña-Romera 2022). Our study provides the first examination of how accounting-based skills are evolving across public companies as opposed to their auditors. We provide evidence that internal control failures provide an important catalyst for public companies to reshape their employees' skill sets, which should be of interest to practitioners/regulators as the demand for skilled labor increases with growing automation.

II. BACKGROUND AND HYPOTHESIS DEVELOPMENT

Prior Research on Internal Control Remediation

Our study is broadly interested in understanding how firms remediate ICWs. Prior research in this area is limited. Goh (2009) finds that firms with entity-level or general material weakness are slower to remediate, potentially due to the severity and systemic nature of these weaknesses. Johnstone et al. (2011) further examine general versus account-specific material weaknesses and show how specific material weaknesses relate to full remediation. Similarly, Bedard et al. (2012) demonstrate that remediation rates vary based on the specific material weakness issue type. Studies also find that complex firms are slower to remediate ICWs (Goh 2009; Chan, Kleinman, and Lee 2009; Johnstone et al. 2011; Hammersley, Myers, and Zhou 2012).[3]

Fewer studies examine the specific actions that U.S. firms take to remediate internal control weaknesses, in part because of data limitations.[4] Related studies generally focus on the highly visible actions firms take with respect to their executives or auditors, which we label a "top-down" approach. Li et al. (2010) and Johnstone et al. (2011) find that ICWs are associated with increased CEO and CFO turnover as well as turnover in boards of directors and audit committees. While important, these studies do not speak directly to how a firm remediates personnel-related issues outside of the executive suite, from which a substantial number of ICWs originate. Executive turnover may be reflective of broader human capital initiatives (i.e., a *complement*) or may be a sufficient response such that it has no bearing on broader human capital investments in the firm. Our study is specifically focused on increased accounting-based skill requirements among rank-and-file employees, which we label a "bottom-up" approach.

To our knowledge, only two related studies specifically examine how a firm's investment in human resources outside of the C-suite relates to internal control quality. Guo et al. (2016) investigate the role of employment policies in reducing internal control deficiencies and find that firms with employee-friendly policies have fewer internal control weaknesses. Choi et al. (2013) use a small sample of Korean-listed firms to examine how human resource investments in full-time internal control personnel influence internal control disclosures and remediation efforts and find that higher levels of internal control personnel reduce internal control weakness disclosure and facilitate more successful remediation.

We differ from these studies in at least two important ways. First, our focus is on how a firm responds *after* the revelation of an ICW. As we discuss below, it is not clear that firms that initially lack adequate skills will respond to ICWs by reshaping the skill sets of rank-and-file employees of the firm (bottom-up approach), when such actions are costly and less visible to market participants. Instead, a top-down approach that involves removing key executive personnel responsible for the financial statements may be preferable and more effective in repairing the firm's reputation. A top-down approach is also consistent with many of the reforms of the Sarbanes-Oxley Act that emphasize the responsibilities of company executives (e.g., CEO and CFO certifications), board and auditor independence, and the importance of audit committee members. Changes in these positions can also address deficiencies in firms' internal control policies and procedures that are frequently cited as causes of ICWs.

[3] Imdieke (2022) finds that not all remediations are actually successful in the long-run and provides evidence about actions that prevent failed remediations.

[4] As we discuss below, Choi et al. (2013) provide evidence that firms that invest in human capital in South Korea have more successful remediation outcomes.

Second, our findings also extend the remediation results of Choi et al. (2013) by focusing on a broader context of accounting-based skill sets across all employees in the firm. Also, as opposed to the Korean setting, we focus on the U.S. market, where personnel-related weaknesses are more common, utilize a more recent time period (2010–2016) as opposed to an earlier regime (2005–2008), and study a larger cross-section of firms.[5]

Literature on Skilled Labor

Our focus on accounting-based skill sets extends a growing literature in economics and finance studying firms' hiring of and demand for skilled labor. In recent decades, the U.S. labor market went through a marked change in the overall skill composition of workers. Firms increasingly automate their work force in response to technological advancements, replacing routine jobs and increasing the skill requirements of other workers (e.g., Goldin and Katz 1999; Acemoglu and Autor 2011; Goos, Manning, and Salomons 2014; Coleman, Merkley, and Pacelli 2022). Related research also documents the critical value of skilled labor for a firm's performance and survival (see, e.g., Hunt and Gauthier-Loiselle 2010; Kerr, Lincoln, and Mishra 2014; Dimmock, Huang, and Weisbenner 2022).

To our knowledge, few studies examine the evolution of accounting skill sets, and these studies focus on audit firms. Ham et al. (2021) find that audit offices have increased their preference for cognitive, technology-related, and social skills over time, with the later having the strongest effect on audit quality. Law and Shen (2021) find that audit offices hiring more people with artificial intelligence (AI) skills experience improved audit outcomes. Similarly, A. Fedyk, Hodson, Khimich, and T. Fedyk (2022) document an auditor displacement effect associated with AI investments. Hendricks et al. (2022) find that audit firms hire former Public Company Accounting Oversight Board (PCAOB) employees in response to inspection findings, resulting in improvements going forward. We complement these studies by focusing more broadly on public companies rather than their auditors.

Hypothesis Development

An internal control weakness suggests a failure in the accounting process that raises concerns about the potential for misstatements in the financial statements. The root causes of such weaknesses are deficiencies in either the design or the operation of internal controls over financial reporting (PCAOB 2007; AuditBoard 2021). A design deficiency occurs when a control does not exist or if a control is not properly designed. An operation deficiency exists if a control does not operate as designed or if the person performing the control does not do so correctly or effectively. Thus, a successful remediation effort involves companies putting in place the right combination of people (employees who perform controls), processes (ways to record and monitor issues and changes), and technology (systems that facilitate the work of people and processes). These efforts should consider not only what is required to fix current deficiencies (i.e., minimum expectation) but should also be proactive in avoiding future concerns (Deloitte 2021).

One way a firm could respond to an internal control weakness is to adopt a "bottom-up" approach focusing on changes to rank-and-file employees. This approach is natural given that prior studies and reports from practitioners identify personnel-related issues as common causes of ICWs (e.g., Ge and McVay, 2005; Doyle et al. 2007; Centri 2021; CFGI 2021). These issues reflect problems with personnel performing controls, possibly due to such personnel lacking expertise or knowledge, conducting ineffective risk assessments, or having insufficient skill to operate controls. In addition, as firms that report ICWs tend to be smaller firms with fewer resources (Doyle et al. 2007), it can also be the case that current personnel are "stretched too thin" to perform these tasks properly or that there are violations in segregation of duties. Thus, the existence of ICWs can be an indicator that a firm's current level of accounting-related expertise is insufficient.

To address personnel-related problems connected to ICWs, firms could hire external consultants to provide recommendations, invest in training and retaining current personnel, or recruit new personnel with accounting-related skills to help address internal control weaknesses. Whereas all three of these approaches are plausible and not mutually exclusive, our study focuses on the recruitment of personnel with accounting skills after an ICW, which we think is very plausible in practice. We note, however, that reshaping rank-and-file skill sets is potentially a long-term and costly strategy. For example, firms need to identify specific personnel issues (e.g., determine which skills are insufficient and which positions have inadequate skill), search and procure suitable job candidates with appropriate skill sets, and devise plans to integrate these skill sets into the accounting system. Such actions are also far less visible to external stakeholders, limiting the ability of this strategy to quickly repair a firm's reputation. Thus, a plausible null is that a firm may *not* seek new employees with accounting-related skills in response to an ICW if the labor-related costs are too high and the immediate capital market benefits are too weak.

[5] For example, Choi et al. (2013) note that only 24 percent of their sample have ICWs directly related to personnel issues, whereas Guo et al. (2016) suggest that about 48.6 percent of U.S. ICWs stem from personnel issues. We further examine the role of personnel-related ICWs in Section IV.

Another non-mutually exclusive response option is to adopt a "top-down" approach. This approach involves removing key executive personnel that are responsible for the preparation of the financial statements. As discussed above, prior studies focus on this approach and document higher levels of turnover among CEOs, CFOs, audit committees, and auditors after ICW disclosure (Li et al. 2010; Newton et al. 2016). In addition to removing the key personnel and governance parties involved with preparing the financial statements and making key business decisions, a top-down approach also has the benefit of being easily observable to market participants. Such actions may have immediate capital market benefits given that ICWs are associated with reduced cost of equity and negative returns (Beneish et al. 2008; Dhaliwal et al. 2011), and reputation-building activities likely help to restore market prices.

The above discussion can be summarized as follows. If ICWs relate to underlying personnel skills and firms seek to remediate these issues, we expect firms' demand for accounting skills to be higher after an ICW disclosure.[6] Alternatively, if firms focus only on the top-down approach, or if the bottom-up approach is too costly or not visible enough, we will not observe a greater demand for accounting skills after ICWs. Empirically, we test this association by examining changes in job postings listing accounting skills. Thus, our main hypothesis (stated in null form):

H1: Internal control weaknesses are not associated with an increased number of job postings listing accounting skills.

III. DATA AND EMPIRICAL DESIGN

Data Sources and Sample Requirements

We obtain job posting data from Burning Glass Technologies, a large repository containing the near universe of online job postings. Burning Glass gathers and scrapes information from online job postings continuously for the period spanning 2010–2017. Job postings are organized using standardized occupation and skill families (such as O*NET and Standard Occupational Classification (SOC) families). Each unique job posting contains information on the firm, facility location, occupation, industry, and unique skill requirements for the job vacancy ad. The data also indicate other relevant information related to the job vacancy, including education requirements, credentials, experience, and occasionally salary. Our measures (discussed in more detail below) rely primarily on the details regarding the job's skill requirements.[7]

Our analyses also rely on public firm data obtained from Compustat and Audit Analytics. We match firm names in Burning Glass to Compustat firms after the matching algorithm discussed in Campello et al. (2019). We require nonmissing data for internal control weaknesses as well as control variables, as discussed below. We retain firm-years in which there is at least one job vacancy post. Our final matched sample contains approximately 24 million job vacancy ads across 16,906 firm-years (3,218 unique firms).

Measuring Accounting Skills

Burning Glass skill data comprise three subcategories. The broadest category details 29 distinct skill cluster families. The data also contain 560 unique skill clusters and 10,189 unique skills. Relevant accounting skills, such as "Accounting and Finance Software," "Accounts Payable and Receivable," and "Auditing" are listed under the "Finance" skill cluster family. We thus rely primarily on this skill cluster family for classifying job postings demanding accounting-related skill sets. We manually review the skill sets included in this category and remove skills that are not directly linked to areas that intersect with a company's accounting system.[8] Appendix A provides a description of the final set of skills included in our classification. In addition to the finance skill cluster family, we also include three separate internal control skills listed under the "Business" skill cluster family. These skills include "Internal Controls Testing," "Internal Control Evaluation," and "Internal Control Procedures." We note, however, that these skill requirements are relatively uncommon and relate to only 0.06 percent of all individual job postings in the sample, whereas 18.6 percent of individual job

[6] An alternative channel may also relate to management self-disclosing an ICW to support hiring personnel with more accounting skills. We discuss this issue in more detail in Section V.

[7] In some cases, it is possible that a single posting could result in multiple hires. Similar to other studies that employ BGT data, it is difficult to completely address this limitation. In addition, whereas these data allow us to identify variation in companies' requirements for certain skills across firms and across time, they do not allow us to identify the number of employees currently employed in different areas. Future research could potentially shed light on this issue using employee data from individual companies or by acquiring data from professional networking sites (e.g., LinkedIn).

[8] Specifically, we remove the following skills: Banking Services, Commercial Lending, Commodities, Financial Advisement, Financial Aid Counseling, Financial Trading, General Lending, Investment Management, Lending Assessment, Mergers and Acquisitions, Mortgage Lending, and Underwriting.

postings relate to the broader set of accounting skills. We define our main variable of interest, *Accounting Skills,* as the percentage of postings in a given firm-year indicating a job vacancy requiring at least one of the skills listed in Appendix A.[9]

Empirical Model

Our main analyses examine the relationship between the disclosure of ineffective internal controls and the percentage of job postings listing accounting skills by estimating the following OLS model:

$$\begin{aligned} Accounting\ \ Skills_{it+1} = {} & \beta_1 ICW_{it} + \beta_2 Restate_{it} + \beta_3 OP404b_{it} + \beta_4 LNAssets_{it} + \beta_5 LNAge_{it} \\ & + \beta_6 BKMKT_{it} + \beta_7 BigN_{it} + \beta_8 Loss_{it} + \beta_9 ROA_{it} + \beta_{10} ZScore_{it} \\ & + \beta_{11} QuickRatio_{it} + \beta_{12} Leverage_{it} + \beta_{13} LNFee_{it} + \beta_{14} LNSegs_{it} \\ & + \beta_{15} Merger_{it} + \beta_{16} Foreign_{it} + \beta_{17} SalesGrowth_{it} \\ & + \beta_{18} R\&DGrowth_{it} + \beta_{19} IncCAPEX_{it} + \gamma Industry_i + \delta Year_t + \varepsilon_{it}, \end{aligned} \tag{1}$$

where i indexes firm and t indexes year. The dependent variable is *Accounting Skills* (as defined above), measured in year $t+1$.[10] Our variable of interest is *ICW*, an indicator variable that takes the value of 1 for firm-years associated with a Section 302 certification, 404(a) management assessment, or 404(b) audit report indicating that an internal control weakness exists.

Equation (1) controls for factors such as size, performance, liquidity, complexity, and growth that prior studies document as being associated with material weaknesses. Variable definitions are provided in Appendix B. All continuous measures are Winsorized at the 1st and 99th percentiles. Equation (1) also controls for macroeconomic conditions through the inclusion of *Year Fixed Effects* and time-invariant industry characteristics with the inclusion of *Industry Fixed Effects* (two-digit SIC). In addition, in some specifications, we include *Firm Fixed Effects* to better control for time-invariant firm characteristics. t-statistics are based on standard errors that are clustered by firm. To the extent that internal control failures predict increases in a firm's demand for accounting skills, we expect a positive loading on β_1.

Descriptive Statistics

Table 1 presents the summary statistics for our variables of interest as well as control variables. Our sample contains 16,906 firm-year observations that are roughly evenly distributed over time. ICWs (302, 404(a), or 404(b)) occur in about 22 percent of observations during our sample period. We note that this percentage differs from studies that focus exclusively on material weaknesses from accelerated and large accelerated filers that are subject to 404(b) audits because we include data from all Securities and Exchange Commission (SEC) registrants. In addition, nonaccelerated filers tend to have a higher percentage of internal control weaknesses as compared to other filers (Bhaskar, Schroeder, and Shepardson 2019).[11] Other control variables are similar to prior studies examining the determinants of internal control weaknesses (e.g., Ge, Koester, and McVay 2017).

IV. MAIN RESULTS

Baseline Analysis of the Relation between ICWs and Accounting-Related Job Postings

Table 2 provides the results from estimating Equation (1). In column (1), we first present the univariate regression results. In column (2), we augment the model with control variables. In column (3), we add industry and year fixed effects. In column (4), we replace *Industry Fixed Effects* with *Firm Fixed Effects*. *Firm Fixed Effects* are a particularly powerful specification as they allow us to control for any time-invariant firm characteristic that may influence the relation between *ICW* and *Accounting Skills*. Across all four columns, we document positive and significant associations

[9] Companies provide information about their remediation plans as part of their ICW disclosures. We examined a random sample of 30 such disclosures and note that many of them contain boilerplate language along with significant variation in the amount of reported detail. In addition, the results of Imdieke (2022) call into question companies' commitment to follow through with these plans. Thus, we argue that job posting data better capture actions actually taken by the company regarding investments in rank-and-file employees in response to ICW disclosures.

[10] In Section IV, we examine the sensitivity of our results to *ICW* timing by re-estimating Equation (1) after measuring *ICW* in year $t-1$ and $t+1$. We find that ICWs in year $t+1$ are not associated with a firm's demand for accounting skills, indicating that our results capture a firm's response to ICWs.

[11] Bhaskar et al. (2019) report that 9.8 percent of firms in their sample subject to 404(b) audits report material weaknesses, whereas 26.4 percent of other firms report material weaknesses and other deficiencies.

TABLE 1

Descriptive Statistics

Variables	Mean	Std. Dev.	p25	p50	p75
Accounting Skills	0.2071	0.1774	0.0833	0.1765	0.2876
IC Skills	0.0006	0.0026	0.0000	0.0000	0.0000
Accounting Positions	0.0180	0.0367	0.0000	0.0051	0.0192
Accounting Skills–Non Accountants	0.1939	0.1712	0.0746	0.1642	0.2703
ICW	0.2199	0.4142	0.0000	0.0000	0.0000
Restate	0.0820	0.2744	0.0000	0.0000	0.0000
OP404b	0.8241	0.3808	1.0000	1.0000	1.0000
LNAssets	6.7664	2.0367	5.3914	6.7856	8.1909
LNAge	3.0106	0.7006	2.5649	2.9957	3.5264
BKMKT	0.4699	0.5117	0.2179	0.4106	0.6758
BigN	0.7789	0.4150	1.0000	1.0000	1.0000
Loss	0.3055	0.4606	0.0000	0.0000	1.0000
ROA	−0.0091	0.1874	−0.0210	0.0351	0.0762
ZScore	−2.7779	1.4832	−3.6240	−2.9131	−2.2174
QuickRatio	2.0874	2.0559	0.9669	1.4537	2.3735
Leverage	0.5393	0.2786	0.3463	0.5181	0.6855
LNFee	14.0655	1.1792	13.3181	14.0779	14.8267
LNSegs	0.7471	0.6440	0.0000	0.6931	1.3863
Merger	0.1940	0.3955	0.0000	0.0000	0.0000
Foreign	0.3489	0.4766	0.0000	0.0000	1.0000
Sales Growth	0.1041	0.3728	−0.0402	0.0492	0.1616
R&D Growth	0.0057	0.0313	0.0000	0.0000	0.0022
Inc CAPEX	0.0000	0.0440	−0.0194	−0.0049	0.0127

This table reports descriptive statistics for the variables used in our primary analyses. The sample contains 16,906 firm-year observations. All variables are constructed using data from Burning Glass, Compustat, CRSP, and Audit Analytics.
Variable definitions are provided in Appendix B.

between *ICW* and *Accounting Skills* ($p < 0.01$), indicating support for our prediction that ICWs prompt firms to increase the number of job postings listing accounting skills. The coefficient magnitudes are relatively stable across models, ranging from 0.010 in our most stringent specification to 0.016 in the less stringent model. This stability suggests that our results are not highly influenced by confounding factors related to internal control weaknesses.

The results also suggest that ICWs have a meaningful impact on firms' demand for accounting skills. The coefficients indicate that ICWs are associated with a 1.0–1.6-percentage point increase in the percentage of job postings requiring accounting skills, which represents a 4.8–7.8-percent increase relative to the unconditional sample mean of 20.7 percent.[12] The significance of the control variables varies to some extent across the models. None of the controls are significant after the inclusion of *Firm Fixed Effects* (column (4)), consistent with this specification controlling for differences that are persistent across time. We further note that the coefficient on *Restate* is insignificant in all the specifications, perhaps because the average severity of restatements (i.e., number of accounting issues, time period, and income effects) has declined over time (Scholz 2014).

In columns (5) and (6), we add corporate governance variables not specified in Equation (1) using data from BoardEx, including *%FinExp AC,* the percentage of audit committee members with financial expertise; *CEO-Chair Duality*, an indicator for whether the CEO is the chairman of the board; *CEO Tenure*, the natural logarithm of the CEO's tenure in years; *CFO Tenure*, the natural logarithm of the CFO's tenure in years; and *%Board Independent*, the

[12] Interpretation of the coefficient requires an exponential transformation since the dependent variable is log-transformed. Our results are robust to using both robust regression techniques that downweight extreme residuals and median/quantile regression analyses that are less sensitive to outliers (untabulated).

TABLE 2

The Relation between ICWs and Accounting Skill-Related Job Postings

DV: *Accounting Skills*	(1)	(2)	(3)	(4)	(5)	(6)
ICW	0.016***	0.016***	0.013***	0.010**	0.016***	0.013***
	(4.25)	(4.04)	(3.49)	(2.57)	(3.86)	(3.21)
Restate		−0.004	−0.002	−0.002	0.000	0.002
		(−0.81)	(−0.33)	(−0.47)	(0.04)	(0.33)
OP404b		0.017**	0.020***	0.005	0.019***	0.003
		(2.55)	(3.05)	(0.68)	(2.60)	(0.36)
LNAssets		0.003	−0.004	−0.008	−0.004	−0.010
		(1.20)	(−1.56)	(−1.40)	(−1.61)	(−1.58)
LNAge		−0.003	−0.009***	0.018	−0.008**	0.020
		(−0.89)	(−2.60)	(0.85)	(−2.07)	(0.88)
BKMKT		0.011**	0.010**	0.003	0.007	−0.002
		(2.42)	(2.17)	(0.49)	(1.30)	(−0.31)
BigN		0.007	0.014**	0.000	0.009	0.002
		(1.09)	(2.22)	(0.02)	(1.33)	(0.18)
Loss		−0.003	−0.003	−0.003	−0.006	−0.003
		(−0.59)	(−0.54)	(−0.61)	(−1.07)	(−0.62)
ROA		−0.112***	−0.050	−0.014	−0.033	0.027
		(−3.21)	(−1.53)	(−0.35)	(−0.80)	(0.50)
ZScore		−0.008	−0.005	0.000	−0.005	0.006
		(−1.26)	(−0.87)	(0.05)	(−0.69)	(0.71)
QuickRatio		0.002	−0.001	0.000	−0.001	0.002
		(1.12)	(−0.88)	(0.22)	(−0.76)	(0.70)
Leverage		0.051**	0.034	−0.008	0.036	−0.028
		(2.28)	(1.61)	(−0.31)	(1.34)	(−0.87)
LNFee		0.008**	0.009**	0.009	0.007	0.009
		(2.01)	(2.23)	(1.42)	(1.51)	(1.33)
LNSegs		−0.005*	−0.003	−0.002	0.001	0.001
		(−1.89)	(−0.64)	(−0.35)	(0.14)	(0.20)
Merger		−0.013***	−0.007	−0.001	−0.008*	−0.004
		(−3.04)	(−1.63)	(−0.34)	(−1.87)	(−0.97)
Foreign		0.005	0.005	0.001	0.006	−0.005
		(1.15)	(1.19)	(0.14)	(1.29)	(−0.90)
Sales Growth		0.018***	0.010*	−0.001	0.001	−0.007
		(3.26)	(1.88)	(−0.17)	(0.25)	(−1.14)
R&D Growth		−0.120*	−0.129*	−0.002	−0.122*	−0.024
		(−1.67)	(−1.86)	(−0.03)	(−1.67)	(−0.32)
Inc CAPEX		0.132***	0.020	−0.031	0.023	−0.019
		(2.66)	(0.40)	(−0.54)	(0.42)	(−0.32)
CEO–Chair Duality					−0.000	0.003
					(−0.05)	(0.51)
CEO Tenure					−0.004**	−0.002
					(−2.17)	(−1.10)
CFO Tenure					−0.002	−0.001
					(−1.56)	(−0.55)
%FinExp AC					0.004	0.001
					(0.51)	(0.05)
%Board Independent					0.026	−0.015
					(1.53)	(−0.61)

(continued on next page)

TABLE 2 (continued)

DV: *Accounting Skills*	(1)	(2)	(3)	(4)	(5)	(6)
Industry Fixed Effects	No	No	Yes	No	Yes	No
Firm Fixed Effects	No	No	No	Yes	No	Yes
Year Fixed Effects	No	No	Yes	Yes	Yes	Yes
Observations	16,906	16,906	16,906	16,906	14,202	14,202
R^2	0.00	0.02	0.12	0.53	0.13	0.55

***, **, * Denote 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table presents results from regressions of *Accounting Skills* on *ICW*. *Accounting Skills* is the percentage of postings in a given firm-year indicating a job vacancy requiring at least one accounting-related skill as described in Appendix A. *ICW* is an indicator variable taking the value of 1 for firm-years disclosing a Section 302 disclosure, 404(a) management assessment, or 404(b) audit report determining that an internal control weakness exists, and 0 otherwise. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

percentage of independent directors. Whereas the data required for these variables reduce our sample, we continue to document similar inferences with respect to the association between *ICW* and *Accounting Skills*.

ICW Timing

To further strengthen our prediction that firms reshape workers' skill profiles in the period immediately *after* the disclosure of ineffective internal controls, we re-examine our baseline analysis after varying the timing of ICW disclosures. These tests help to alleviate any concerns regarding pre-trends (skill changes prior to the ICW event). Table 3 reports the results of this analysis. In columns (1) and (2), we augment our baseline model with a lagged internal control weakness indicator (period $t-1$) and find that the ICW variable (period t) continues to load ($p < 0.05$), whereas there is no evidence that lagged ICWs influence the frequency with which job postings list accounting skills in year $t+1$.

In columns (3) and (4), we include a lead ICW indicator (i.e., $t+1$) to assess whether firms change the number of job postings listing accounting-related skills and disclose an ICW simultaneously. We continue to find evidence that ICWs in period t relate to firms' job postings with accounting-related skills in period $t+1$ ($p < 0.01$, $p < 0.05$, respectively), but there is no evidence to indicate that lead ICWs are associated with firms' job postings listing accounting-related skills. Finally, in columns (5) and (6), we consider the lag, contemporaneous, and lead ICWs in the same regression. In column (5) we continue to find no evidence that lead or lagged ICWs are associated with firms' job postings listing accounting-related skills at conventional levels of significance ($p > 0.10$). In column (6), we find some weak evidence of a positive relation between lag ICW and *Accounting Skills* but no evidence of a relation for lead ICW. Importantly, ICWs in period t remain positively and significantly associated with *Accounting Skills* in both columns. Overall, these analyses suggest that ICW timing is important. Firms increase their demand for accounting skills only in the periods after ICW disclosure.

Broad Demand for Business Skills

Our previous analyses based on the inclusion of a variety of time-varying controls, *Industry Fixed Effects* and *Firm Fixed Effects*, and variation in ICW timing support the notion that firms respond to ICWs by seeking employees with accounting-related skills and address a variety of alternative explanations. We provide further support for our inferences by examining another alternative explanation—namely, that our main results might be driven by a firm-level increase in the demand for business-related skills more broadly after ICWs and not necessarily by accounting skills *per se*. For example, it is possible that after an ICW disclosure, firms increase the skills required across all business functions, and not just those related to accounting.

We assess this alternative explanation by replacing the dependent variable in Equation (1) with four alternative measures: (1) *Admin Skill,* the percentage of job postings requiring administration skills; (2) *Business Skill*, the percentage of job postings requiring general business skills; (3) *IndKnowledge Skill*, the percentage of job postings requiring industry knowledge skills; and (4) *Marketing Skill*, the percentage of job postings requiring marketing skills. We focus on these areas as they encompass business skills that are not directly related to finance or accounting. Table 4 reports the results. We find no evidence of an association between ICWs and any of these alternative skill requirement variables.

TABLE 3

ICW Timing and Accounting Skill Demand

DV: *Accounting Skills*$_{t+1}$	(1)	(2)	(3)	(4)	(5)	(6)
ICW_{t-1}	0.003	0.005			0.004	0.006*
	(0.96)	(1.59)			(1.00)	(1.72)
ICW_t	0.013***	0.009**	0.012***	0.009**	0.011***	0.008**
	(3.42)	(2.34)	(3.24)	(2.50)	(3.17)	(2.28)
ICW_{t+1}			0.003	−0.000	0.002	0.001
			(0.86)	(−0.02)	(0.72)	(0.17)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	No	Yes	No	Yes	No
Firm Fixed Effects	No	Yes	No	Yes	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,709	16,709	16,527	16,527	16,336	16,336
R^2	0.12	0.53	0.12	0.54	0.12	0.54

***, **, * Denote 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table varies the timing of ICW disclosures in our baseline regression. The table provides results of regressions of *Accounting Skills* on ICWs disclosed in period t, $t-1$, and $t+1$. *Accounting Skills* is the percentage of postings in a given firm-year indicating a job vacancy requiring at least one accounting-related skill as described in Appendix A. *ICW* is an indicator variable taking the value of 1 for firm-years disclosing a Section 302 disclosure, 404(a) management assessment, or 404(b) audit report determining that an ICW exists, and 0 otherwise. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

TABLE 4

General Business Skill Demand

DV:	*Admin Skill*		*Business Skill*		*IndKnowledge Skill*		*Marketing Skill*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICW	0.004	0.004	0.003	0.003	−0.002	−0.002	−0.002	0.002
	(1.08)	(1.20)	(0.70)	(0.57)	(−0.95)	(−1.11)	(−0.41)	(0.56)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	No	Yes	No	Yes	No	Yes	No
Firm Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,906	16,906	16,906	16,906	16,906	16,906	16,906	16,906
R^2	0.10	0.53	0.21	0.60	0.23	0.62	0.17	0.58

***, **, * Denote 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table presents four sets of placebo tests related to our main analyses where the outcome variable considers alternative types of skill sets. *Admin Skill* is the percentage of job postings requiring administration skills. *Business Skill* is the percentage of job postings requiring general business skills. *IndKnowledge Skill* is the percentage of job postings requiring industry knowledge skills. *Marketing Skill* is the percentage of job postings requiring marketing skills. *ICW* is an indicator variable taking the value of 1 for firm-years disclosing a Section 302 disclosure, 404(a) management assessment, or 404(b) audit report determining that an ICW exists, and 0 otherwise. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

These results suggest that our findings are not easily explained by a general demand for more skilled labor in other related business areas in a firm.

Additional Robustness Tests

We also conduct two additional tests to further alleviate endogeneity concerns (untabulated). First, we quantify how significant a theoretical correlated omitted variable must be to affect our inferences (Frank 2000; Larcker and

Rusticus 2010). We find that a correlated omitted variable would need to be at least 10.9-percent positively correlated with both *ICW* and *Accounting Skills* to affect our baseline analysis (Table 2, column (3)). Such a correlation is higher than that of any of our existing control variables, suggesting that the potential for an omitted correlated variable affecting our inferences is low.

Second, we apply an instrumental variables approach using (1) the percentage of firms in a firm's industry that reported ICWs in the previous year (i.e., industry-level conditions that could trigger internal control problems not directly determined by the firm of interest) and (2) the percentage of firms sharing the same audit office that reported ICWs in the previous year (i.e., the general tendency of audit offices to detect and prevent internal control problems). Given these measures are highly industry-dependent, we re-examine our baseline model including both instruments using 2SLS with only *Year Fixed Effects*, along with the other time-varying controls. We continue to find support that ICWs lead firms to seek employees with accounting-related expertise (untabulated).[13]

V. CROSS-SECTIONAL ANALYSES

Variation in Firm Characteristics

We next consider whether the association between ICWs and firms' requirements for accounting skills varies based on (1) firm performance and financial constraints and (2) firm complexity, both of which prior studies identify as being significantly associated with ICWs (Krishnan 2005; Ashbaugh-Skaife, Collins, and Kinney 2007; Doyle et al. 2007). We proxy for performance and financial constraints based on return on assets (*ROA*), net losses (*Loss*), bankruptcy risk (*ZScore*), and financial leverage (*Leverage*) and for firm complexity based on the number of business segments (*LNSegs*), recent merger activity (*Merger*), and the presence of foreign sales (*Foreign*). We expect firms with better performance and lower financial constraints to be more able to seek new employees with accounting skills when responding to ICWs. We expect firms with greater complexity to have greater incentives to respond more to ICWs as complexity often requires more significant judgment from accounting-related personnel.

To examine these cross-sectional differences, we augment Equation (1) with interaction terms between *ICW* and the identified proxies. Table 5 reports the results of this analysis. We find that the relation between *ICW* and *Accounting Skills* is more positive for firms with higher ROA ($p < 0.05$), lower bankruptcy risk ($p < 0.05$), and less leverage ($p < 0.10$), consistent with these firms having greater resources to respond to ICWs. However, we find no evidence that the relation between *ICW* and *Accounting Skills* is associated with our proxies for complexity.

Variation in ICW Characteristics

It is likely that the association between *ICW* and *Accounting Skills* also varies based on ICW characteristics due to variation in the need for personnel with accounting-related skills. First, we consider whether the severity of ICW disclosures influences the association between ICWs and accounting-related job postings. Conceptually, the very nature of reporting an internal control weakness may lead firms to demand more accounting skills as such disclosures suggest a relevant and costly problem. However, it could be the case that a firm's incentive to respond to the ICW increases with the severity of the problems identified. We measure *ICW–Severity* as the natural logarithm of 1 plus the number of unique ICW category keys identified in Audit Analytics. We replace *ICW* with *ICW–Severity* and repeat our main analysis from Equation (1). Columns (1) and (2) of Table 6 report the results of this analysis. The coefficients on *ICW–Severity* are significantly positive ($p < 0.01$ and $p < 0.05$, respectively) and similar in magnitude. These findings suggest when companies have greater numbers of issues within an ICW disclosure, they increase the requirements for accounting-related skills to a greater extent.

Second, we consider variation in whether disclosed ICWs are likely to be driven by personnel-related issues (i.e., issues related to manual as opposed to automated controls, where poor human action or judgment are likely to be the underlying cause of the problem). On the one hand, one might expect our results to be more pronounced for these types of ICWs as the potential cause of the ICW and its remedy are aligned. On the other hand, the disclosure of any ICW is a significant event and is likely a catalyst for re-evaluation of the entire accounting system as it represents a public

[13] Consistent with the inclusion restriction, the first stage results (untabulated) suggest that both instruments are significantly positively correlated with a firm having an internal control weakness event ($p < 0.05$). Results are similar if we employ indicators of these measures based on whether an observation's value is in the top sample quartile for each measure instead of the continuous measures. In the second stage, we find that the instrumented ICW measure is positively correlated with the percentage of job postings listing accounting skills ($p < 0.10$ using the continuous instrument measures; $p < 0.05$ using indictor instrument measures). We note that since the variation we exploit in the instruments is at the industry level, the Section IV results are not robust to the inclusion of *Industry Fixed Effects* or *Firm Fixed Effects*.

TABLE 5

Firm Characteristics, ICWs, and Accounting Skill-Related Job Postings

DV: *Accounting Skills*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ICW	0.014***	0.015***	−0.002	0.026***	0.016***	0.013***	0.010**
	(3.74)	(3.50)	(−0.26)	(3.06)	(2.78)	(2.66)	(2.12)
ICW × *ROA*	0.048**						
	(2.11)						
ICW × *Loss*		−0.005					
		(−0.63)					
ICW × *ZScore*			−0.006**				
			(−2.21)				
ICW × *Leverage*				−0.023*			
				(−1.69)			
ICW × *LNSegs*					−0.004		
					(−0.73)		
ICW × *Merger*						0.002	
						(0.31)	
ICW × *Foreign*							0.008
							(1.08)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,906	16,906	16,906	16,906	16,906	16,906	16,906
R^2	0.12	0.12	0.12	0.12	0.12	0.12	0.12

***, **, * Denote 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table presents results from regressions of *Accounting Skills* on *ICW*. *Accounting Skills* is the percentage of postings in a given firm-year indicating a job vacancy requiring at least one accounting-related skill as described in Appendix A. *ICW* is an indicator variable taking the value of 1 for firm-years disclosing a Section 302 disclosure, 404(a) management assessment, or 404(b) audit report determining that an internal control weakness exists, and 0 otherwise. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

acknowledgment that changes are needed. Given the important role of personnel in these systems, it is possible that firms respond to ICWs by hiring workers with more accounting skills as part of a comprehensive review regardless of whether the disclosed problem is specifically designated as personnel-related.

Although the classification of ICWs is imperfect, we rely on the description key provided by Audit Analytics. We first review the classification keys for areas that we consider to be a function of manual controls (e.g., account-specific issues, accounting estimation, nonroutine closing) and items that specifically refer to personnel (such as inadequate staff or insufficient review) under the assumption that these activities are *more* likely to be personnel-related. When at least one of these issues is identified in the key description, we then classify the ICW as personnel-related. Appendix C describes the details of this classification. We also identify ICWs that specifically relate to IT issues (e.g., technology or software issues). We assume that these ICWs should be *less* likely to relate to personnel and in turn have little bearing on a firm's demand for accounting skills because these issues are less likely to arise from deficiencies in employees' accounting skills. When at least one of these issues is identified in Audit Analytics, we code the variable *ICW–IT* as equal to 1 (and 0 otherwise). Finally, for completeness, we classify ICWs that do not contain instances of personnel or IT-related issues as a separate group (*ICW–Other*). We then re-estimate Equation (1) and replace *ICW* with *ICW–Personnel*, *ICW–IT*, and *ICW–Other*.

Columns (3) and (4) of Table 6 report the results from the ICW type analysis. In column (3), we find that *ICW–Personnel* loads significantly positive ($p < 0.01$), whereas the coefficients on *ICW–IT* and *ICW–Other* are not significantly different from 0. This evidence is consistent with the positive association between *ICW* and *Accounting Skills* in our baseline results being driven primarily by personnel-related ICWs. Column (4) reports results including firm fixed effects; the coefficient on *ICW–Personnel* declines and is significant only at the $p = 0.116$ level. The limited significance could potentially relate to the data and conceptual limitations previously discussed.

TABLE 6

Variation in ICW Characteristics

DV: *Accounting Skills*	(1)	(2)	(3)	(4)
ICW–Severity	0.008***	0.006**		
	(2.84)	(2.14)		
ICW–Personnel			0.011***	0.006
			(2.59)	(1.57)
ICW–IT			0.009	0.002
			(1.28)	(0.25)
ICW–Other			−0.004	−0.000
			(−0.23)	(−0.01)
Controls	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	No	Yes	No
Firm Fixed Effects	No	Yes	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	16,874	16,874	16,906	16,906
R^2	0.12	0.53	0.12	0.53

***, **, * Denote 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table reports results on the relation between *ICW* and *Accounting Skills* based on variation in ICW characteristics. *Accounting Skills* is the percentage of postings in a given firm-year indicating a job vacancy requiring at least one accounting-related skill as described in Appendix A. *ICW–Severity* is the natural logarithm of 1 plus the number of unique ICW category keys identified in Audit Analytics. *ICW–Personnel*, *ICW–IT*, and *ICW–Other* are indicator variables for whether the ICW disclosure indicates a relation to personnel issues, IT issues, and other issues, respectively. This classification is based on the description key from Audit Analytics, as described in Appendix C. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

We also explore managerial incentives to self-report ICWs to encourage hiring accounting staff. We categorize ICWs as mandatory and as self-reported based on two different classification schemes and re-examine our baseline analysis. First, we focus only on accelerated filers and define ICWs based on SOX404(b) disclosures to be mandatory (*ICW–Mandatory*) and all others as voluntary (*ICW–Self Report*). Column (1) of Table 7 reports the results. We find evidence of a positive association with *Accounting Skills* for both measures but do not find evidence of significant difference across the two coefficients (F-test; $p < 0.58$). Second, building on the findings of Kinney and Shepardson (2011), we focus on all filers and define ICWs based on SOX404(a) and 404(b) as mandatory and all others as voluntary (e.g., SOX302). Column (2) reports the results. We continue to find that both mandatory and voluntary ICWs are positively associated with *Accounting Skills* and find no differences across the associations (F-test; $p < 0.39$). These results do not rule out the possibility of CFOs self-disclosing ICWs as a strategy for hiring accounting personnel, but they do suggest that such incentives are unlikely to explain the entirety of our results.

Variation in Accounting-Related Skills

We next consider variation in the definition of accounting-related skills (i.e., our primary dependent variable). First, we consider a more restrictive measure of accounting skills in the spirit of Choi et al. (2013), who measure accounting skills using the number of full-time ICW employees. *IC Skills* is the percentage of firm-year job postings that reference skills classified as "Internal Controls Testing," "Internal Control Evaluation," and "Internal Control Procedures." Columns (1) and (2) of Table 8 report the results. In both columns, the coefficient on *ICW* is positive, but it is only significant in the column (1) results (without *Firm Fixed Effects*). These results suggest that companies seek to hire more workers specializing in internal controls after ICWs.

Next, we consider companies' demand for personnel to fill positions that are specifically designated as accountants. Following Hoopes, Merkley, Pacelli, and Schroeder (2018), we define an accountant job posting as a job posting indicating a SOC code of 13-2011 (Accountants and Auditors). We define *Accounting Positions* as the percentage of total job postings designated as accountant job postings. Columns (3) and (4) of Table 8 report the results from this analysis. The coefficients on *ICW* in both columns are significantly positive ($p < 0.01$). These results suggest that the change in employee skill sets extends beyond internal control positions to accountants more generally.

TABLE 7

ICW Disclosure Type

DV: *Accounting Skills*	(1)	(2)
ICW–Mandatory	0.017*	0.013*
	(1.91)	(1.79)
ICW–Self Report	0.012***	0.008**
	(2.93)	(2.25)
Controls	Yes	Yes
Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Observations	13,932	16,906
R^2	0.14	0.12
F-test: *ICW–Mandatory* − *ICW–Self Report* = 0	p = 0.58	p = 0.39

***, **, * Denote 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table presents results from regressions of *Accounting Skills* on *ICW–Mandatory* and *ICW–Discretionary*. *Accounting Skills* is the percentage of postings in a given firm-year indicating a job vacancy requiring at least one accounting-related skill as described in Appendix A. In columns (1) and (2), *ICW–Mandatory* is an indicator variable set to 1 for firm-years disclosing a 404(b) audit report that indicates the existence of an internal control weakness, whereas *ICW–Self Report* is an indicator variable set to 1 for firm-years disclosing any other internal control weakness (Section 302 disclosure, 404(a) management assessment). Only accelerated filers are included in these analyses. In columns (3) and (4), *ICW–Mandatory* is an indicator variable set to 1 for firm-years disclosing a 404(b) audit report or a 404(a) management assessment that indicates the existence of an internal control weakness, while *ICW–Self Report* is an indicator variable set to 1 for firm-years disclosing any other internal control weakness (Section 302 disclosure). All filers are included in these analyses. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

Finally, we consider whether firms' demand for accounting-related skills extends beyond nonaccounting personnel. Regardless of whether recruiting nonaccounting employees with accounting-related skills is aimed directly at remediating ICWs, the existence of ICWs could encourage a firm to increase its demand for such skills more broadly to prevent future ICWs and to improve the overall effectiveness of their financial reporting processes.[14]

To test this conjecture, we employ the variable *Accounting Skills–Non Accountants*, defined as the number of job postings requiring accounting-related skills for nonaccountant jobs scaled by the number of all nonaccountant jobs posted by a firm in a given year. Columns (5) and (6) report these results. In both columns, the coefficient on *ICW* is significantly positive ($p < 0.01$ and $p < 0.05$, respectively), suggesting that the increase in job postings listing accounting-related skills that we document is not restricted to formal accounting roles.

VI. ADDITIONAL ANALYSES

Having established a robust relationship between ICWs and firms' interest in employees with accounting skills, we next conduct two sets of additional analyses. In the first set of analyses, our objective is to better understand the relation between a firm's top-down response (*vis-à-vis*, for example, replacing executives) and its demand for accounting skills among rank-and-file personnel. To do so, we extend prior literature examining the association between ICWs and changes in high-level positions, including CFOs, CEOs, and audit committees, as well as auditor changes. In the second analysis, we test whether the number of job postings with accounting skills is associated with improvements in internal control as well as more successful remediation efforts.

ICWs and Top-Down Response

As previously discussed, most prior studies that examine firms' responses to ICWs focus on changes at the top of the firm, such as replacements of CEOs, CFOs, audit committees, and auditors. We examine how a firm's requirements for accounting skills among rank-and-file employees in response to an ICW relates to such effects. For example, the

[14] To illustrate this point, we analyzed a large sample of job postings containing any Finance skill cluster family requirement during the first quarter of 2022 (untabulated). Not surprisingly, bookkeepers and accountants most frequently require a financial skill. However, many jobs that are not traditionally considered accounting-focused, such as construction managers, retail associates, and restaurant managers, also frequently require accounting skills.

TABLE 8

Variation in Accounting Skill Definitions

DV:	*IC Skills*		*Accounting Positions*		*Accounting Skills–Non Accountants*	
	(1)	(2)	(3)	(4)	(5)	(6)
ICW	0.000***	0.000	0.004***	0.003***	0.011***	0.008**
	(2.76)	(0.75)	(4.71)	(3.59)	(2.99)	(2.18)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	No	Yes	No	Yes	No
Firm Fixed Effects	No	Yes	No	Yes	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,906	16,906	16,906	16,906	16,881	16,881
R^2	0.02	0.38	0.06	0.41	0.11	0.53

***, **, * Denote 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table presents results based on variation in accounting-related skills. *IC Skills* is the percentage of postings in a given firm-year indicating a job vacancy requiring at least one internal control-specific skill as described in Appendix A. *Accounting Positions* is the percentage of job postings in a given firm-year that have SOC Code 13-2010–Accountants and Auditors. *Accounting Skills–Non Accountants* is as the percentage of postings in a given firm-year indicating a job vacancy requiring at least one accounting-related skill as described in Appendix A, excluding postings with SOC Code 13-2010–Accountants and Auditors. *ICW* is an indicator variable taking the value of 1 for firm-years disclosing a Section 302 disclosure, 404(a) management assessment, or 404(b) audit report determining that an internal control weakness exists, and 0 otherwise. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

top-down and bottom-up strategies may be complements, suggesting that new executives may put a greater emphasis on employee accounting skills. Alternatively, executive turnover may be a substitute for investing in accounting skills. This could be the case if lower-level employees are not uniquely important for internal control quality or if they perform a role similar to that of executives in preparing financial statements. Finally, it is possible that the top-down and bottom-up approaches serve distinct functions and thus that one response does not moderate the other.

Prior studies examine executive turnover utilizing sets of firms and time periods that are different from those of our sample. Thus, we first examine ICW consequences in our sample by replacing the dependent variable in Equation (1) with the following variables: *CFO Turnover*, an indicator set to 1 if the CFO leaves the firm in the year after the ICW disclosures, and 0 otherwise; *CEO Turnover*, an indicator set to 1 if the CEO leaves the firm in the year after the ICW disclosures, and 0 otherwise; *Audit Committee Change*, an indicator that turns to 1 if the firm appoints a new audit committee member in the year after the ICW disclosures, and 0 otherwise; and *Auditor Change*, an indicator equal to 1 if the firm changes auditors in the year after the ICW disclosures, and 0 otherwise. We obtain data on executive and auditor turnover from Audit Analytics' Director and Officer Changes dataset and data on new audit committee appointments from BoardEx.

Table 9 reports results on the relation between ICW and top-down changes in firm management. Columns (1) and (2) report results for *CFO Turnover*. The coefficients on *ICW* are significantly positive ($p < 0.05$) in both columns, consistent with findings from prior studies that ICWs are associated with CFO changes. Columns (3) and (4) report results for *CEO Turnover*. In column (3), we find that *ICW* is marginally associated with *CEO Turnover*, but this association is not significant with the addition of *Firm Fixed Effects* in column (4). We find no evidence of a positive association between ICWs and audit committee changes and weak evidence of a negative association when including firm fixed effects (columns (5) and (6)). Finally, we find that *ICW* loads significantly positive in columns (7) and (8), suggesting a higher auditor turnover rate after ICWs.[15] Taken together, our results suggest that firms often respond to ICWs by changing management and auditors.

In our next analysis, we examine whether the relation between ICWs and job postings with accounting skills is influenced by executive and auditor turnover. We re-estimate Equation (1) but control for and interact ICW with each of the

[15] Desai, Hogan, and Wilkins (2006) and Hennes, Leone, and Miller (2008) document a positive association between restatements and executive turnover using a sample of restatements disclosed between 1997 and 2002 and between 2002 and 2006, respectively. In untabulated analyses, we also examined the impact of restatements in our sample period, which spans from 2010 to 2017. We find no evidence of significant positive association between restatement announcements and subsequent executive turnover.

TABLE 9

Top-Down Responses to ICW

DV:	*CFO Turnover*		*CEO Turnover*		*Audit Committee Change*		*Auditor Change*	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
ICW	0.032***	0.021***	0.009*	0.002	−0.000	−0.008*	0.032***	0.016***
	(5.01)	(2.71)	(1.77)	(0.35)	(−0.07)	(−1.69)	(7.02)	(2.90)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	No	Yes	No	Yes	No	Yes	No
Firm Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,906	16,906	16,906	16,906	16,906	16,906	16,906	16,906
R^2	0.02	0.23	0.02	0.23	0.03	0.45	0.03	0.24

***, **, * Denote 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table presents results from regressions of various measures of firms' top-down responses on *ICW*. *CFO Turnover*, *CEO Turnover*, *Audit Committee Changes*, and *Auditor Change* are indicator variables set to 1 if the firm experiences changes in the CFO, CEO, audit committee, and external audit firm in year $t+1$, respectively, and 0 otherwise. *ICW* is an indicator variable taking the value of 1 for firm-years disclosing a Section 302 disclosure, 404(a) management assessment, or 404(b) audit report determining that an internal control weakness exists, and 0 otherwise. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

turnover measures. Table 10 reports the results. Columns (1) and (2) report the results after controlling for the various top-down responses. In both columns, we continue to find that the coefficient on *ICW* loads significantly positive and generates similar magnitude to our baseline results. Columns (3) and (4) report results after including interactions between *ICW* and managerial/auditor turnover. In all cases, the coefficients on the interaction terms are negative, but statistically insignificant, consistent with there being no significant positive or complementary relation between high-level and rank-and-file personnel responses in connection with ICWs. Overall, these results suggest that reshaping rank-and-file employees' skill profiles constitutes a distinct response to ICWs with potentially different implications for remediation success. We explore this issue in more detail in the next section.

Internal Control Improvements and Remediation

Our results thus far provide strong evidence that firms respond to ICWs by requiring accounting skills when hiring rank-and-file employees. A natural follow-up question is whether such actions facilitate improvements in internal control and ultimately more successful remediation. In our final analyses, we explore this question in more detail.

First, we consider the entire sample and classify observations into three groups, (1) *Improvement* (change from reporting ICWs to reporting no ICWs), (2) *Decline* (change from reporting no ICWs to reporting ICWs), and (3) *No Change* (no change in ICW reporting), based on changes in internal control status between period t and period $t+2$.[16] We then estimate the following multinomial logit regression model, which allows us to simultaneously compare these groups:

$$\begin{aligned} Group\{Improvement,\ Decline,\ No\ Change\}_{it+2} = {} & \beta_1 Accounting\ \ Skills_{it+1} + \beta_2 CEO\ \ Change_{it+1} \\ & + \beta_3 CFO\ \ Change_{it+1} + \beta_4 Auditor\ \ Change_{it+1} \\ & + \beta_5 Audit\ \ Committee\ \ Appointment_{it+1} + \beta_6 Employee\ \ Training_{it+1} \\ & + Controls\ + \gamma Industry_j + \delta Year_t + \varepsilon_{it}. \end{aligned} \quad (2)$$

This model allows us to separately compare the *Improvements* and *Declines* groups with the *No Change* group and report the coefficients across the different variables. Our primary focus is on *Accounting Skills*, but we include the

[16] We focus on changes in internal control status from period t to $t+2$, given that the response (job postings listing accounting skills) is measured in $t+1$.

TABLE 10

Accounting Skill Demand, ICW, and Top-Down Responses

DV: *Accounting Skills*	(1)	(2)	(3)	(4)
ICW	0.013***	0.009**	0.014***	0.013***
	(3.33)	(2.47)	(3.41)	(3.24)
CFO Turnover	0.005	0.004	0.004	0.008
	(0.86)	(0.83)	(0.62)	(1.32)
CEO Turnover	0.010**	0.002	0.011*	0.006
	(2.10)	(0.45)	(1.82)	(1.07)
Audit Committee Change	−0.007	−0.016**	−0.006	−0.013*
	(−1.07)	(−2.37)	(−0.86)	(−1.88)
Auditor Change	0.009	0.009	0.015	0.012
	(1.10)	(1.29)	(1.50)	(1.22)
ICW × *CFO Turnover*			−0.002	−0.012
			(−0.17)	(−1.17)
ICW × *CEO Turnover*			0.003	−0.016
			(0.23)	(−1.25)
ICW × *Audit Committee Change*			−0.004	−0.014
			(−0.27)	(−0.95)
ICW × *Auditor Change*			−0.018	−0.007
			(−1.08)	(−0.44)
Controls	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	No	Yes	No
Firm Fixed Effects	No	Yes	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	16,906	16,906	16,906	16,906
R^2	0.12	0.53	0.12	0.53

***, **, * Denote 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table presents results from regressions of *Accounting Skills* on *ICW* after controlling for top-down responses. *Accounting Skills* is the percentage of postings in a given firm-year indicating a job vacancy requiring at least one accounting-related skill as described in Appendix A. *ICW* is an indicator variable taking the value of 1 for firm-years disclosing a Section 302 disclosure, 404(a) management assessment, or 404(b) audit report determining that an internal control weakness exists, and 0 otherwise. *CFO Turnover*, *CEO Turnover*, *Audit Committee Changes*, and *Auditor Change* are indicator variables set to 1 if the firm experiences changes in the CFO, CEO, audit committee, and external audit firm in year $t+1$, respectively. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

measures of managerial/auditor turnover from Tables 9 and 10 as well as the controls from our previous analyses, including *Industry Fixed Effects* and *Year Fixed Effects*. We also control for employee training (*Employee Training*), as an alternative firm response to ICWs.[17]

Table 11 reports the results of this analysis. In column (1), the coefficient on *Accounting Skills* loads significantly positive ($p < 0.05$), suggesting that increased demand for accounting skills is associated with improvements in firms' internal controls. We find no evidence of a significant difference in column (2) when examining declines. This difference suggests an asymmetry in the relation between the firms' requirements for accounting-related skills and internal controls.

Given that multinomial logit analyses are not well suited for fixed effect designs (Greene 2004), we repeat this analysis in columns (3) and (4) using OLS after changing the dependent variable to an indicator variable. In column (3), the

[17] *Employee Training* is an indicator set to 1 for observations that have at least one instance of phrases referring to "additional training," "provide training," "on-going training," "improve training," "training program," "enhanced training," or "conduct training" in their 10-K filing. About 17 percent of our observations make references to employee training as captured by this approach. In untabulated analyses, we validate this training measure as an alternative response by showing that *Employee Training* is positively associated with ICWs disclosed in the concurrent 10-K filing or in earlier quarterly filing pertaining to the same fiscal year.

TABLE 11

Accounting Skill Demand, Internal Control Quality, and Remediation

	Multinomial Logit		OLS		
DV:	***Improvement***	***Decline***	***Improvement***	***Decline***	***Remediation***
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Accounting Skills	0.404**	0.038	0.039*	−0.019	0.180***
	(2.26)	(0.24)	(1.80)	(−0.81)	(2.81)
CEO Change	0.066	0.007	0.010	−0.008	0.058
	(0.58)	(0.07)	(0.80)	(−0.57)	(1.58)
CFO Change	0.258***	0.089	0.018	−0.010	0.014
	(2.63)	(1.02)	(1.52)	(−0.84)	(0.49)
Auditor Change	0.450***	0.140	0.027	−0.004	0.069*
	(3.36)	(1.13)	(1.56)	(−0.21)	(1.93)
Audit Committee Appointment	0.007	0.182	−0.009	−0.001	−0.006
	(0.05)	(1.52)	(−0.45)	(−0.06)	(−0.15)
Employee Training	−0.087	−0.021	0.009	−0.014	−0.016
	(−0.94)	(−0.28)	(0.66)	(−0.97)	(−0.41)
Restate	0.913***	−0.075	0.083***	−0.070***	0.040*
	(10.03)	(−0.76)	(5.67)	(−5.31)	(1.69)
OP404b	0.351***	0.152	0.023	−0.026	0.068
	(3.27)	(1.62)	(1.35)	(−1.19)	(1.06)
LNAssets	−0.300***	−0.068*	0.008	−0.016	−0.049
	(−6.67)	(−1.92)	(0.58)	(−1.03)	(−1.43)
LNAge	−0.216***	−0.200***	−0.062	−0.022	−0.037
	(−3.80)	(−4.34)	(−1.13)	(−0.37)	(−0.25)
BKMKT	0.380***	−0.014	0.035***	−0.035***	0.020
	(4.98)	(−0.22)	(2.85)	(−2.78)	(0.56)
BigN	−0.273***	0.166*	−0.030	0.074**	−0.044
	(−2.74)	(1.82)	(−0.89)	(2.37)	(−0.72)
Loss	0.027	−0.070	0.004	−0.007	0.034
	(0.31)	(−0.85)	(0.35)	(−0.53)	(1.16)
ROA	−0.630	0.160	0.064	−0.000	−0.014
	(−1.05)	(0.35)	(0.90)	(−0.00)	(−0.09)
ZScore	−0.086	−0.028	0.016	0.000	0.004
	(−0.78)	(−0.33)	(1.32)	(0.03)	(0.14)
QuickRatio	−0.039	−0.042*	−0.005	0.004	−0.001
	(−1.46)	(−1.95)	(−1.41)	(1.15)	(−0.08)
Leverage	0.493	−0.186	−0.014	−0.116**	−0.029
	(1.32)	(−0.62)	(−0.30)	(−2.14)	(−0.27)
LNFee	0.600***	0.099*	0.148***	−0.122***	−0.007
	(8.23)	(1.74)	(8.20)	(−6.73)	(−0.17)
LNSegs	0.017	0.103*	0.007	−0.012	−0.012
	(0.25)	(1.76)	(0.63)	(−1.04)	(−0.49)
Merger	1.267***	−0.301***	0.207***	−0.131***	−0.004
	(18.36)	(−3.94)	(17.99)	(−12.54)	(−0.23)
Foreign	0.086	0.037	0.016	0.005	0.024
	(1.20)	(0.60)	(0.95)	(0.25)	(0.73)
Sales Growth	0.167*	0.094	0.015	−0.002	0.038
	(1.87)	(1.22)	(1.40)	(−0.22)	(1.51)
R&D Growth	0.954	−2.735***	−0.025	−0.201	−0.290

(continued on next page)

TABLE 11 (continued)

	Multinomial Logit		OLS		
DV:	***Improvement***	***Decline***	***Improvement***	***Decline***	***Remediation***
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	(0.96)	(−3.06)	(−0.22)	(−1.60)	(−0.88)
Inc CAPEX	−0.077	−1.234*	−0.209*	0.170	−0.253
	(−0.09)	(−1.68)	(−1.84)	(1.37)	(−0.59)
Industry Fixed Effects	Yes		No	No	No
Firm Fixed Effects	No		Yes	Yes	Yes
Year Fixed Effects	Yes		Yes	Yes	Yes
Observations	13,805		13,805	13,805	2,851
Pseudo R^2	0.06		0.31	0.26	0.65

***, **, * Denote the 10 percent, 5 percent, and 1 percent levels of significance, respectively.
This table considers the relation between *Accounting Skills* and subsequent improvements in internal control quality. Columns (1) and (2) report analyses based on a single multinomial logit regression, where the dependent variable (DV) takes on three possible values, *Improvements*, *Declines*, and *No Change*, based on differences in internal control status in year t+2 relative to t. The *No Change* group is the reference or benchmark category for the reported coefficients in each column. Columns (3)–(5) report results based on individual OLS regressions. The dependent variable in column (3) [4] is *Improvements* [*Declines*], an indicator variable equal to 1 if an observation represents an improvement (decline) in internal control, and 0 otherwise. Column (5) reports a remediation analysis based on a subsample of observations that report ICWs in year t. The dependent variable, *Remediation*, is an indicator variable set to 1 if a firm reports effective internal controls at the end of year t+2. *Accounting Skills* is the percentage of postings in a given firm-year indicating a job vacancy requiring at least one accounting-related skill as described in Appendix A. Standard errors are clustered by firm.
All other variables are defined in Appendix B.

dependent variable is an indicator set to 1 if the firm has improved its internal control (i.e., change from reporting ICW to not reporting an ICW), and 0 otherwise. In column (4), the dependent variable is an indicator set to 1 if the firm's internal control situation has declined (i.e., change from not reporting an ICW to reporting an ICW), and 0 otherwise. We include the same control variables as in the previous analyses, except we replace *Industry Fixed Effects* with *Firm Fixed Effects*. The coefficient on *Accounting Skills* in column (3) is positive and marginally significant ($p < 0.10$), consistent with the results in column (1), whereas the coefficient in column (4) is insignificant, similar to column (2). Thus, the results from this analysis serve to complement those from the multinomial logit analysis.

In our final test, we focus on a remediation analysis. Specifically, we examine the subset of firms that experience at least one ICW and examine whether variation in the firms' job postings with accounting skills is associated with a higher likelihood of internal control remediation. To conduct this analysis, we define *Remediation* as an indicator variable that equals 1 if a firm reports effective internal controls over financial reporting in its financial statements at the end of the following year (i.e., no 404(a) or 404(b) material weaknesses in the 10-K at the end of fiscal year t+2), and 0 otherwise. We include the control variables from Equation (1) as well as the controls from top-down responses based on the analyses in Tables 8 and 9 along with *Firm Fixed Effects* and *Year Fixed Effects* to control for time-invariant firm characteristics and differences across time.

Column (5) of Table 11 reports the results of this analysis. The positive and significant coefficient on *Accounting Skills* indicates that firms with job postings listing accounting skills more successfully remediate internal control problems. The coefficient of 0.18 suggests that a one-standard-deviation increase in the percentage of job postings requiring accounting skills is associated with a 3.2-percentage point increase in the probability of remediation. This result is consistent with accounting-related skills helping firms to improve their internal controls over financial reporting.[18]

VII. CONCLUSION

Ineffective internal controls are often related to a lack of qualified personnel with sufficient accounting and technical expertise. Prior research largely focuses on a firm's top-down response with respect to replacing executives and auditors.

[18] In untabulated analyses, we repeat the remediation analysis: (1) using only observations with ICWs that are classified as personnel-related as described in Appendix C and (2) including a control for the percentage of job postings that require work experience. Results are unchanged in terms of direction and significance, and economic magnitudes are similar in both of these analyses as compared with the results reported in column (5).

In this study, we extend this literature by examining whether firms respond to internal control failures with an increased emphasis on accounting skills at the rank-and-file level (a bottom-up approach).

We find that firms significantly increase their demand for accounting skills after ICWs as measured by the percentage of job postings that require accounting-related skills. Our analyses help rule out alternative explanations, including general increases in the demand for related business skills. In additional analyses, we find that the increase in the demand for accounting skills extends across the firm to both accountants and nonaccountants and that this increase in the demand for accounting skills is associated with the remediation of internal control weaknesses. Importantly, a firm's effort to reshape its employees' skill profile appears to serve functions that are distinct from and unique to its top-down responses to replace executives responsible for the preparation of the financial statements.

We note important limitations to the data used in the study. First, the job posting data we utilize do not indicate whether the job posting is filled. Furthermore, the job posting data do not allow us to observe the number of employees hired, and our empirical analyses do not distinguish between firms replacing versus expanding their labor force. Finally, whereas our empirical proxy is based only on job postings, we expect that the requirement for accounting skills for new employees is likely reflective of a broader strategy that encompasses other actions in the firm. Despite these limitations, our findings are relevant to the literature on internal control remediation as we provide evidence on the importance of a bottom-up investment in rank-and-file skill sets for remediating ICWs.

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APPENDIX A

Defining Accounting-Related Skills

We measure firms' requirement for accounting-related skill sets based on more than 20 million job postings issued between 2010 and 2017 from Burning Glass Technologies (BGT). BGT classifies job posting skill requirements broadly based on skill cluster families which are then decomposed into skill clusters. We classify a job posting as requiring accounting-related skills if it includes any of the skill clusters below from the Finance and Business skill cluster families.

Finance Skill Cluster Family

Accounting and Finance Software
Accounts Payable and Receivable
Auditing
Billing and Invoicing
Cash Management
Corporate Accounting
Cost Accounting
Costing
Financial Accounting

Financial Analysis
Financial Management
Financial Reporting
General Accounting
Specialized Accounting
Tax

Business Skill Cluster Family

Internal Controls Testing
Internal Control Evaluation
Internal Control Procedures

APPENDIX B

Variable Definitions

Dependent Variables	
Accounting Skills	Percentage of postings in a given firm-year indicating a job vacancy requiring at least one skill in the Finance skill cluster family or one of the three internal control skills in the Business skill cluster family described in Appendix A. Obtained from Burning Glass.
IC Skills	Percentage of postings in a given firm-year indicating a job vacancy requiring at least one skill in the three internal control skills in the Business skill cluster family described in Appendix A. Obtained from Burning Glass.
Accounting Positions	Percentage of job vacancy postings in a given firm-year designated as accountants relative to total postings. Posting designated as accountants are defined as those with SOC code 13-2011. Obtained from Burning Glass.
Accounting Skills–Non Accountants	Percentage of nonaccountant job vacancy postings in a given firm-year indicating a need for finance skills. Non-accountants defined as those without SOC code 13-2011. Obtained from Burning Glass.
Test Variables	
ICW	An indicator variable equal to 1 for firm-years disclosing an internal control weakness in one or more of the following reports: Section 302 quarterly certifications, 404(a) management assessment, and/or 404(b) audit report, 0 otherwise.
ICW–Severity	The natural logarithm of 1 plus the number of unique ICW category keys identified in the Audit Analytics data base. When no ICW is disclosed, this variable is set to 0.
ICW–Personnel	An indicator variable equal to 1 for firm-years disclosing an ICW that is personnel-related based on whether the ICW disclosure contains a classification code from the categorization described in Appendix C, 0 otherwise. Obtained from Audit Analytics.
ICW–IT	An indicator variable equal to 1 for firm-years disclosing an ICW that is IT-related based on whether the ICW disclosure contains a classification code from the categorization described in Appendix C, 0 otherwise. Obtained from Audit Analytics.
ICW–Other	An indicator variable equal to 1 for firm-years where *ICW–Personnel* and *ICW–IT* are equal to 0, 0 otherwise.
Control Variables	
Restate	An indicator variable equal to 1 if the firm announces a restatement during year *t*, and 0 otherwise (obtained from Audit Analytics).
LNAssets	Natural log of total assets (at).
LNAge	Natural log of the number of years the firm has filed with the SEC per Compustat.
BKMKT	Book value (at-lt) divided by market value of equity (csho*prcc_f).
BIGN	An indicator variable equal to 1 if the firm is audited by a Big 4 firm based on Audit Analytics, and 0 otherwise.
LOSS	An indicator variable equal to 1 if the firm experiences a loss during the current year (ib), and 0 otherwise.
ROA	Income before extraordinary items (ib) divided by average total assets (at).

(continued on next page)

APPENDIX B (continued)

ZScore	The Zmijweski measure (Zmijewski 1984) of financial distress using coefficients from Shumway (2001).
QuickRatio	Current assets (act) less inventory (invt) divided by total liabilities (lt).
Leverage	Total liabilities (lt) divided by total assets (at).
LNFee	Natural log of total audit fees obtained from Audit Analytics.
LNSegs	Natural log of business segments as available from the Compustat segment file.
Merger	An indicator variable equal to 1 if the firm discloses merger or acquisition activity, and 0 otherwise (obtained from the Compustat footnote file).
Foreign	An indicator variable equal to 1 if the firm discloses foreign sales, and 0 otherwise (obtained from the Compustat footnote file).
Sales Growth	Percentage change in sales (sale) between current and period year sales.
R&D Growth	The difference between current R&D expense (xrd) and prior period expense scaled by prior year total assets (at).
Inc CAPEX	Current period capital expenditures (capx) less depreciation from the statement of cash flows (dpc) scaled by total assets (at).
%FinExp AC	The percentage of audit committee members with financial expertise (BoardEx).
CEO–Chair Duality	An indicator for whether the CEO is the chairman of the board (BoardEx).
CEO Tenure	The natural logarithm of the CEO's tenure in years (BoardEx).
CFO Tenure	The natural logarithm of the CFO's tenure in years (BoardEx).
Employee Training	An indicator set to 1 for observations that have at least one instance of phrases referring to "additional training," "provide training," "on-going training," "improve training," "training program," "enhanced training," or "conduct training" in their 10-K filing, and 0 otherwise (SEC Analytics Suite).
%Board Independent	The percentage of independent directors (BoardEx).
Firm Fixed Effects	Indicator variables for each firm using gvkey.
Year Fixed Effects	Indicator variables for each year in the sample period.
Industry Fixed Effects	Indicator variables for two-digit SIC codes.

Compustat data items are in parentheses with all other data sources noted above.

APPENDIX C

Classifying ICWs

We classify ICWs based on the key descriptions provided by the Audit Analytics SOX 404 Internal Controls and SOX 302 Disclosure Controls data bases. This classification consists of three non-mutually exclusive groups:

1. *Personnel-Related Controls*. These represent the issues that we suspect are most likely to be related to personnel and include issues such as lack of staff, personnel inadequacies, and manual control issues (e.g., account-specific issues, accounting estimation, and non-routine closing) that allow for significant human judgment or error. We label this variable *ICW–Personnel*.
2. *IT-related Application Controls*. These represent issues that relate to technology and software infrastructure and involve little human input. We label this variable *ICW–IT*.
3. *Other Control Failures*. These represent broader issues such as those related to corporate governance, board or audit committee, and regulatory compliance issues. If an ICW is disclosed but does not contain issues classified as *ICW–Personnel* or *ICW–IT*, we classify it as *ICW–Other*.

Personnel-Related ICW Issues

Description	Key
DC—Acquisition, etc.—integration and/or challenges noted	key_56
DC—Financial close processing/policy/information accumulation and timeliness issues	key_50
DC—Personnel inadequacies/segregation of duty issues	key_51
IC—Accounting personnel resources, competency/training	key_44
Acc—Revenue recognition issues	key_39
Acc—Tax expense/benefit/deferral/other (FAS 109) issues	key_41
DC—Insufficient management review, inadequate control procedures	key_58
Acc—Unspecified/unidentified/inapplicable FASB/GAAP issues	key_68
DC—Period end close and nonroutine adjustment issues	key_53
Acc—Inventory, vendor, and cost of sales issues	key_32
IC—Segregations of duties/design of controls (personnel)	key_42
Acc—Liabilities, payables, reserves, and accrual estimation failures	key_33
Acc—Foreign, related party, affiliated, and/or subsidiary issues	key_38
Acc—Accounts/loans receivable, investments, and cash issues	key_15
Acc—PPE, intangible, or fixed asset (value/diminution) issues	key_16
IC—Non-routine transaction control issues	key_77
Acc—Expense recording (payroll, SG&A) issues	key_29
Acc—Acquisition, merger, disposal, or reorganization issues	key_35
Acc—Debt, quasi-debt, warrants, and equity (BCF) security issues	key_47
IC—Untimely or inadequate account reconciliations	key_12
Acc—Lease, FAS 5, legal, contingency, and commit issues	key_3
IC—Journal entry control issues	key_76
Acc—Consolidation, (Fin46r/Off BS), and foreign currency translation issues	key_24
Acc—Depreciation, depletion, or amortization issues	key_28
Acc—Lease, leasehold, and FAS 13 (98) (subcategory) issues	key_73
Acc—Capitalization of expenditures issues	key_14
Acc—Intercompany/investment with subsidiary/affiliate issues	key_8
Acc—Financial statement, footnote, U.S. GAAP conversion, segment disclosures	key_40
Acc—Financial derivatives/hedging (FAS 133) accounting issues	key_30
IC—Ethical or compliance issues with personnel	key_21
IC—Insufficient or nonexistent internal audit function	key_18
Acc—Pension and other post-retirement benefit issues	key_80
DC—Non-standard or nonfinancial close processing issues	key_60
Acc—Asset retirement obligation issues	key_81
Acc—Gain or loss recognition issues	key_31
Acc—Loan covenant violations/issues	key_34

IT-Related ICW Issues

Description	Key
DC—Information technology, software, access/security issues	key_52
IC—Information technology, software, security, and access issues	key_22