ACCOUNTING STANDARDS UPDATES, INVESTMENTS IN ACCOUNTING INFORMATION SYSTEMS, AND FIRMS' INTERNAL INFORMATION ENVIRONMENTS

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While the implementation of new accounting standards requires significant firm resources, the literature is largely silent on how firms allocate resources to comply with new accounting standards. I investigate whether firms make information systems (IS) investments to comply because IS are the primary means through which firms' economic activities are captured, aggregated, and summarized for managerial decision-making. I use a requirement that firms disclose factors that materially affect their internal controls to identify IS investments. I find that—despite the large direct and indirect costs of IS investments and alternatives to comply with GAAP changes—new accounting standards lead to significant IS investments for the firms most affected by the GAAP changes. Moreover, the IS investments improve firms' internal information environments. The results suggest that the IS investments and IIE improvements extend beyond the scope of the GAAP changes.

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ABBREVIATIONS

AAA	American Accounting Association
ASU	Accounting Standards Update
CFO	Chief Financial Officer
CIO	Chief Information Officer
ERP System	Enterprise Resource Planning System
FASB	Financial Accounting Standards Board
GAAP	Generally Accepted Accounting Principles
IIE	Internal Information Environments
IS	Information Systems
IT	Information Technology
ITCV	Impact Threshold for an Omitted Confounding Variable
IV	Instrumental Variable
MAD	Mean Absolute Deviation
MB	Market-to-Book
PCAOB	Public Company Accounting Oversight Board
SAB	Staff Accounting Bulletin
SEC	United States Securities and Exchange Commission
SG&A	Selling, General, and Administrative
SIC	Standard Industrial Classification
SOX	Sarbanes-Oxley Act of 2002

INTRODUCTION

Understanding the costs and benefits of a proposed standard is critically important to our stakeholders—as they want to be satisfied that the expected benefit of an accounting standard justifies the cost of implementing it.

Russell Golden
Former FASB Chairmen

Complying with changes to financial reporting standards is a fundamental responsibility of firms' management, and firms' use and maintenance of information systems are key determinants of successful financial reporting. I examine two related questions that arise when firms adopt financial reporting standards: 1) whether the implementation of GAAP changes leads to investments in firms' information systems (IS) and 2) whether such investments affect firms' internal information environments (IIE). Research investigating GAAP changes primarily focuses on the capital market consequences of the mandated accounting changes (e.g., Beatty and Weber 2006; Callahan et al. 2012; Ettredge et al. 2005; Hayes et al. 2012; Jones 2013). A few exceptions show that following the *adoption* of a new accounting standard, managers collect and process information relevant to investments (Cheng et al. 2018; Heitzman and Huang 2019; Shroff 2017; Roychowdhury et al. 2019 for a review). Yet there is little evidence documenting how managers allocate resources *to implement* GAAP changes and whether they receive benefits, beyond regulatory compliance, from doing so. This gap in the literature is surprising, given the importance regulators and practitioners place on a comprehensive cost-benefit analysis of GAAP changes. My

study attempts to extend our understanding of the overall impact of GAAP changes, with a focus on the effects of GAAP implementation costs on firms' decisions and information environment.[1]

To comply with GAAP changes ("accounting changes" or "new accounting standards"), resource-constrained firms expend effort and capital to identify, collect, and process new and existing information. I focus on IS investments made in response to GAAP changes because information systems are the primary means by which economic activities are identified, aggregated, analyzed, and disclosed in accordance with GAAP (e.g., Ashraf et al. 2020; AAA 2022).[2] Unlike other GAAP adoption costs that are more transitory (e.g., implementation task forces) or confined to specific financial reporting tasks (e.g., additional human capital or manual workarounds), IS investments made to comply with mandated accounting changes can spill over to firms' IIE because of long IS life cycles and the potential for IS to interact with many aspects of management. Moreover, although worldwide spending on information systems has more than doubled in the last 10 years, increasing from $245 billion in 2010 to $529 billion in 2020,[3] there is little evidence about why and when firms upgrade their accounting information systems and whether these investments affect their internal information environments (Grabski et al. 2011).

Ultimately, it is an empirical question whether GAAP changes lead to IS investments. On the one hand, GAAP changes can induce IS investments because mandated accounting changes increase the marginal benefit of these investments, decrease their incremental implementation costs, or both. On the other hand, GAAP changes will not lead to new IS investments if, for

[1] Although financial statement users and firms potentially receive economic benefits following the adoption of an accounting change, such as a reduced cost of capital, the analysis of the economic impact of an accounting change is "separate and distinct from the cost-benefit analysis." https://www.fasb.org/cs/ContentServer?d=Touch&c=Page&pagename=FASB%2FPage%2FSectionPage&cid=1176164441838

[2] I define IS as the software and hardware used to collect, process, and summarize financial data. IS range from large, enterprise-wide systems such as SAP to specialized subledgers that track processes such as leases or inventory.

[3] See report from Gartner: https://www.statista.com/statistics/203428/total-enterprise-software-revenue-forecast/

instance, the GAAP change cannot overcome the significant costs of an IS upgrade (e.g., large irreversible expenses, opportunity costs, career risk, and uncertain benefits) or if the firm already has a sufficiently sophisticated information system to comply with the accounting change.

When GAAP changes induce IS upgrades, managers acquire new, detailed information or additional analytical abilities, which in turn can improve firms' IIE (e.g., Dorantes et al. 2013; Hemmer and Labro 2008; Kaplan 1984; Masli et al. 2010). However, implementing IS upgrades to comply with GAAP changes may not improve firms' IIE. Competitive forces and prior regulations (e.g., Sarbanes-Oxley Act of 2002 audits of internal control over financial reporting and the Foreign Corrupt Practices Act of 1977) ought to provide managers incentives to implement and maintain high quality information systems. These prior IS upgrades may subsume improvements to firms' IIE from GAAP-inspired IS investment. Also, GAAP changes could force managers to shift their limited resources to external compliance tasks, which may not incrementally benefit managerial decision-making. Therefore, it is unclear whether IS investments made to comply with GAAP changes will improve the IIE of well-run firms.[4]

To my knowledge, the literature has not examined whether GAAP changes result in new IS investments. One likely reason is that IS investments are largely unobservable (Masli et al. 2011). To overcome this challenge, I exploit a paragraph of SOX §302(a)(6) that requires firms to disclose on a quarterly basis "whether or not there were significant changes in internal controls or in other factors that could significantly affect internal controls." Since internal controls are intertwined with IS, SOX §302(a)(6) requires firms to disclose significant upgrades to their

[4] My analysis is a partial equilibrium. Although GAAP-inspired IS investments could improve firms' IIE, I cannot identify the total cost of implementation and therefore, I cannot determine whether there is a net benefit. In this regard, my findings document that there are some observable benefits.

information systems.[5] I use these disclosures to identify a sample of firms making significant IS investments around two new accounting pronouncements.

I investigate IS investments around Accounting Standards Update (ASU) 2014-09 *Revenue from Contracts with Customers (Topic 606)* and ASU 2016-02 *Leases (Topic 842)*.[6] The standards provide a powerful setting to test my predictions because they arguably represent the most significant GAAP changes since the passage of SOX. Also, anecdotal evidence suggests these two GAAP changes required firms to collect new data or reprocess existing data. For example, the revenue standard requires new disclosures, such as information on contract balances, outstanding performance obligations, and transaction prices allocated to the outstanding performance obligations.[7] These new requirements can motivate firms to undertake new IS investments.

To test whether GAAP changes affect IS investments, I employ a stacked difference-in-differences methodology in which I investigate the years surrounding the ASU announcement but before the adoption dates of the new standards.[8] The FASB issued the revenue standard in May 2014 and the lease standard in February 2016, with mandatory adoption required for fiscal years beginning after December 15, 2017 and December 15, 2018, respectively. I examine the change in firms' investment in IS in the three event-years following the ASU announcement, relative to the three event-years beforehand. I identify treatment intensity using cross-sectional variation in firms' exposure to the GAAP changes. I use two proxies to identify firms' exposure to the revenue

[5] While SOX §302 does not specifically reference IS investments, disclosure of an IS investment to comply with SOX §302 is prima facie evidence the IS investment is significant—although I do not observe the magnitude of the IS investments. Table 1 reports that approximately 16.6% of the firms in my sample disclose at least one IS investment over the sample period between 2011 and 2018.

[6] Since the revenue and lease adoption periods overlap, excluding one ASU could introduce bias when estimating the treatment effect of an ASU (Baker et al. 2021).

[7] An Ernst & Yong (2018) survey of 300 public company CFOs found that nearly 90% of respondents stated it had been difficult to gather data to meet disclosure requirements of the new revenue recognition standard.

[8] Figure 1 illustrates how the research design incorporates the timeline of ASU announcement and adoption dates. See Appendix A for variable definitions.

GAAP change. Since the revenue standard primarily affects revenue recognition timing, my first proxy is deferred revenue scaled by revenue. However, the revenue standard could also affect firms without deferred revenue. For my second proxy, I use firms' disclosures of the anticipated impact of the new revenue accounting standard required by Staff Accounting Bulletin (SAB) 74 (Ahn et al. 2021). The new lease standard required firms to recognize operating leases on the balance sheet. I use minimum future rental commitments, which should be correlated with operating leases, scaled by total assets, to identify exposure to the lease GAAP change.[9]

I find that firms significantly affected by GAAP changes are 12% more likely to disclose material IS investments following the ASU announcements, relative to firms not significantly affected by GAAP changes. Subsample tests of investments in enterprise resource planning systems—which are broad IS that integrate purchasing, sales, human resources, and reporting functions—suggest that the GAAP changes lead to more IS investments that are pervasive and beyond the specific topic of the mandated GAAP change.

These results are robust to controlling for firm characteristics and year, firm, or industry fixed effects. There is no evidence of pre-trend differences in IS investments between treated and control firms. To strengthen my interpretation, I perform cross-sectional tests and demonstrate that the GAAP-inspired IS investments are concentrated among firms with the largest expected marginal benefit of IS investments (e.g., by coordinating financial reporting) as measured by complexity (large number of segments) and high operational uncertainty (product market fluidity from Hoberg et al. 2014). Moreover, GAAP-inspired IS investments are concentrated among firms with the smallest marginal cost of IS investments as measured by audit committees with IT expertise. Despite the large direct and indirect costs of IS investments and alternatives for

[9] Since the two GAAP changes use different proxies for treatment intensity, an omitted variable must be correlated with the revenue and lease treatment proxies and the respective ASU announcements to affect my inferences.

compliance with GAAP changes, my difference-in-differences results suggest that GAAP changes prompt firms to make significant IS investments.

Next, I investigate whether new IS investments made in response to GAAP changes affect firms' IIE. Following the literature, I use material control weaknesses and reporting lag (i.e., the number of days between fiscal quarter-end and the earnings release date) as proxies for the quality of firms' IIE (Gallemore and Labro 2015; Heitzman and Huang 2019).[10] Since I am interested in the effect of IS investments that result from GAAP changes, in this set of tests I restrict the sample to firms that are significantly affected by GAAP changes (i.e., treated firms). I compare treated firms that did make IS investments to treated firms that did not, comparing them both before and after the GAAP changes. Among firms significantly affected by the GAAP changes, I find that those implementing new IS report fewer material weaknesses and take less time to announce earnings after the IS investments. The observed differences are both statistically significant and economically meaningful. Specifically, in event-years following an IS investment, compared to firms that did not make IS investments, material weaknesses decrease by 16%, relative to the unconditional mean, and reporting lag decreases by 6%, relative to its mean absolute deviation.[11]

Next, I employ an instrumental variable to address the concern that IS investments aimed to improve firms' IIE for reasons unrelated to GAAP changes. In the first stage, I use firms' exposure to the GAAP changes as an instrument to predict IS investment.[12] In the second stage, I regress the proxies for firms' IIE on the predicted IS investment from the first stage. The second-

[10] "Material control weaknesses" refer to disclosure control or internal control weaknesses disclosed in SOX §302 reports. In most cases, a disclosure control weakness is triggered by a parallel internal control weakness.

[11] I scale the effect of IS investment on reporting lag by the mean absolute deviation of the reporting lag because it more closely aligns with the emphasis of the literature that focuses on the earnings release date, relative to an expected reporting date (e.g., deHaan et al. 2015; Johnson and So 2018).

[12] The exposure to GAAP changes satisfies the conventional criteria for instrument relevance (partial F-statistic of 20.16 for the material weaknesses sample and 18.25 for the reporting lag sample). I argue GAAP changes are correlated with IS investments but, due to the plausibly exogenous nature of GAAP changes, are uncorrelated with the error term in my model explaining firms' internal information environments.

stage results report a statistically significant negative relation between the predicted IS investment and both material weaknesses and reporting lag. I interpret these findings as consistent with the conjecture that GAAP changes induce IS investments that then improve firms' IIE.

I also investigate how improvements in firms' IIE affects the weight managers place on internal information (change in profitability) and external information (market-to-book) sources when making capital expenditures and internal capital allocations (Heitzman and Huang 2019). I find treated firms that invest in IS following the GAAP change are more (less) sensitive to internal (external) information. These results are consistent with IS investments improving firms' IIE, which shifts managers' reliance from external to internal information sources.

To ensure my results are not sensitive to the variables' construction, I replicate my tests using alternative measures of IS investments and firms' IIE. For example, among firms significantly affected by the GAAP changes, I find that firms implementing new IS report fewer *non-revenue* and *non-lease* material control weaknesses. This result suggests the resources required to comply with GAAP changes have spillover effects on firms' IIE beyond the topic of the GAAP change. Overall, the results of the robustness tests are consistent with and reinforce the interpretation of my main findings.

My study makes several contributions. First, I use a new measure of IS investment to document an unintended consequence of *preparing to comply with* external GAAP reporting requirements. Specifically, I document GAAP changes inspire significant IS investments that subsequently improve firms' IIE. The results suggest that the IS investments and IIE improvements extend beyond the scope of the GAAP changes. This unintended consequence is important because IS are ubiquitous and IIE are critical to managers' investment decisions (Cheng et al. 2013; Goodman et al. 2014; Heitzman and Huang 2019), accurate earnings guidance (Feng et al. 2009),

and tax planning (Gallemore and Labro 2015). While anecdotal evidence suggests a relation between GAAP changes and investment in IS, the effect has not been empirically studied (e.g., Monga 2017). To my knowledge, my paper is the first to show that GAAP changes result in significant IS investments.

Second, my findings build on the literature on firms' learning following the adoption of GAAP changes (e.g., Cheng et al. 2018; Shroff 2017; Roychowdhury et al. 2019). A limitation of focusing on firm actions before and after adoption of a new accounting standard is that, following adoption, both reported accounting values and information sets change, which can affect external monitoring and the cost of capital. In contrast, I extend the literature that examines firms prior to the adoption of the accounting standard (Chatterjee 2021; Christensen et al. 2021) and focus on the effect of accounting regulations on investments in IS and the resulting changes to firms' IIE.

Finally, I provide more direct causal evidence between IS investments and changes in firms' IIE. Research generally relies on the voluntary disclosure of IS investments by large firms with sample periods that substantially overlap with the implementation of SOX (e.g., Dorantes et al. 2013; Masli et al. 2010). Samples of voluntarily disclosed IS investments likely exclude unsuccessful IS investments—potentially introducing a selection bias toward a positive relation between IS investments and firms' IIE. My novel sample of IS investments resulting from mandatory SOX §302 disclosures, combined with my setting of significant GAAP changes, offer plausibly exogenous variation in IS investments and suggest that GAAP-inspired IS investments can improve firms' IIE—including positive spillovers for areas unrelated to the ASU.

1.0 BACKGROUND AND HYPOTHESIS DEVELOPMENT

1.1 BACKGROUND ON ACCOUNTING STANDARDS UPDATES

In May 2014, the Financial Accounting Standards Board (FASB) issued Accounting Standards Update 2014-09 *Revenue from Contracts with Customers (Topic 606)*. The Accounting Standards Update (ASU) replaced the industry-specific revenue recognition rules with a five-step, principles-based framework in an effort to remove inconsistencies in revenue recognition, improve comparability across entities and industries, and expand disclosures (FASB 2014). Specifically, the new revenue standard required firms to 1) identify contracts with customers, 2) identify the performance obligations in the contact, 3) determine the transaction price, 4) allocate (or estimate) the transaction price to the performance obligations in the contract, and 5) then recognize revenue after the firm satisfies the pre-identified performance obligations. The standard required firms to disclose new information, such as revenue and impairments for groups of contracts, including the transaction price for unsatisfied performance obligations.

Anecdotal evidence suggests the new revenue recognition standard required firms to collect and process significant amounts of data. For the revenue change, firms need to review sales contracts to determine whether and how the sales revenue is recognized. For example, Verizon Communications Inc. spent three years and thousands of hours to prepare for its new revenue recognition policies and, as a result, began recognizing revenue earlier and differently from how customers are billed (Monga 2017). Similarly, the data management company Hortonworks Inc. reviewed its service contracts and determined revenue from software support subscriptions needed to be recognized later but revenue from professional service contracts needed to be recognized

earlier. The CFO of Hortonworks stated the revenue standard "impacts every aspect of how you go to market and run the business, [including] changes in systems" (Tzuo 2017). Ernst & Young LLP (2018) surveyed 300 CFOs and CIOs from public companies across multiple industries on the implementation of the revenue recognition standard. Nearly 90% of respondents stated they had been challenged by the gathering of data necessary to meet the financial disclosure requirements. Also, nearly 38% of respondents reported a need to transform systems and automate processes; 42% of respondents reported a perceived improvement in the quality of data.

In February 2016, the FASB issued ASU 2016-02 *Leases (Topic 842)*. The ASU requires operating leases, which had not been recognized on the balance sheet, to be recorded as an asset along with an associated liability. Amie Thuener, chief accountant of Alphabet Inc., described the company's extensive search through its systems for key words to determine whether contracts included a lease under Topic 842: "You now have to look at a lease and see what all the components are, because you might have lease and non-lease components in a lease. You may also have multiple leases in a lease, and you need to account for them all separately" (Strauss 2018). Many firms reported a need to "go through all of their filing cabinets across the world to find all the documents marked lease" (Strauss 2018). KPMG partner Prabhakar Kalavacherla stated that, across all types of companies, implementing the new lease standard was not as simple as capitalizing the rent commitments in the notes to the financial statements (Strauss 2018).[13] After the change, a firm's initial measurement of a lease required incremental knowledge and assessment of fixed lease payments, index-based variable lease payments (e.g., payments pegged to the

[13] Prior to the new lease standard, firms had to disclose future minimum rental payments. To the extent firms have significant amount of the lease information available, this would work against finding an increase in IS investments or improvement in their internal information environments. Alternatively, reviewing existing information can still change the information set. Also, there is often a different level of effort and materiality applied to numbers that are disclosed in a footnote versus recognized in the financial statements (e.g., Müller et al. 2015; Schipper 2007).

Consumer Price Index), residual value guarantees, and the likelihood of exercising lease options.

For public entities, the revenue GAAP change was originally effective for fiscal periods beginning after December 15, 2016, but ASU 2015-14 delayed the mandatory adoption date one year. Early adoption was only permitted after December 15, 2016. For public entities, the lease GAAP change was effective for fiscal periods beginning after December 15, 2018, and allowed early adoption. Figure 1 presents a timeline of ASU issuance and adoption dates. While both ASUs permitted early adoption, few firms actually adopted the standards early. Hill, Lobo, and Wang (2021) find only 15 firms (out of a sample of 2,307) adopted the lease standard early.[14]

1.2 BACKGROUND ON SOX 302 DISCLOSURE CONTROLS

The Sarbanes-Oxley Act of 2002 (SOX) significantly expanded the firm's requirement *to regularly disclose* management's evaluation of and conclusions on the effectiveness of the firm's disclosure controls and internal controls over financial reporting.[15] Research tends to focus on SOX §404, which requires management to assess the quality of internal controls and receive an attestation report on internal controls over financial reporting (e.g., Alexander et al. 2013; Coates and Srinivasan 2014). In contrast, management's assessment of the SOX §302 disclosure control requirements are unaudited, but the assessments are more frequent (quarterly as opposed to annually for SOX §404) and broader than the internal controls over financial reporting. Disclosure

[14] Both standards were debated publicly for several years before the ASU were issued (FASB, 2014, 2016). If firms systematically anticipated the ASU changes, then this should bias against my results because the IS investments would occur in the pre-period and I would find a relative decrease in investment following the ASU announcement.

[15] The Foreign Corrupt Practices Act of 1977 required that firms establish internal accounting systems that provide reasonable assurance that transactions receive appropriate approval and the financial statements are prepared in accordance with GAAP.

controls include all controls and procedures designed to ensure that information is "recorded, processed, summarized and reported, within the time periods specified in the [SEC]'s rules and forms" and communicated to management to allow for timely decisions (17 C.F.R. 240.13a-15(e)). As a result, the disclosure controls provide additional information about non-GAAP disclosures, such as cyber security breaches, ethics, and information systems upgrades (Audit Analytics 2019). Specifically, I use the disclosures under SOX §302(a)(6)—which require firms to disclose quarterly the factors (i.e., material upgrades to information systems) that could significantly affect their internal controls—to build a sample of firms that significantly upgrade their information systems in the years surrounding the recent revenue and lease GAAP changes.[16] See Appendix B for examples of SOX §302 IS investment disclosures.

1.3 HYPOTHESIS DEVELOPMENT

1.3.1 GAAP Changes and IS Investment

I expect GAAP changes to invite IS investments because the mandated accounting change increases the marginal benefit of the IS investment, decreases the incremental implementation costs of the IS investment, or both. When investing in the new information system helps facilitate firms' compliance with the new GAAP standard, the IS investment's marginal benefit is greater following the accounting pronouncement than it was beforehand. For example, a new IS can

[16] My measure of IS investment relies on mandatory SOX §302 disclosures, but there exists discretion in the interpretation and application of the disclosure requirements. Firms can deviate from the disclosure requirements by either disclosing a non-existent IS upgrade or by failing to disclose an IS upgrade. Due to litigation risk from disclosing non-existent IS investments, my measure of IS investment more likely classifies firms that do invest in IS as non-investment firms, which would bias against finding support for my predictions.

automate repetitive tasks such as the preliminary identification of potential leases in new contracts or processing data to support a new required disclosure. Moreover, often the process to implement a new GAAP standard resembles the one taken when firms implement new IS investments (e.g., creating a project task force or documenting existing and required processes). If a portion of the implementation costs for the GAAP change and the IS investment are fixed and overlap, then the fact that the firm *must* now undertake the implementation costs to comply with the new GAAP standard effectively lowers the incremental costs incurred to implement the new information system.[17] Either of these effects (higher marginal benefits or lower incremental implementation costs) make it more likely firms will undertake new IS investments following GAAP changes.

On the other hand, there exist significant frictions to IS investments,[18] and there are less complex and less risky ways to comply with a GAAP change. Moreover, if the GAAP change is too small to justify the significant burden of an IS upgrade or if the firm already has a sufficiently sophisticated accounting information system, then the GAAP change will not induce the firm to make new IS investments. Therefore it is an empirical question whether GAAP changes induce significant IS investments, and I state my first hypothesis in the null form as follows.

> **H1**: Firms more affected by changes to GAAP exhibit no greater propensity to invest in information systems.

[17] An everyday example is having to incur fixed costs to go to the grocery store. If you only need a few items, you might not go. But if you need to pick up dry cleaning (e.g., for an important meeting the next day) from a cleaners near to the grocery story, you are likely to end up going to the grocery store, too, because part of the fixed costs of going out (especially on a rainy day) are effectively covered by the necessary trip to the cleaners.

[18] IS investments often involve multi-year, large, irreversible direct and indirect costs that provide uncertain benefits. These investments have notoriously high failure rates, cost overruns, and time delays. Evidence of their benefits is mixed and often difficult to quantify (e.g., Masli et al. 2010; Tian and Xu 2015). Since most IS investments are at least partially irreversible, uncertainty tends to increase their real option values, which in turn dampens or delays the investment (e.g., Badertscher et al. 2013; Bloom et al. 2007; Pindyck 1990). Finally, managers have little incentive to champion significant IS investments: successful IS investments do not directly generate revenue and, at least temporarily, increase expenses, which can harm compensation. Moreover, an unsuccessful IS investment can cost a manager her job.

1.3.2 IS Investments and Firms' Internal Information Environments

It is unclear how investing in new IS in response to GAAP changes will affect firms' IIE. GAAP-inspired IS investments could improve firms' IIE. Kaplan (1984) argues that financial reporting systems are closely aligned with managerial accounting systems used to evaluate and guide the firm's operations because internal and external performance benchmarks are similar (e.g., earnings and revenue targets).[19] Relatedly, Hemmer and Labro (2008) develop a formal model to demonstrate the factors that affect the design of financial reporting systems also affect the design of managerial accounting systems. Building on the noted connection between information used in financial reporting and managerial accounting systems, I conjecture that the implementation and subsequent use of the upgraded IS affords managers the opportunity to acquire new, detailed information and analytical ability, thereby improving firms' IIE and decision-making. For example, upgraded IS can improve the accuracy of data through incremental data cleaning or generate new reports, which in turn reduces mangers' information processing costs.

However, firms' IIE may not improve following GAAP-inspired IS investments. First, the primary motivation of the IS investment is to comply with *external* reporting requirements. Firms will not necessarily realize an improvement in their *internal* information environments, especially if the purpose of the GAAP IS investment is to automate tasks (e.g., digitally reading and categorizing contracts for leases) rather than to collect and summarize new information for decision-making.

Second, SOX and the subsequent changes to the auditing standards substantially improved

[19] Similarly, Dichev et al. (2013) survey 169 public company CFOs (or chief accounting officers or equivalent) of which over 80% rate earnings as very important for *internal* use by the company's own managers. The survey also emphasizes management's use of "one number" throughout the organization to internally assess performance and to externally report.

the overall quality of financial reporting (e.g., Alexander et al. 2013) and increased the auditors' responsibility for assessing the quality of existing IS as part of the tests of internal controls over financial reporting (PCAOB 2007; PCAOB 2010). Following SOX, auditors must consider specific financial reporting risks related to IS: accuracy of data processing, unauthorized data access, unauthorized data changes, and inappropriate manual intervention within the IS. Therefore, the potential spillover benefits on firms' IIE from GAAP-inspired IS investments could have already been subsumed by upgrades to IS made in response to SOX.

Finally, competitive forces create incentives for managers to efficiently invest in IS to better monitor performance and identify opportunities (Grabski et al. 2011; Lim et al. 2011; Masli et al. 2011), while regulations (e.g., GAAP changes) impose additional costs on firms that potentially distort optimal resource allocation (e.g., Shleifer 2005). That is, a rational, resource-constrained firm that exerts additional effort to comply with a new accounting standard must necessarily exert less effort on tasks endogenously selected prior to the regulation. The observed change to the internal information environment will be the net effect of the new accounting standard and the forgone tasks.

To summarize, the relation between financial and managerial accounting systems suggests investments in new IS made to comply with a GAAP change could affect the managerial accounting systems and therefore improve firms' IIE and decision-making. However, these IS investments made to comply with *external* GAAP reporting requirements do not necessarily lead to improved IIE if GAAP changes shift resources toward compliance and away from other value-added investments in firms' IIE. Therefore I state my second hypothesis in the null form as follows.

H2: Firms that invest in information systems to comply with a GAAP change subsequently experience no improvement in their internal information environments.

There is limited large-scale, empirical evidence linking IS implementations to firms' IIE (see Masli et al. 2011 for a review). Studies of IS investments made in the 1990s and 2000s document a positive association between IS investments and firms' IIE, such as the improved frequency and accuracy of management forecasts (Dorantes et al. 2013) and fewer material weaknesses, smaller changes in audit fees, and fewer audit delays (Masli et al. 2010).[20] However, the generalizability of these studies is unclear: the research relies on the voluntary disclosure of IS investments by large firms with sample periods that substantially overlap with the implementation of SOX (e.g., Dorantes et al. 2013; Masli et al. 2010; Morris 2011). Samples of voluntarily disclosed IS investments likely exclude unsuccessful IS investments, introducing a potential selection bias. Also, SOX adoption could confound inferences. Moreover industry surveys often find poor outcomes for large IT investments. A 2015 Panorama Consulting survey found that only 58% of respondents considered their IS projects a success while reporting that 55% had cost overruns and 41% stated they realized substantially fewer benefits than expected.[21] My paper adds to this literature by using a set of mandatory IS investment disclosures from a large set of firms to examine how IS investments made in response to mandatory accounting changes affect firms' IIE.

[20] Masli et al. (2010) only examine IS investments related to monitoring internal controls. Other related papers that investigate IS—but not in the context of GAAP changes—include, for example, Tian and Xu (2015), Pincus et al. (2017), and Ashraf et al. (2020).

[21] See https://www.panorama-consulting.com/wp-content/uploads/2016/07/2015-ERP-Report-3.pdf.

2.0 EMPIRICAL SPECIFICATION

2.1 MEASURING GAAP EXPOSURE

Since the revenue and lease GAAP changes affect different financial reporting areas, I use separate methods to identify two samples of firms that are significantly affected by the GAAP changes. My treatment variable, $GAAP\ Exposure_{ig}$, equals 1 if firm i is expected to be significantly affected by GAAP change g. For the revenue ASU, I use two proxies to identify firms' exposure to the revenue GAAP change. Since the revenue standard primarily affects revenue recognition timing, my first proxy is deferred revenue scaled by revenue. However, the revenue standard could also significantly affect firms without deferred revenue, such as those with undisclosed contracts or those that will begin deferring more revenue under the new standard. Therefore, for my second proxy, I use firms' disclosures of the anticipated impact of the new revenue accounting standard required by SAB 74 (Ahn et al. 2021).[22] Audit Analytics uses these disclosures to identify whether firms expect the revenue standard to affect such matters as revenue timing, disclosure presentation, or capitalization of costs.[23] I classify firms with 1) an above median level of deferred revenue scaled by revenue or 2) disclose an affected revenue area per SAB 74 as treated and set $GAAP\ Exposure_{i,Revenue} = 1$.

[22] SAB 74 disclosures are made after the ASU is issued and requires firms to discuss the expected impact of adopting the ASU on the financial statements. The risk of bias in classifying my treatment firms is low because revenue policies are unlikely to have materially changed between the ASU announcement and the SAB 74 disclosure, and I am less concerned that the market could be unaware of the information in the SAB 74 disclosures.

[23] Approximately 48% of firms in the Audit Analytics database disclose at least one (out of nine) broad areas that is significantly impacted by the revenue standard. The most affected areas are revenue timing (29% of all firms) and disclosure presentation (20% of all firms).

For the lease ASU, I identify firms with exposure to the ASU based on the minimum rental payments scaled by total assets; firms with a large ratio of future minimum rental commitments (i.e., likely operating leases) to total assets are on average more likely to be affected by the lease accounting change. I classify firms with non-zero minimum rental commitments to total assets as treated and set $GAAP\ Exposure_{i,Lease} = 1$ (Christensen et al. 2021).

2.2 INFORMATION SYSTEMS INVESTMENT MODEL

My first hypothesis predicts that firms more affected by GAAP changes are more likely to invest in accounting information systems. To examine this relation, I employ a stacked difference-in-differences model that combines the two ASU-specific datasets centered on the revenue (May 2014) and lease (February 2016) announcements ("events"). Each event-specific dataset is limited to the 12 quarters pre and post the ASU announcement (aggregated to plus or minus three event-years). Figure 1 presents a timeline of ASU issuance dates and the resulting ASU event windows.

I use three measures of investment in IS. First, $IS\ Investment$ measures the average of quarterly IS investment disclosures per SOX §302 during the event-year (i.e., the mean of a quarterly indicator variable that equals 1 for quarters for which Audit Analytics identified an IS change).[24] The measure ranges from 0 (no IS disclosures during the event-year) to 1 (IS disclosures in every quarter of the event-year). Second, $IS\ Investment\ Count$ measures the log of 1 + the average number of times the firm mentions an IS word (e.g., financial reporting system) near an investment verb (e.g., implemented) in the SOX §302 disclosure during the event-year. Third,

[24] To mitigate the concern that changes in IS investments are driven by the firms' response to material control weaknesses, $IS\ Investment$ excludes observations from quarters when the firm discloses both an IS change and ineffective controls.

$ERP\ Investment$ captures a subset of $IS\ Investment$ that relate to investments in enterprise resource planning (ERP) systems. See Appendix A for variable definitions. I estimate the following stacked difference-in-differences model to test whether GAAP changes affect IS investments (hypothesis 1).

$$IS\ Investment_{itg} = \beta Post_{tg} \times GAAP\ Exposure_{ig} + \boldsymbol{\Gamma Controls\ IS_{itg}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}, \quad \textbf{(1)}$$

where $IS\ Investment_{itg}$ is a proxy for firm i's investment in IS in year t of GAAP change g (i.e., event g). α_{ig} are firm-event fixed effects; α_{tg} are year-event fixed effects. The main variable of interest is $Post_{tg} \times GAAP\ Exposure_{ig}$, where $Post_{tg}$ is an indicator variable equal to 0 (1) for the three years preceding (following) the announcement of GAAP change g. $GAAP\ Exposure_{ig}$ is an indicator variable equal to 1 if firm i is expected to be significantly affected by GAAP change g (i.e., treatment firms). $\boldsymbol{Controls\ IS_{itg}}$ is a vector of control variables that have been shown to explain IS budgets (Kobelsky et al. 2008): $Size$, return on sales (ROS), $Sales\ Growth$, $Book\ Leverage$, industry concentration ($Ind.Concentration$), and volatility of the return on sales ($Profit\ Volatility$). ϵ_{itg} is the error term. Per hypothesis 1, a positive β suggests that following the ASU announcement, firms that are significantly affected by the GAAP change are more likely to invest in IS, relative to the control firms.

2.3 INTERNAL INFORMATION ENVIRONMENT MODEL

My second hypothesis examines whether firms' IIE improve following GAAP-motivated IS investments. Since I am interested in the effect of IS investments as a result of the GAAP

change, I restrict my sample to treated firms (i.e., $GAAP\ Exposure = 1$). I use material control weaknesses and reporting lag (the number of days between fiscal quarter-end and earnings release date) as proxies for firms' IIE (Gallemore and Labro 2015; Heitzman and Huang 2019). Research suggests material weaknesses undermine the accuracy and reliability of internal information and are associated with less accurate management guidance (Feng et al. 2009) and lower investment efficiency (Cheng et al., 2013; Cheng et al., 2018; McNichols & Stubben, 2008).

Preparing *timely* financial reports is a primary purpose of accounting IS. The ability to close the books, consolidate entities, perform reconciliations, and investigate discrepancies determines how quickly firms can report earnings (Gallemore and Labro 2015). Low-quality information environments waste manager and auditor time and delay the earnings release (Ashton et al. 1987; Gallemore and Labro 2015; Jennings et al. 2014). To the extent new IS improve the accuracy of information through incremental data cleaning and reduce the cost of accessing information, firms can more quickly resolve issues to ensure financial reports are accurate and timely. I use the following model to explore the benefits of the GAAP IS investments on treated firms' IIE following an ASU announcement (hypothesis 2).

$$IIE_{itg} = \beta Post\ IS\ Investment_{itg} + \boldsymbol{\Gamma Controls\ IIE_{itg}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}, \qquad \textbf{(2)}$$

where IIE_{itg} is one of two proxies for firms' IIE. As before, α_{ig} are firm-event fixed effects, and α_{tg} are year-event fixed effects. The main variable of interest, $Post\ IS\ Investment_{itg}$, is an indicator variable that equals 1 for event-firm-years with or following an IS investment made in the post period. $\boldsymbol{Controls\ IIE_{itg}}$ is a vector of control variables that have been shown to explain firms' IIE (Doyle et al. 2007): return on assets (ROA), $Size$, firm age ($Log\ Firm\ Age$), net losses ($Loss$), $Altman\ Z$, number of geographic and operating segments ($Log\ Num.Segments$),

foreign exchange transactions ($FX\ Transactions$), $Extreme\ Sales\ Growth$, $Restructuring\ Charge$, and Big Four auditor ($Big\ 4$). ϵ_{itg} is the error term. Per hypothesis 2, a negative β suggests that on average firms have fewer material control weaknesses and issue earnings more quickly following GAAP-inspired IS investments, relative to treated firm-event-years without an IS investment.

2.4 INSTRUMENTAL VARIABLES

A limitation of my setting is that I cannot perfectly identify why firms invest in IS. If IS investments are made with the intention to improve firms' IIE for reasons unrelated to GAAP changes, then this would induce a positive bias between IS investments and firms' IIE. I employ an instrumental variable approach to strengthen the causal inference and help overcome limitations of previous studies that investigate endogenously disclosed IS investments and firms' IIE.

Since I am interested in the effect of IS investments that result from GAAP changes, I restrict the sample to event-years following the ASU issuance (i.e., observations with $Post = 1$). In the first stage, I use $GAAP\ Exposure$ as an instrument to predict $Post\ IS\ Investment$. This regression isolates the variation in $Post\ IS\ Investment$ attributable to GAAP changes, conditional on the control variables. In the second stage, I regress the proxies for firms' IIE on the predicted $Post\ IS\ Investment$ from the first stage.

A valid instrument must be correlated with $Post\ IS\ Investment$, conditional on other covariates (relevance condition), and be uncorrelated with the error term in Equation (2) (exclusion restriction). The testing of hypothesis 1 suggests the relevance condition (i.e., GAAP changes are correlated with IS investments) is satisfied, but the exclusion restriction is untestable. I argue the

exclusion restriction is satisfied because GAAP changes offer plausibly exogenous variation in IS investment. However, a concern of regulation-based instruments is the possibility that concurrent market events either affect the dependent variables or cause the change in regulation. It is unlikely that concurrent market events affect the exclusion restriction because, to affect my inferences, an omitted variable must be correlated with the revenue and lease treatment proxies and the ASU announcements. Moreover, my sample is limited to the time between the ASU announcement and adoption, which mitigates the concern that direct real or market effects of the ASU adoption affect firms' IIE (although indirect, anticipatory affects could exist). Also, it is unlikely concurrent market events initiated the GAAP change because the FASB publicly deliberated the revenue and lease changes for over five years before the ASUs were finally issued (FASB 2014; FASB 2016).

Finally, if GAAP changes do directly affect material weaknesses and reporting lag, the bias is more likely in the opposite direction of my predicted relation between IS investments and firms' IIE. That is, firms significantly affected by GAAP changes could have more material weaknesses and a longer reporting lag due to a greater likelihood of ASU implementation problems. Nevertheless, because the exclusion restriction is untestable, I cannot rule out that GAAP changes could be correlated with the error term in Equation (2), which could bias my IV estimate.

3.0 EMPIRICAL RESULTS

3.1 SAMPLE SELECTION

The sample is restricted to Compustat firms in the 12 quarters before (pre-period) and 12 quarters after (post-period) FASB issued ASU 2014-09 *Revenue from Contracts with Customers (Topic 606)* and ASU 2016-02 *Leases (Topic 842)*. The sample window is based on the assumption that any IS investments related to GAAP changes need to occur before the adoption date of the standard. I exclude financial services (SIC 6000–6999) and utilities (SIC 4900–4999). Since I am interested in the effect of GAAP changes on IS investment, I exclude firms with quarterly asset growth in the first and 99th percentiles that are likely undergoing large mergers and acquisitions or restructurings, which could also require IS investment. These restrictions reduce my sample to 112,302 quarterly observations between 2011 and 2018.

I require that a firm is either materially affected by only the revenue ASU, only the lease ASU, or not materially affected by either (Baker et al. 2021; Cengiz et al. 2019). Because the revenue and lease ASUs are issued less than two years apart, the post-period of the revenue ASU overlaps with the pre-period of the lease ASU. Baker et al. (2021) show staggered difference-in-differences estimates can be biased when the treatment effect varies across firms or time. Therefore I drop firms that are materially affected by both. This sample restriction has two effects. First, dropping firms that are most affected by both GAAP changes reduces the power of my tests, which should bias against finding my predicted results. Second, dropping repeat treatment firms mitigates the concern that I mistakenly compare treatment firms to recently treated control firms.

I aggregate quarterly observations to event-years to balance the quarterly disclosure requirements of SOX §302(a)(6) with noise from seasonal changes in firm performance and the longer process of IS upgrades. I also require that firms have at least one observation in the pre- and post-window to ensure the documented effect is not the result of a change in sample pre and post ASU. Firms have on average 4.8 (5.1) event-years for the revenue (lease) ASU. The final sample includes 10,214 firm-event-years between 2011 and 2018 from 59 two-digit SIC industries. See Table 1 for sample breakdown by GAAP change. About 14.1% (16.7%) of firms disclose an IS investment during the revenue (lease) event-window. Although the effect of GAAP changes could relate to industry characteristics, industries are similarly represented between the control and treatment groups. See Table 2. For example, firms from SIC 28 contribute approximately 14% of the control sample observations and 15% of the treated sample observations.

3.2 DESCRIPTIVE STATISTICS

Table 3 reports descriptive statistics of the main dependent variables and control variables. All continuous variables are winsorized at the first and 99th percentiles. The sample is relatively balanced: the $Post$-period accounts for 50% of the sample and treated firms ($GAAP\ Exposure$) account for 67% of the sample. The sample firms have an average (median) $Total\ Assets$ of \$8.26 billion (\$708.87 million) and an average (median) $Book\ Leverage$ of 26% (23%). Consistent with other research (Audit Analytics 2019), on average 9% of event-years report a SOX §302 $Material\ Weakness$. The average (median) $Reporting\ Lag$ is 42.43 (40.75) days. The average of $IS\ Investment$ is 0.03, and the average of $IS\ Investment\ Count$ is 0.02.

Unbiased estimation of the difference-in-differences design relies on the untestable parallel-trends assumption (e.g., Imbens and Wooldridge 2009): absent treatment, the difference between control and treatment groups would be the same. In Table 4, I compare the difference in means between the control and treatment subsamples in the pre-ASU period and find that the differences are not statistically different across variables such as $Size$, $Sales\ Growth$, $Book\ Leverage$, ROA, $Altman\ Z$, and $Big\ 4$. The difference in the frequency of SOX §302 material weaknesses is not statistically different from zero and mitigates the concern that treatment firms are investing in IS to remediate control weaknesses. The statistically insignificant difference in means prior to the ASU announcements mitigate the possibility that these variables systematically vary around GAAP changes and between the treatment and control groups.

3.3 DO GAAP CHANGES AFFECT ACCOUNTING INFORMATION SYSTEMS?

Table 4: Difference in Means by Treatment

Variables	Control	Treated	Difference	N (Treatment and Control)
Size	6.76	6.52	-0.24	5,098
ROS	-0.97	-2.07	-1.10	5,098
Sales Growth	0.32	0.30	-0.02	5,098
Book Leverage	0.23	0.26	0.02	5,098
Ind. Concentration	0.47	0.44	-0.03	5,098
Profit Volatility	0.67	0.71	0.05	5,098
ROA	-0.03	-0.04	-0.02	5,098
Log Firm Age	2.77	2.96	0.19***	5,098
Loss	0.40	0.38	-0.02	5,098
Altman Z	3.44	3.19	-0.25	5,098
Log Num. Segments	1.58	1.60	0.02	5,098
FX Transactions	0.45	0.31	-0.13**	5,098
Extreme Sales Growth	0.19	0.19	-0.01	5,098
Restructuring Charge	-0.00	-0.00	-0.00	5,098
Big 4	0.69	0.70	0.02	5,098
Material Weakness	0.09	0.08	-0.01	5,098

This table tests the difference in means between treatment and control groups in the years prior to ASU issuance. The difference in means for variables such as Log Firm Age and FX Transactions are statistically different. The concern is that these variables are correlated with IS investment and systematically vary through time around GAAP changes and between the treatment and control groups. This concern is unlikely in my setting because the consistent firm-sample ensures the *difference* in firm age between the treatment and control group is constant through time, which suggests Log Firm Age will not affect the difference-in-differences estimate. Similarly, I find that FX Transactions is highly persistent and therefore unlikely to change significantly around the ASU announcement. For example, the β coefficient estimating $\text{FX Transactions}_t = \alpha + \beta \text{FX Transactionst} - 1 + \epsilon$ is 0.95. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 5 provides the results from estimating Equation (1). Columns 1–2 (3–4) use $IS\ Investment$ ($IS\ Investment\ Count$) as a proxy for investment in IS. In column 1, I find a positive coefficient on $Post \times GAAP\ Exposure$ (coef. = 0.017 , t-stat = 2.148), indicating that firms significantly affected by an accounting change are more likely to invest in IS following the ASU announcement, relative to firms not significantly affected. The coefficient of 0.017 indicates that a one within-unit standard deviation increase of 0.22 in $Post \times GAAP\ Exposure$ increases $IS\ Investment$ by 12%, relative to the unconditional mean ((0.017×0.22)/0.03 = 12%). Column 2 shows a similar result after controlling for firm characteristics associated with IT budgets (Kobelsky et al. 2008). Columns 3 and 4 report similar results using $IS\ Investment\ Count$ as a proxy for IS investment.[25]

Columns 5 and 6 report similar results using $ERP\ Investment$ as a proxy for IS investment, which provides context for the types of IS investments and—to the extent that an investment in ERP systems captures pervasive and broad IS investment—suggests that GAAP changes could lead to IS investments beyond the topic of the GAAP change. Cooper and Haltiwanger (2006) offer a possible explanation for the spillover effect of GAAP changes on IS investment in other areas of the firms: large periods of inactivity and then bursts of investments occur when investments are irreversible and include nonconvex costs. Both are characteristics of IS investments. As a result, conditional on an IS investment, firms tend to make large IS investments (e.g., a firm is more likely to upgrade the lease and purchasing systems instead of the leasing system alone).[26] Collectively, the results indicate that firms significantly affected by

[25] I find consistent results after including industry-event fixed effects and control variables in lieu of firm-event fixed effects (untabulated).

[26] As an everyday example, kitchen remodels are irreversible (you cannot easily transfer your kitchen) and include nonconvex/fixed costs. As such, kitchen investments include large periods of inactivity (several years without remodeling) and bursts of large investments (new cabinets, countertops, floors, and appliances are upgraded together).

GAAP changes are more likely to invest in IS following GAAP changes, relative to firms not significantly affected by GAAP changes.

In Table 6, I test the pre-period trends in IS investment for treated and control firms. I estimate a modified version of Equation (1), where I replace $Post$ with a separate indicator variable for each event-year. The interaction terms $EventYear_{-3} \times GAAP\ Exposure$ to $EventYear_{2} \times GAAP\ Exposure$ capture trends in the relative IS investment in the six-year event-window centered on the ASU adoption. Event-year $t-1$ is set as the baseline year. In Figure 2 Panel A (Panel B), I use $IS\ Investment$ ($IS\ Investment\ Count$) as the dependent variable and display the coefficients on $EventYear_{tg} \times GAAP\ Exposure_{ig}$ and the 90% confidence interval based on standard errors clustered at the industry level. There is no evidence of pre-trend differences in IS investment between treated and control firms. In contrast, the positive coefficients in event-years 0, 1, and 2 represent an increase in IS investments among treated firms following ASU announcements. Also, the magnitude of the coefficients peak in event-year $t = 1$, consistent with firms needing time to interpret the ASU, identify resource needs, and invest in IS before the ASU is adopted. Overall, the results in Table 6 and Figure 2 support hypothesis 1 and mitigate the concern that the results are due to pre-trend differences between the treatment and control firms.

To strengthen my interpretation, in Table 7 I use organizational complexity, operational uncertainty, audit committee IT expertise, and the existence of management clawback provisions to perform cross-sectional tests. First, I use the total number of segments as a proxy for complexity (e.g., Ashbaugh-Skaife et al. 2007; Ge and McVay 2005); I expect more complex firms to require more coordination and thereby to need more IS to support operations following a GAAP change (Kobelsky et al. 2008).

Second, I use product market fluidity (Hoberg et al. 2014) to proxy for operational uncertainty. High product market fluidity implies the firm's product market is highly competitive and continually evolving—these firms face high operational uncertainty (Hoberg et al. 2014). To the extent the new revenue and lease standards have economic consequences, firms with high operational uncertainty have greater demand for IS investments to collect and process information to mitigate uncertainty surrounding the competitive effects of GAAP changes (Kobelsky et al. 2008). Third, I expect audit committees with IT expertise can better identify the need for and assist in the implementation of IS upgrades (Ashraf et al. 2020). I predict these firms are more likely to invest in IS following a GAAP change. Fourth, I expect managers of firms with clawback provisions have a larger incentive to maintain GAAP compliance since restatements or material weaknesses can adversely affect their compensation either directly by triggering the clawback provision or indirectly if the provision is correlated with the association between financial reporting quality and management compensation. I measure the four cross-sectional variables in event-year t = -1.

In Table 7 Panel A columns 1 and 2, I estimate Equation (1) for firms in the high composite scores (i.e., firms that rank high in 2 or more factors) and low composite scores, respectively.[27] The coefficient on $Post \times GAAP\ Exposure$ is positive and statistically significant for firms with a high composite score (coef. = 0.063, t-stat = 2.820) but not statistically different from zero for firms with a low composite score (coef. = 0.007, t-stat = 0.775). A one-sided F-test shows the difference between the coefficients is statistically significant (p-value = 0.01). In Table 7 Panel B

[27] A firm is considered high (low) complexity if it is in the top (bottom) quartile of total number of segments. A firm is considered high (low) uncertainty if it is in the top (bottom) quartile of product market fluidity (Hoberg et al. 2014). A firm is considered to have audit committee IT expertise if it has a member that has worked as an IT expert such as roles that include information officer, information services, information systems (Ashraf et al. 2020). A firm is considered to have clawback provisions if the firm mentions clawback provisions (or similar words) in its proxy statements (Babenko et al. 2017).

columns 1–8, I estimate Equation (1) for firms in the high and low groups for each of the four cross-sectional variables and calculate one-sided F-tests. Overall, I find the effect of $Post \times GAAP\ Exposure$ on IS Investment is concentrated in firms with high complexity, high uncertainty, audit committees with IT expertise, and clawback provisions—particularly in firms that fall into two or more of these groups.

3.4 ACCOUNTING INFORMATION SYSTEMS AND INTERNAL INFORMATION ENVIRONMENTS

3.4.1 Effect of IS Investments on Treated Firms

In this section, I investigate how investment in IS affects firms' IIE. Since I am interested in the effect of investment in IS as a result of GAAP changes, I restrict my sample to treated firms (i.e., $GAAP\ Exposure = 1$). Table 8 provides the results from estimating Equation (2), where disclosure of $Material\ Weakness$ (columns 1 and 2) and $Reporting\ Lag$ (columns 3 and 4) proxy for firms' IIE (Gallemore and Labro 2015). In column 1, the negative coefficient on $Post\ IS\ Investment$ (coef. = -0.091, t-stat = -3.721)—after controlling for variables shown to be associated with firms' IIE following Doyle et al. (2007)—indicates that firms disclose fewer material weaknesses in the event-years following IS investments, relative to event-years without a new IS investment. $Post\ IS\ Investment$ decreases $Material\ Weakness$ by approximately 16% of its unconditional mean.[28] Column 2 shows a similar result controlling for industry-event fixed

[28] Calculated as the coefficient from Table 8 column 1 times the within-unit standard deviation scaled by the unconditional mean material weaknesses: (-0.091×0.16)/0.09 = -16%

effects and lagged material weakness. [29] In column 3, the negative coefficient on *Post IS Investment* (coef. = -1.139, t-stat = -1.749) indicates that firms report earnings more quickly in the event-years following IS investments, relative to event-years without new IS investments. A one within-unit standard deviation increase in *Post IS Investment* decreases *Reporting Lag* by approximately 6% of the mean absolute deviation.[30,31]

Next, to mitigate endogeneity concerns between IS investments and firms' IIE, I assess the magnitude of a potential unobservable confounding variable needed to overturn my results. This analysis is based on the intuition that an unobserved variable must be correlated with both the x- and the y-variable, conditional on the other variables, to affect the results (Larcker and Rusticus 2010). In Table 9, I follow Frank (2000) and calculate the impact threshold for an omitted confounding variable (ITCV) necessary to invalidate the inference on *Post IS Investment* in Table 8, columns 2 and 4.[32] The larger the ITCV, the more robust the results are to correlated omitted variables. I find an unobservable confounding variable must exceed the ITCV of -0.018 (-0.005) to invalidate the inferences for *Material Weakness* (*Reporting Lag*). A potential correlated omitted variable must have a correlation of 0.135 (0.068) with *Post IS Investment* and a correlation of -0.135 (-0.068) with *Material Weakness* (*Reporting Lag*), conditional on

[29] To control for the persistence in the dependent variables, I include the lagged dependent variable in all tests of IS investments on firms' internal information environments that use industry-event fixed effects. This helps isolate the change in the dependent variables associated with IS investment.

[30] Calculated as the coefficient Table 8 column 3 times the within-unit standard deviation scaled by the mean absolute deviation (MAD) in reporting lag: (-1.139×0.16)/3.10= -6%. I scale the effect by the within-firm MAD of the reporting lag because it closely aligns with the literature focusing on the deviations of earnings release dates from an expected earnings release date. My regressions control for either firm-fixed effects or the previous period's reporting lag, which captures deviations from means. Note MAD in reporting lag is smaller than reported in other studies because reporting lag is the average over several quarters, which smooths the lag and decreases the MAD.

[31] I find similar results using next period's *Material Weakness* and *Reporting Lag* as the dependent variable.

[32] I set the significance level at 5%, which means these statistics report the effect needed to turn *Post IS Investment* statistically insignificant (i.e., push the p-value from less than 0.05 to above 0.05). I use the models in Table 8 with industry-event fixed effects as a conservative estimate because firm-event fixed effects absorb more variation and would require even larger effect to invalidate the results.

the other control variables, to turn the result in Table 8, column 2 (4), statistically insignificant.[33]

Since I cannot measure an unobservable variable, I calculate the impact of each control variable on the coefficient of $Post\ IS\ Investment$ as a benchmark to interpret the ITCV. The magnitude needed to invalidate my results is large, relative to the impact of observable control variables, which mitigates the concern a confounding variable drives the results.[34]

3.4.2 Instrumental Variables Test

Table 10 reports the results of the instrumental variable tests. Columns 1 and 4 report the first-stage regressions, which isolate the variation in $Post\ IS\ Investment$ attributable to $GAAP\ Exposure$, conditional on the control variables.[35] The first-stage partial F-statistics of 20.16 (column 2 for dependent variable $Material\ Weakness$) and 18.25 (column 5 for dependent variable $Reporting\ Lag$) support the relevance condition of the instrument. Column 2 (5) reports the second-stage results of $Material\ Weakness$ ($Reporting\ Lag$). The negative coefficient on $Post\ IS\ \widehat{Investment}$ suggests that investments in IS related to GAAP changes lead to improvements in firms' IIE (i.e., fewer material weaknesses and more timely earnings releases).[36]

In column 3, I rerun the IV after excluding observations with material control weaknesses related to revenue or leases. Excluding these control weaknesses from my analysis mitigates the

[33] For example, 0.135 × -0.135 = ITCV of -0.018. The omitted confounding variables are after conditioning on the observed covariates, and the signs of the correlations are interchangeable. See Xu et al. (2019) for overview.

[34] To invalidate my results, the impact from an unobservable variable must be approximately the magnitude of the lagged outcome variable ($Material\ Weakness$ ITCV of -0.018 versus $Material\ Weakness_{t-1}$ impact of 0.048) or an impact that is a multiple of the impact from existing control variables. Specifically, an unobserved confounding variable must be more highly correlated with $Post\ IS\ Investment$ and $Material\ Weakness$ than $Material\ Weakness_{t-1}$.

[35] I use industry-event fixed effects because firm-event fixed effects fully absorbs $GAAP\ Exposure$ and therefore is not useful as an instrument.

[36] The IV tests neither speak to the net benefit of IS investments nor rule out that control firms' internal information environments also improve following IS investments.

concern that the results are driven by changes in internal controls associated with the new standards. Importantly, the results suggest GAAP changes lead to IS investments that improve firms' IIE beyond the topic of the GAAP change, consistent with the spillover effect of GAAP changes on IS investment in other areas of the firms as suggested in Table 4: Difference in Means by Treatment

Variables	Control	Treated	Difference	N (Treatment and Control)
Size	6.76	6.52	-0.24	5,098
ROS	-0.97	-2.07	-1.10	5,098
Sales Growth	0.32	0.30	-0.02	5,098
Book Leverage	0.23	0.26	0.02	5,098
Ind. Concentration	0.47	0.44	-0.03	5,098
Profit Volatility	0.67	0.71	0.05	5,098
ROA	-0.03	-0.04	-0.02	5,098
Log Firm Age	2.77	2.96	0.19***	5,098
Loss	0.40	0.38	-0.02	5,098
Altman Z	3.44	3.19	-0.25	5,098
Log Num. Segments	1.58	1.60	0.02	5,098
FX Transactions	0.45	0.31	-0.13**	5,098
Extreme Sales Growth	0.19	0.19	-0.01	5,098
Restructuring Charge	-0.00	-0.00	-0.00	5,098
Big 4	0.69	0.70	0.02	5,098
Material Weakness	0.09	0.08	-0.01	5,098

This table tests the difference in means between treatment and control groups in the years prior to ASU issuance. The difference in means for variables such as Log Firm Age and FX Transactions are statistically different. The concern is that these variables are correlated with IS investment and systematically vary through time around GAAP changes and between the treatment and control groups. This concern is unlikely in my setting because the consistent firm-sample ensures the *difference* in firm age between the treatment and control group is constant through time, which suggests Log Firm Age will not affect the difference-in-differences estimate. Similarly, I find that FX Transactions is highly persistent and therefore unlikely to change significantly around the ASU announcement. For example, the β coefficient estimating $\text{FX Transactions}_t = \alpha + \beta \text{FX Transactionst} - 1 + \epsilon$ is 0.95. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 5. Overall, Table 10 suggests GAAP changes induce IS investments that then improve firms' IIE.

3.5 EFFECT OF IS INVESTMENT ON CAPITAL EXPENDITURES

In this section, I investigate how improvements in firms' IIE affects the weight managers place on internal and external sources of information when making investment decisions: investments by managers with high quality internal information are more sensitive to profits and less sensitive to market prices (Heitzman and Huang 2019). I use the following general model to explore the effects of IS investment on treated firms.

$$\begin{aligned} Investment_{i,t+1,g} &= \beta Post\ IS\ Investment_{itg} + \boldsymbol{\gamma Info.Sources_{itg}} \\ &+ \boldsymbol{\delta Post\ IS\ Investment_{itg}} \times \boldsymbol{Info.Sources_{itg}} \\ &+ \boldsymbol{\varphi Post_{tg}} \times \boldsymbol{Info.Sources_{itg}} \\ &+ \boldsymbol{\Gamma Controls\ Investment_{itg}} + \alpha_{jg} + \alpha_{tg} + \epsilon_{itg}, \end{aligned} \tag{3}$$

where $Investment_{i,t+1,g}$ is a measure of firms' future investment and $\boldsymbol{Info.Sources_{itg}}$ is a vector of internal (e.g., change in profitability) and external information sources (e.g., market to book).[37] The variables of interest are $Post\ IS\ Investment_{itg}$ and $\boldsymbol{Post\ IS\ Investment_{itg}} \times \boldsymbol{Info.Sources_{itg}}$, which captures the incremental effect of the information sources on future investment following an IS investment. $\boldsymbol{Post_{itg}} \times \boldsymbol{Info.Sources_{itg}}$ captures the incremental effect of the information sources on future investment following the announcement of the ASU for observations without an IS investment. $\boldsymbol{Controls\ Investment_{itg}}$ is a vector of control variables shown to explain firms' IIE (Shroff 2017): market to book (MB), future cash flow from operations

[37] I use the decile rank of MB in this regression to account for the non-linear relationship between investment and Tobin's Q (e.g., McNichols and Stubben 2008).

(CFO), cash ($Cash$), asset growth ($Asset\ Growth$), firm age ($Log\ Firm\ Age$), book leverage ($Book\ Leverage$), $Size$, and current investment. α_{jg} are industry-event fixed effects, and α_{tg} are year-event fixed effects. ϵ_{itg} is the error term. A positive (negative) δ suggests that following GAAP-inspired IS investments, future investment is on average more (less) sensitive to the particular type of information source.

Table 11 provides the results from estimating Equation (3) using $Net\ Investment$, $Gross\ Investment$, and $Segment\ Allocation$ as measures of investment. In columns 1 and 2, the positive (negative) coefficient on $IS\ Investment \times Change\ in\ Profitability$ ($Post\ IS\ Investment \times MB\ Rank$) suggests that treated firms that invest in IS following the GAAP change are more (less) sensitive to internal (external) information. In column 3 I use $Segment\ Allocation$, which measures how well firms allocate capital to business segments whose industry is more profitable in the future, as a measure of the firms' internal capital market efficiency as a proxy for investment (Cheng et al. 2018). The positive coefficient on $Post\ IS\ Investment \times Segment\ Allocation$ suggests that treated firms that invest in IS following the GAAP change are more sensitive to successful internal capital allocations. These results are consistent with IS investment improving firms IIE, which shifts managers reliance from external to internal information sources.

4.0 ADDITIONAL ANALYSIS

4.1 ALTERNATIVE EVENT-WINDOW

To ensure my results are not sensitive to my event window of plus/minus 12 quarters surrounding the ASU announcement, in Table 12 I estimate Equation (1) using only data plus/minus four quarters (one event-year) or eight quarters (two event-years) around the ASU announcement.[38] My results are consistent with those reported in Table 4: Difference in Means by Treatment

Variables	Control	Treated	Difference	N (Treatment and Control)
Size	6.76	6.52	-0.24	5,098
ROS	-0.97	-2.07	-1.10	5,098
Sales Growth	0.32	0.30	-0.02	5,098
Book Leverage	0.23	0.26	0.02	5,098
Ind. Concentration	0.47	0.44	-0.03	5,098
Profit Volatility	0.67	0.71	0.05	5,098
ROA	-0.03	-0.04	-0.02	5,098
Log Firm Age	2.77	2.96	0.19***	5,098
Loss	0.40	0.38	-0.02	5,098
Altman Z	3.44	3.19	-0.25	5,098
Log Num. Segments	1.58	1.60	0.02	5,098
FX Transactions	0.45	0.31	-0.13**	5,098
Extreme Sales Growth	0.19	0.19	-0.01	5,098
Restructuring Charge	-0.00	-0.00	-0.00	5,098
Big 4	0.69	0.70	0.02	5,098
Material Weakness	0.09	0.08	-0.01	5,098

This table tests the difference in means between treatment and control groups in the years prior to ASU issuance. The difference in means for variables such as Log Firm Age and FX Transactions are statistically different. The concern is that these variables are correlated with IS investment and systematically vary through time around GAAP changes and between the treatment and control groups. This concern is unlikely in my setting because the consistent firm-sample ensures the *difference* in firm age between the treatment and control group is constant through time, which suggests Log Firm Age will not affect the difference-in-differences estimate. Similarly, I find that FX Transactions is highly persistent and therefore unlikely to change significantly around the ASU announcement. For example, the β coefficient estimating $\text{FX Transactions}_t = \alpha + \beta \text{FX Transactionst} - 1 + \epsilon$ is 0.95. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

[38] I cannot estimate event-windows longer than plus or minus 12 quarters because this overlaps with the mandatory adoption dates of the GAAP changes.

Table 5, mitigating concerns that the results are driven by the choice of the length of the event window (e.g., Baker et al. 2021).

4.2 ALTERNATIVE PROXIES FOR IS INVESTMENT AND INTERNAL INFORMATION ENVIRONMENTS

In Table 13, I estimate Equation (1) using several alternative proxies of IS investment. My first alternative measure aggregates across the quarters by using an indicator variable equal to 1 if a firm invests in IS any time during the event-year. Second, a concern is that a firm makes a material IS investment not in response to the GAAP change but in response to a control weakness. Thus, I also limit the sample of IS investments to firms that disclose effective controls, per SOX §302, in the current and previous period. Finally, I limit the IS investments to the first time a firm mentions an IS investment to mitigate the concern that there is a mechanical relation between $GAAP\ Exposure$ and IS investments due to a high autocorrelation in both variables. The findings are robust.

In Table 14, I estimate Equation (2) using several alternative proxies of firms' IIE: 1) an indicator variable equal to 1 if there are any material weaknesses disclosed during the event-year, 2) a restricted sample of the reporting lag for only fiscal year-ends, 3) an indicator variable equal to 1 if the firm restated any portion of the event-year, 4) the number of non-revenue and non-lease issues,[39] and 5) the number of non-information system issues. Fewer non-revenue and non-lease issues following investment in IS suggest the

[39] A firm may report multiple issues related to various areas, such as payroll/SG&A expenses or related-party transactions within a SOX §302 report (e.g., a firm reports five issues as part of the overall material control weakness).

resources required to comply with GAAP changes spill over to firms' broader IIE. Overall, the results of the robustness tests are consistent with and reinforce the interpretation of my main findings.

4.3 PLACEBO TESTS

I perform two placebo tests in Table 15. First in Panel A, I randomly assign $GAAP\ Exposure$ to firms and estimate Equation (1) 200 times. Second in Panel B, I randomly assign $IS\ Investment$ to firms and estimate Equation (1) 200 times. Consistent with expectations, in both placebo tests the percent of iterations with a significant coefficient for $Post \times GAAP\ Exposure$ are not significantly different from the expected sample error of 5%.

5.0 CONCLUSION

I investigate whether GAAP changes affect firms' investments in information systems. I use a disclosure requirement of SOX §302 to identify a sample of firms making significant IS investments. I show that, in the event-years following the announcements of the recent revenue and lease accounting standard changes, firms that are significantly affected by these GAAP changes are 12% more likely to invest in IS, relative to the unconditional mean. Despite GAAP's emphasis on external reporting and the competitive and regulatory forces that create incentives for firms to maintain high quality IIE, IS investments made in response to GAAP changes improve firms' IIE. Specifically, firms' IIE improve, as measured by fewer material weaknesses and more timely earnings announcements. Consistent with firms' IIE improving, I also find treated firms that invest in IS following the GAAP change shift reliance from external to internal information sources when making capital expenditures and internal capital allocations. My study highlights spillover effects of GAAP changes—important to practitioners and regulators—on firms' IS investments and IIE, which play a critical role in firms' external reporting and operational decisions.

My study has a few limitations. First, I focus on IS investments following material GAAP changes. While I expect other significant GAAP or regulatory changes could have a similar impact on firms' IS investments and IIE, it is unlikely that small GAAP changes lead to IS investments or that small IS investments significantly affect firms' IIE. Another limitation of my study is that, since I cannot identify the magnitude of software or hardware changes that comprise the investments, I cannot speak to the net cost (including opportunity

costs) or benefit of the GAAP changes. Also, I cannot separate the effect of IS investment on management learning from the effect of IS investment on improved monitoring and reduced agency costs within the firm. However, by definition, learning implies the information set changes, which affects information asymmetry and therefore agency costs. Finally, although I attempt to address the endogeneity between GAAP IS investments and firms' IIE, GAAP exposure captures an underlying business characteristic, which could relate to future material weaknesses and reporting lags. However, identifying a correlated omitted variable that explains the findings for both standards would be challenging. Nevertheless, to the extent the instrument fails to meet the exclusion restriction, it is difficult to attribute causality.

References

AAA. 2022. What is Accounting Information Systems? American Accounting Association.

Ahn, J., U. Hoitash, and R. Schmardebeck. 2021. The Impact of Accounting Standard Adoption Complexity on Financial Reporting Quality and Market Outcomes: Evidence from ASC 606. *SSRN*.

Alexander, C. R., S. W. Bauguess, G. Bernile, Y.-H. A. Lee, and J. Marietta-Westberg. 2013. Economic Effects of SOX Section 404 Compliance: A Corporate Insider Perspective. *Journal of Accounting and Economics* 56 (2–3): 267–290.

Ashbaugh-Skaife, H., D. W. Collins, and W. R. Kinney. 2007. The Discovery and Reporting of Internal Control Deficiencies Prior to SOX-mandated Audits. *Journal of Accounting and Economics* 44 (1–2): 166–192.

Ashraf, M., P. N. Michas, and D. Russomanno. 2020. The Impact of Audit Committee Information Technology Expertise on the Reliability and Timeliness of Financial Reporting. *The Accounting Review* 95 (5): 23–56.

Ashraf, M., and J. Sunder. 2020. Does consumer protection regulation benefit shareholders? Evidence from data breach disclosure laws and the cost of equity. *SSRN*.

Ashton, R. H., J. J. Willingham, and R. K. Elliott. 1987. An Empirical Analysis of Audit Delay. *Journal of Accounting Research* 25 (2): 275–292.

Audit Analytics. 2019. Trends in Disclosure Controls: 2010 - 2017.

Babenko, I., B. Bennett, J. Bizjak, and J. Coles. 2017. Clawback Provisions. *SSRN*.

Badertscher, B., N. Shroff, and H. D. White. 2013. Externalities of Public Firm Presence: Evidence from Private Firms' Investment Decisions. *Journal of Financial Economics* 109 (3): 682–706.

Baker, A. C., D. F. Larcker, and C. C. Y. Wang. 2021. How Much Should We Trust Staggered Difference-In-Differences Estimates? *SSRN*.

Beatty, A., and J. Weber. 2006. Accounting Discretion in Fair Value Estimates: An Examination of SFAS 142 Goodwill Impairments. *Journal of Accounting Research* 44 (2): 257–288.

Bloom, N., S. Bond, and J. Van Reenen. 2007. Uncertainty and Investment Dynamics. *Review of Economic Studies* 74 (2): 391–415.

Callahan, C. M., R. E. Smith, and A. W. Spencer. 2012. An Examination of the Cost of Capital Implications of FIN 46. *The Accounting Review* 87 (4): 1105–1134.

Cengiz, D., A. Dube, A. Lindner, and B. Zipperer. 2019. The Effect of Minimum Wages on Low-Wage Jobs. *The Quarterly Journal of Economics* 134 (3): 1405–1454.

Chatterjee, C. 2021. Efficiency Gains from Accounting Regulatory Compliance. *Working Paper*.

Cheng, M., D. Dhaliwal, and Y. Zhang. 2013. Does Investment Efficiency Improve After the Disclosure of Material Weaknesses in Internal Control over Financial Reporting? *Journal of Accounting and Economics* 56 (1): 1–18.

Cheng, Q., Y. J. Cho, and H. Yang. 2018. Financial Reporting Changes and the Internal Information Environment: Evidence from SFAS 142. *Review of Accounting Studies* 23 (1): 347–383.

Christensen, D., D. Lynch, and C. Partridge. 2021. You Don't Know What You Don't Know: Improvements in Investment Efficiency Prior to a Mandated Accounting Change. *SSRN*.

Coates, J. C., and S. Srinivasan. 2014. SOX after Ten Years: A Multidisciplinary Review. *Accounting Horizons* 28 (3): 627–671.

Cooper, R. W., and J. Haltiwanger. 2006. On the Nature of Capital Adjustment Costs. *Review of Economic Studies* 73 (3): 611–633.

deHaan, E., T. Shevlin, and J. Thornock. 2015. Market (In)attention and the Strategic Scheduling and Timing of Earnings Announcements. *Journal of Accounting and Economics* 60 (1): 36–55.

Dichev, I. D., J. R. Graham, C. R. Harvey, and S. Rajgopal. 2013. Earnings Quality: Evidence from the Field. *Journal of Accounting and Economics* 56 (2–3): 1–33.

Dorantes, C., C. Li, G. F. Peters, and V. J. Richardson. 2013. The Effect of Enterprise Systems Implementation on the Firm Information Environment. *Contemporary Accounting Research* 30 (4): 1427–1461.

Doyle, J., W. Ge, and S. McVay. 2007. Determinants of Weaknesses in Internal Control over Financial Reporting. *Journal of Accounting and Economics* 44 (1–2): 193–223.

Ernst & Young LLP. 2018. EY Revenue Recognition Survey: Public and private companies still have work to do.

Ettredge, M. L., S. Y. Kwon, D. B. Smith, and P. A. Zarowin. 2005. The Impact of SFAS No. 131 Business Segment Data on the Market's Ability to Anticipate Future Earnings. *The Accounting Review* 80 (3): 773–804.

FASB. 2014. ASU No. 2014-09 Revenue from Contracts with Customers (Topic 606).

———. 2016. ASU No. 2016-02 Leases (Topic 842).

Feng, M., C. Li, and S. McVay. 2009. Internal Control and Management Guidance. *Journal of Accounting and Economics* 48 (2–3): 190–209.

Frank, K. A. 2000. Impact of a Confounding Variable on a Regression Coefficient. *Sociological Methods & Research* 29 (2): 147–194.

Gallemore, J., and E. Labro. 2015. The Importance of the Internal Information Environment for Tax Avoidance. *Journal of Accounting and Economics* 60 (1): 149–167.

Ge, W., and S. McVay. 2005. The Disclosure of Material Weaknesses in Internal Control after the Sarbanes-Oxley Act. *Accounting Horizons* 19 (3): 137–158.

Goodman, T. H., M. Neamtiu, N. Shroff, and H. D. White. 2014. Management Forecast Quality and Capital Investment Decisions. *The Accounting Review* 89 (1): 331–365.

Grabski, S. V., S. A. Leech, and P. J. Schmidt. 2011. A Review of ERP Research: A Future Agenda for Accounting Information Systems. *Journal of Information Systems* 25 (1): 37–78.

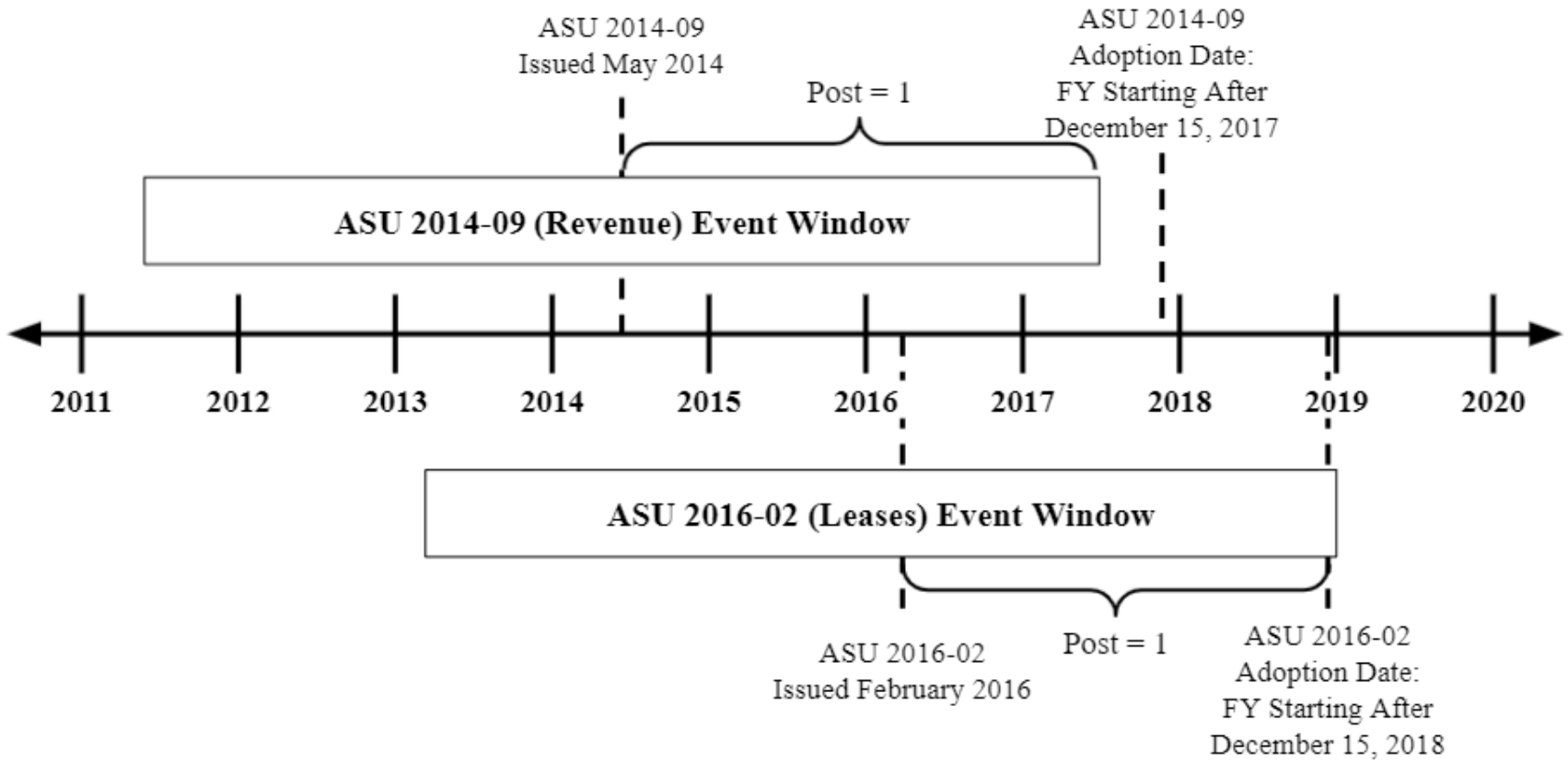
Hayes, R. M., M. Lemmon, and M. Qiu. 2012. Stock Options and Managerial Incentives for Risk Taking: Evidence from FAS 123R. *Journal of Financial Economics* 105 (1): 174–190.

Heitzman, S., and M. Huang. 2019. Internal Information Quality and the Sensitivity of Investment to Market Prices and Accounting Profits. *Contemporary Accounting Research* 36 (3): 1699–1723.

Hemmer, T., and E. Labro. 2008. On the Optimal Relation between the Properties of Managerial and Financial Reporting Systems. *Journal of Accounting Research* 46 (5): 1209–1240.
Hill, P., G. Lobo, and S. Wang. 2021. The Implementation of US GAAP Update 2016-02. *SSRN*.
Hoberg, G., G. Phillips, and N. Prabhala. 2014. Product Market Threats, Payouts, and Financial Flexibility: Product Market Threats, Payouts, and Financial Flexibility. *The Journal of Finance* 69 (1): 293–324.
Imbens, G. W., and J. M. Wooldridge. 2009. Recent Developments in the Econometrics of Program Evaluation. *Journal of Economic Literature* 47 (1): 5–86.
Jennings, J., H. Seo, and L. Tanlu. 2014. The Effect of Organizational Complexity on Earnings Forecasting Behavior. *SSRN*.
Johnson, T. L., and E. So. 2018. Time Will Tell: Information in the Timing of Scheduled Earnings News. *Journal of Financial and Quantitative Analysis* 53 (6): 2431–2464.
Jones, D. A. 2013. Changes in the Funded Status of Retirement Plans after the Adoption of SFAS No. 158 : Economic Improvement or Balance Sheet Management? *Contemporary Accounting Research* 30 (3): 1099–1132.
Kaplan, R. 1984. The Evolution of Management Accounting. In *Emmanuel C., Otley D., Merchant K. (eds) Readings in Accounting for Management Control*. Boston, MA: Springer.
Kobelsky, K. W., V. J. Richardson, R. E. Smith, and R. W. Zmud. 2008. Determinants and Consequences of Firm Information Technology Budgets. *The Accounting Review* 83 (4): 957–995.
Larcker, D. F., and T. O. Rusticus. 2010. On the use of Instrumental Variables in Accounting Research. *Journal of Accounting and Economics* 49 (3): 186–205.
Lim, J.-H., T. C. Stratopoulos, and T. S. Wirjanto. 2011. Path Dependence of Dynamic Information Technology Capability: An Empirical Investigation. *Journal of Management Information Systems* 28 (3): 45–84.
Masli, A., G. F. Peters, V. J. Richardson, and J. M. Sanchez. 2010. Examining the Potential Benefits of Internal Control Monitoring Technology. *The Accounting Review* 85 (3): 1001–1034.
Masli, A., V. J. Richardson, J. M. Sanchez, and R. E. Smith. 2011. The Business Value of IT: A Synthesis and Framework of Archival Research. *Journal of Information Systems* 25 (2): 81–116.
McNichols, M. F., and S. R. Stubben. 2008. Does Earnings Management Affect Firms' Investment Decisions? *The Accounting Review* 83 (6): 1571–1603.
Monga, V. 2017. Tech Teams Rush to Catch Up as New Accounting Rule Looms. *WSJ.*
Morris, J. J. 2011. The Impact of Enterprise Resource Planning (ERP) Systems on the Effectiveness of Internal Controls over Financial Reporting. *Journal of Information Systems* 25 (1): 129–157.
Müller, M. A., E. J. Riedl, and T. Sellhorn. 2015. Recognition versus Disclosure of Fair Values. *The Accounting Review* 90 (6): 2411–2447.
PCAOB. 2007. Auditing Standard No. 5: An Audit of Internal Control over Financial Reporting that is Integrated with an Audit of Financial Statements.

———. 2010. Auditing Standard No. 12: Identifying and Assessing Risks of Material Misstatement.
Pincus, M., F. Tian, P. Wellmeyer, and S. X. Xu. 2017. Do Clients' Enterprise Systems Affect Audit Quality and Efficiency? *Contemporary Accounting Research* 34 (4): 1975–2021.
Pindyck, R. 1990. Irreversibility, Uncertainty, and Investment. *Working Paper*.
Roychowdhury, S., N. Shroff, and R. S. Verdi. 2019. The Effects of Financial Reporting and Disclosure on Corporate Investment: A review. *Journal of Accounting and Economics* 68 (2–3): 1–27.
Schipper, K. 2007. Required Disclosures in Financial Reports. *The Accounting Review* 82 (2): 301–326.
Shleifer, A. 2005. Understanding Regulation. *European Financial Management* 11 (4): 439–451.
Shroff, N. 2017. Corporate Investment and Changes in GAAP. *Review of Accounting Studies* 22 (1): 1–63.
Strauss, N. 2018. Implementing the New Lease Accounting Standards. *CPA Journal*, August.
Tian, F., and S. X. Xu. 2015. How Do Enterprise Resource Planning Systems Affect Firm Risk? Post-Implementation Impact. *MIS Quarterly* 39 (1): 36–60.
Tzuo, T. 2017. Yes, It's Accounting, But ASC 606 Could Have a Huge Impact On Your Company. *Forbes*.
Xu, R., K. A. Frank, S. J. Maroulis, and J. M. Rosenberg. 2019. konfound: Command to Quantify Robustness of Causal Inferences. *The Stata Journal* 19 (3): 523–550.

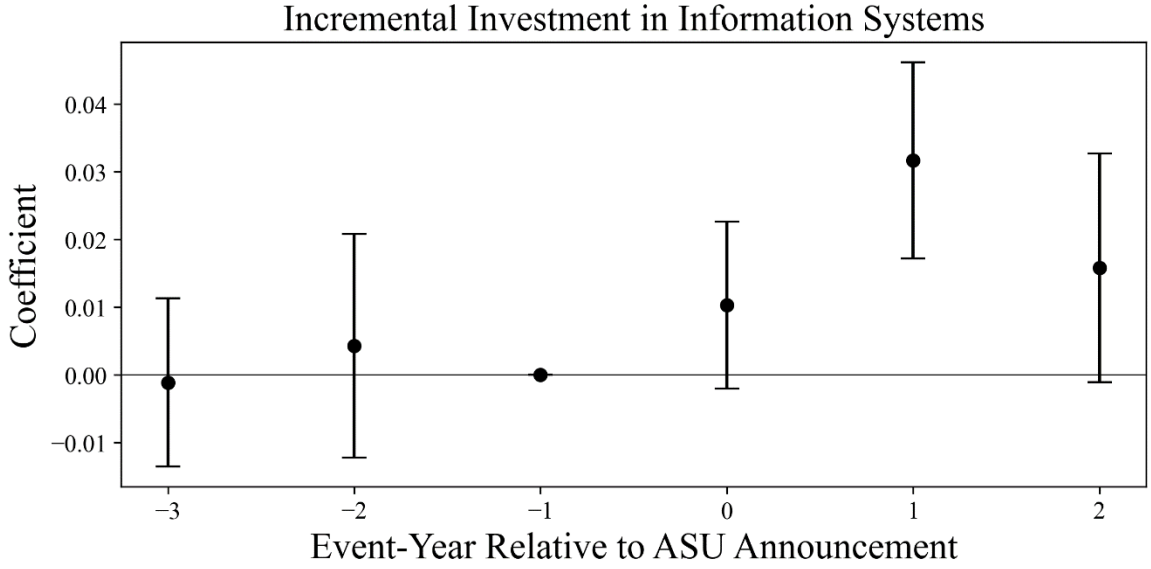
Figure 1: Research Design Timeline Around ASUs



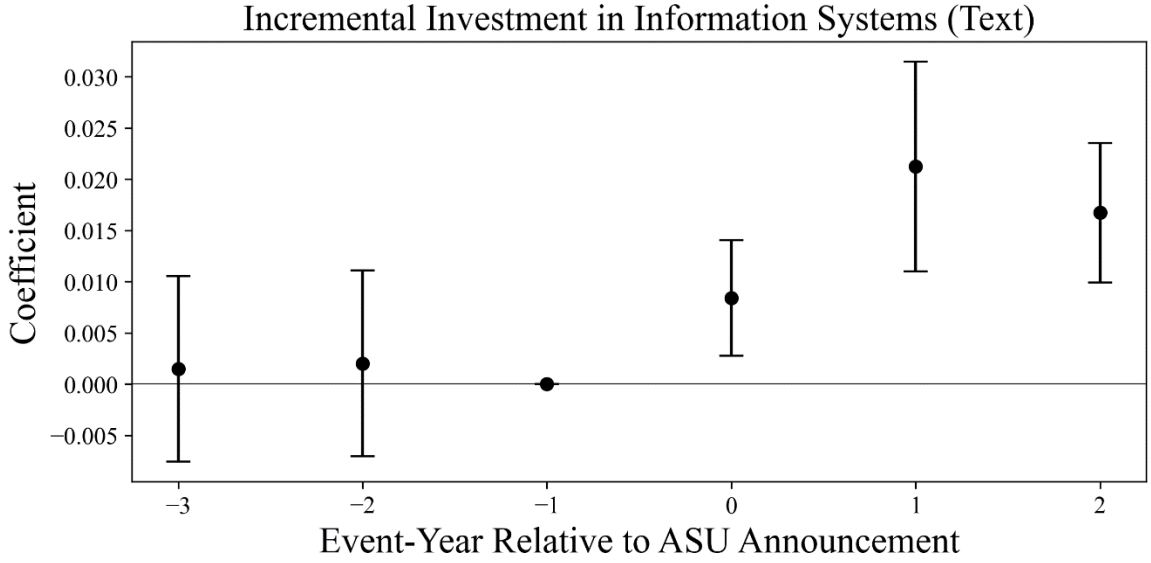
This figure depicts the timeline of the revenue and lease ASU announcements and mandatory adoption dates. The two rectangles indicate the six event-years surrounding each ASU included in the sample. The lease event window ends December 31, 2018 to ensure quarterly observations occur prior to the mandatory ASU adoption date.

Figure 2: Information Systems Investment by Event-Year: Pre-Trends Tests

Panel A: Pre-Trends Test using *IS Investment* as Outcome Variable



Panel B: Pre-Trends Test using *IS Investment Count* as Outcome Variable



The points show the incremental IS investment for firms significantly affected by GAAP in the years surrounding the ASU issuance. The x-axis is in event-time and centered on the ASU announcement (event-year $t = 0$) and the y-axis represents the $\boldsymbol{\beta}$ coefficients from a modified version of Equation (1):

$$IS\ Investment_{itg} = \boldsymbol{\beta EventYear_{tg}} \times \boldsymbol{GAAP\ Exposure_{ig}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}$$

where $\boldsymbol{EventYear_{tg}}$ is an indicator variable representing each event-year. The fixed effects absorb the main effects of the interaction. The vertical bars report the 90% confidence interval from standard errors clustered by industry. I set event-year $t - 1$ as the benchmark year.

Table 1: Sample Summary by GAAP Change

	Lease	Revenue	Total
Quarterly observations between 2011-2018 excluding: - Financials (SIC 6000–6999) - Utilities (SIC 4900–4999) - Observations with asset growth in first or 99th percentile	112,302		
Less: Observations outside +/- 3-year event window	-31,236	-27,858	
Less: Firms without observations in pre- and post-period	-10,001	-10,496	
Less: Observations treated multiple times	-42,178	-59,402	
Number of Quarterly Observations	**28,887**	**14,546**	**43,433**
Observations after aggregating to event-year	7,901	3,988	
Less: Missing primary control variables	-1,204	-471	
Number of Event-Year Observations	**6,697**	**3,517**	**10,214**
Average event-years per firm	5.1	4.8	
Number of industries (SIC2)	58	52	59†
Number of unique firms	1,310	737	1,808†
Number of firms with IS investment disclosure per SOX §302	219	104	301†
Percent of firms with IS investment	16.7%	14.1%	16.6%

This table summarizes the main sample selection process from Compustat. The Lease and Revenue columns report summary statistics for the respective ASU event-window. A control (treated) firm can (cannot) be included in both sample windows. †These totals do not double count control firms in both the Lease and Revenue columns.

Table 2: Distribution of Observations by Treatment and Industry

SIC2	Description	Control	Treated
28	Chemicals and Allied Products	14%	15%
73	Business Services	6%	12%
36	Electronic & Other Electrical Equipment & Components	9%	8%
13	Oil and Gas Extraction	11%	7%
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks	4%	6%
35	Industrial and Commercial Machinery and Computer Equipment	3%	5%
20	Food and Kindred Products	3%	3%
37	Transportation Equipment	2%	3%
48	Communications	3%	3%
34	Fabricated Metal Products	0%	2%
	Other industry codes	45%	36%
	Total	**100%**	**100%**

This table summarizes the distribution of firms by two-digit SIC and treatment group.

Table 3: Descriptive Statistics

Variable	Count	Mean	Std. Dev.	25%	50%	75%
IS Investment Tests						
IS Investment	10,214	0.03	0.14	0	0	0
IS Investment Count	10,214	0.02	0.10	0	0	0
ERP Investment	10,214	0.01	0.09	0	0	0
Post	10,214	0.50	0.50	0	1	1
GAAP Exposure	10,214	0.67	0.47	0	1	1
Total Assets ($M)	10,214	8,257.52	31,477.54	124.07	708.87	3,389.68
Size	10,214	6.57	2.28	4.83	6.57	8.13
ROS	10,214	-1.95	14.84	0.00	0.10	0.21
Sales Growth	10,214	0.19	0.94	-0.15	0.02	0.19
Book Leverage	10,214	0.26	0.25	0.05	0.23	0.40
Ind. Concentration	10,214	0.45	0.19	0.30	0.38	0.58
Profit Volatility	10,214	0.86	2.29	0.03	0.09	0.30
Internal Info. Environment Tests						
Material Weakness	10,214	0.09	0.27	0	0	0
Reporting Lag (Days)	10,214	42.43	14.36	33.50	40.75	48.75
Post IS Investment	10,214	0.04	0.20	0	0	0
ROA	10,214	-0.06	0.26	-0.07	0.02	0.06
Log Firm Age	10,214	2.90	0.68	2.40	2.94	3.37
Loss	10,214	0.41	0.49	0	0	1
Altman Z	10,214	2.61	8.47	0.95	2.37	4.21
Log Num. Segments	10,214	1.55	0.63	1.10	1.61	1.98
FX Transactions	10,214	0.36	0.44	0	0	1
Extreme Sales Growth	10,214	0.20	0.31	0	0	0.25
Restructuring Charge	10,214	-0.01	0.05	0	0	0
Big 4	10,214	0.68	0.46	0	1	1
Investment Tests						
Net Investment	10,207	0.02	0.12	-0.01	0.00	0.02
Gross Investment	10,207	0.04	0.16	-0.01	0.01	0.05
Segment Allocation	9,772	-0.06	0.20	-0.07	-0.01	0.00
MB	10,214	1.57	1.40	0.74	1.13	1.85
CFO	10,214	0.02	0.20	0.01	0.07	0.12
Cash	10,214	0.19	0.23	0.04	0.10	0.24
Asset Growth	10,214	0.07	0.36	-0.07	0.01	0.12

This table provides the mean, standard deviation, and quartiles for the main variables. All continuous variables are winsorized at the first and 99th percentiles. See Appendix A for variable definitions.

Table 4: Difference in Means by Treatment

Variables	Control	Treated	Difference	N (Treatment and Control)
Size	6.76	6.52	-0.24	5,098
ROS	-0.97	-2.07	-1.10	5,098
Sales Growth	0.32	0.30	-0.02	5,098
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ROA	-0.03	-0.04	-0.02	5,098
Log Firm Age	2.77	2.96	0.19***	5,098
Loss	0.40	0.38	-0.02	5,098
Altman Z	3.44	3.19	-0.25	5,098
Log Num. Segments	1.58	1.60	0.02	5,098
FX Transactions	0.45	0.31	-0.13**	5,098
Extreme Sales Growth	0.19	0.19	-0.01	5,098
Restructuring Charge	-0.00	-0.00	-0.00	5,098
Big 4	0.69	0.70	0.02	5,098
Material Weakness	0.09	0.08	-0.01	5,098

This table tests the difference in means between treatment and control groups in the years prior to ASU issuance. The difference in means for variables such as $Log\ Firm\ Age$ and $FX\ Transactions$ are statistically different. The concern is that these variables are correlated with IS investment and systematically vary through time around GAAP changes and between the treatment and control groups. This concern is unlikely in my setting because the consistent firm-sample ensures the *difference* in firm age between the treatment and control group is constant through time, which suggests $Log\ Firm\ Age$ will not affect the difference-in-differences estimate. Similarly, I find that $FX\ Transactions$ is highly persistent and therefore unlikely to change significantly around the ASU announcement. For example, the β coefficient estimating $FX\ Transactions_t = \alpha + \beta FX\ Transactions_{t-1} + \epsilon$ is 0.95. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 5: How Exposure to GAAP Changes Affects Investment in IS

	Pr. Sign	(1) IS Investment	(2) IS Investment	(3) IS Investment Count	(4) IS Investment Count	(5) ERP Investment	(6) ERP Investment
Post × GAAP Exposure	?	0.017**	0.017**	0.013**	0.013**	0.008*	0.008*
		(2.148)	(2.125)	(2.493)	(2.439)	(1.992)	(1.922)
Size			0.002		0.009**		0.003
			(0.363)		(2.521)		(1.461)
ROS			0.000**		-0.000		-0.000
			(2.042)		(-1.323)		(-1.046)
Sales Growth			-0.000		0.001		0.000
			(-0.383)		(1.283)		(0.956)
Book Leverage			0.003		0.002		0.002
			(0.264)		(0.189)		(0.360)
Ind. Concentration			-0.003		0.011		0.009
			(-0.052)		(0.242)		(0.248)
Profit Volatility			0.001		0.001		-0.000*
			(0.530)		(1.602)		(-1.770)
Year-Event FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm-Event FE		Yes	Yes	Yes	Yes	Yes	Yes
N		10,214	10,214	10,214	10,214	10,214	10,214
Adj. R-Squared		0.24	0.24	0.29	0.29	0.25	0.25

This table examines IS investments around GAAP changes. This table reports coefficients and t-statistics (in parentheses) from linear regressions of Equation (1):

$$IS\ Investment_{itg} = \beta Post_{tg} \times GAAP\ Exposure_{ig} + \boldsymbol{\Gamma Controls\ IS_{itg}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}$$

where $IS\ Investment_{itg}$ is the measure for investment in IS per SOX §302, α_{ig} are firm-event fixed effects; α_{tg} are year-event fixed effects. $Post_{tg} \times GAAP\ Exposure_{ig}$ is the main variable of interest. The fixed effects absorb the main effects of the interaction. A positive β indicates that following the issuance of the GAAP standard, firms significantly affected by the GAAP change invest more in IS, relative to the control group that was not significantly affected by the GAAP change. $\boldsymbol{Controls\ IS}$ is a vector of firm control variables. The sample includes observations from plus or minus three event-years surrounding the ASU issuance. See Appendix A for variable definitions. Standard errors are clustered by industry. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 6: Pre-Trends Surrounding ASU Announcement

Dependent Variable:	Pr. Sign	(1) IS Investment	(2) IS Investment Count
EventYear$_{-3}$ × GAAP Exposure	0	-0.001	0.001
		(-0.147)	(0.266)
EventYear$_{-2}$ × GAAP Exposure	0	0.004	0.002
		(0.427)	(0.363)
EventYear$_0$ × GAAP Exposure	+	0.010	0.008**
		(1.380)	(2.445)
EventYear$_1$ × GAAP Exposure	+	0.032***	0.021***
		(3.591)	(3.413)
EventYear$_2$ × GAAP Exposure	+	0.016	0.017***
		(1.544)	(4.053)
Controls		No	No
Year-Event FE		Yes	Yes
Firm-Event FE		Yes	Yes
N		10,214	10,214
Adj. R-Squared		0.24	0.29

This table examines relative trends in IS investments between treatment and control groups. I replace $Post_{tg}$ in Equation (1) with indicator variables for the event-years surrounding the GAAP change. The baseline coefficient is equal to event-year $t-1$ and therefore, is excluded from the table. This table reports coefficients and t-statistics (in parentheses) from linear regressions of Equation (1):

$$IS\ Investment_{itg} = \boldsymbol{\beta EventYear_{tg}} \times \boldsymbol{GAAP\ Exposure_{ig}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}$$

where $IS\ Investment_{itg}$ is the measure for investment in IS per SOX §302, α_{ig} are firm-event fixed effects; α_{tg} are year-event fixed effects. The vector $\boldsymbol{EventYear_{tg}} \times \boldsymbol{GAAP\ Exposure_{ig}}$ contains the main variables of interest. The fixed effects absorb the main effects of the interaction. A positive β_t indicates that in event-year t, firms significantly affected by the GAAP change invest in more IS relative to the control group not significantly affected by the GAAP change. The sample includes observations from plus or minus three event-years surrounding the ASU issuance. See Appendix A for variable definitions. Standard errors are clustered by industry. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 7: Cross Sectional Tests of GAAP Changes and Investment in IS

Panel A: Cross Sectional Test using Composite Score

	Pr. Sign	(1) High Composite IS Investment	(2) Low Composite IS Investment
Post × GAAP Exposure	+,0	0.063***	0.007
		(2.820)	(0.775)
Size		0.025**	-0.003
		(2.028)	(-0.933)
ROS		0.000**	-0.000*
		(2.310)	(-1.889)
Sales Growth		0.000	0.001
		(0.133)	(0.776)
Book Leverage		-0.010	0.009
		(-0.647)	(0.587)
Ind. Concentration		0.278	-0.067
		(1.381)	(-0.707)
Profit Volatility		0.001	0.000
		(0.239)	(0.129)
Year-Event FE		Yes	Yes
Firm-Event FE		Yes	Yes
N		1,630	4,533
Adj. R-Squared		0.29	0.20
One-sided p-value		0.01	

Panel B: Cross Sectional Tests using Components of Composite Score

	Pr. Sign	(1) High Complexity IS Investment	(2) Low Complexity IS Investment	(3) High Uncertainty IS Investment	(4) Low Uncertainty IS Investment
Post × GAAP Exposure	+,0,+,0	0.041***	0.001	0.031***	0.023
		(2.743)	(0.097)	(3.888)	(1.208)
Controls		Yes	Yes	Yes	Yes
Year-Event FE		Yes	Yes	Yes	Yes
Firm-Event FE		Yes	Yes	Yes	Yes
N		2,652	3,094	1,844	1,868
Adj. R-Squared		0.23	0.22	0.22	0.30
One-sided p-value		0.02		0.36	

	Pr. Sign	(5) IT Expertise IS Investment	(6) No IT Expertise IS Investment	(7) Clawback IS Investment	(8) No Clawback IS Investment
Post × GAAP Exposure	+,0,+,0	0.044	0.012	0.037**	0.014
		(1.301)	(1.612)	(2.060)	(1.653)
Controls		Yes	Yes	Yes	Yes
Year-Event FE		Yes	Yes	Yes	Yes
Firm-Event FE		Yes	Yes	Yes	Yes
N		905	6,161	3,011	6,796
Adj. R-Squared		0.23	0.24	0.31	0.19
One-sided p-value		0.18		0.11	

This table examines IS investments around GAAP changes, conditional on measures of IS investment demand or investment frictions. This table reports coefficients and t-statistics (in parentheses) from subsample linear regressions of Equation (1):

$$IS\ Investment_{itg} = \beta Post_{tg} \times GAAP\ Exposure_{ig} + \boldsymbol{\Gamma Controls\ IS_{itg}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}$$

where $IS\ Investment_{itg}$ is the measure for investment in IS per SOX §302, α_{ig} are firm-event fixed effects; α_{tg} are year-event fixed effects. $Post_{tg} \times GAAP\ Exposure_{ig}$ is the main variable of interest. The fixed effects absorb the main effects of the interaction. In Panel A, firms that rank high in 2 or more (less than 2) factors are classified as high (low) composite score. A firm is considered high (low) complexity if it is in the top (bottom) quartile of total number of segments. A firm is considered high (low) uncertainty if it is in the top (bottom) quartile of product market fluidity (Hoberg et al. 2014). A firm is considered to have audit committee IT expertise if it has a member that has worked as an IT expert such as roles that include information officer, information services, information systems (Ashraf et al. 2020). A firm is considered to have clawback provisions if the firm mentions clawback-related provisions in its proxy statements (Babenko et al. 2017). In Panel B the sample is split on each of the four cross-sectional variables. A positive β indicates that following the issuance of the GAAP standard, firms significantly affected by the GAAP change invest more in IS relative to the control group that was not significantly affected by the GAAP change. $\boldsymbol{Controls\ IS}$ is a vector of firm control variables. The sample includes observations from plus or minus three event-years surrounding the ASU issuance. Sample sizes vary based on availability of cross-sectional variables. I measure the four cross-sectional variables in event-year t = -1. See Appendix A for variable definitions. Standard errors are clustered by industry. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 8: Effect of IS Investment on Treated Firms' Internal Information Environments

	Pr. Sign	(1) Material Weakness	(2) Material Weakness	(3) Reporting Lag	(4) Reporting Lag
Post IS Investment	?	-0.091***	-0.056***	-1.139*	-0.929**
		(-3.721)	(-3.421)	(-1.749)	(-2.330)
ROA		-0.026	-0.007	-4.720***	-1.061
		(-0.931)	(-0.397)	(-3.218)	(-1.212)
Size		0.007	-0.000	-0.594	-0.375***
		(0.859)	(-0.237)	(-1.394)	(-5.289)
Log Firm Age		0.002	-0.005	0.417	-0.251
		(0.030)	(-1.358)	(0.177)	(-1.651)
Loss		0.033***	0.033***	0.990***	0.884***
		(4.841)	(5.042)	(2.900)	(3.268)
Altman Z		-0.000	-0.000	0.010	-0.013
		(-0.896)	(-0.948)	(0.399)	(-0.877)
Log Num. Segments		-0.021	0.003	1.045**	0.600***
		(-1.617)	(0.667)	(2.113)	(2.885)
FX Transactions		0.006	0.017***	-0.291	0.331
		(0.177)	(4.013)	(-0.368)	(1.372)
Extreme Sales Growth		-0.005	0.005	0.540*	0.523**
		(-0.609)	(0.433)	(1.761)	(2.277)
Restructuring Charge		-0.165	-0.034	-13.332	-9.380
		(-1.426)	(-0.364)	(-1.548)	(-1.072)
Big 4		0.030	-0.020***	0.397	-0.458
		(0.604)	(-3.233)	(0.339)	(-1.419)
Material Weakness$_{t-1}$			0.662***		
			(47.492)		
Reporting Lag$_{t-1}$					0.787***
					(32.067)
Year-Event FE		Yes	Yes	Yes	Yes
Ind-Event FE		No	Yes	No	Yes
Firm-Event FE		Yes	No	Yes	No
N		6,892	6,802	6,892	6,892
Adj. R-Squared		0.52	0.47	0.78	0.70

This table examines the effect of IS investments on firms' internal information environments, conditional on being treated. This table reports coefficients and t-statistics (in parentheses) from linear regressions of Equation (2):

$$IIE_{itg} = \beta Post\ IS\ Investment_{itg} + \boldsymbol{\Gamma Controls\ IIE_{itg}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}$$

where IIE_{itg} is a proxy for firms' internal information environments (material weakness or reporting lag), α_{ig} are firm-event fixed effects; α_{tg} are year-event fixed effects. $Post\ IS\ Investment_{itg}$ is the main variable of interest. A negative β indicates that on average firms have fewer material control weaknesses (columns 1–2) and more quickly release earnings (columns 3–4) subsequent to an IS investment, relative to treated firm-event-years without an IS investment. $\boldsymbol{Controls\ IIE}$ is a vector of firm control variables. The sample includes observations from treated firms. See Appendix A for variable definitions. Standard errors are clustered by industry. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 9: Analysis of Unobservable Confounding Variables

	Material Weakness			Reporting Lag		
Bias Threshold to Invalidate	42.70%			15.86%		
Impact Threshold for a Confounding Variable	-0.018			-0.005		
	Partial Correlation between Control Variable and			**Partial Correlation between Control Variable and**		
Control Variable	Post IS Investment	Material Weakness	Impact	Post IS Investment	Reporting Lag	Impact
Material Weakness$_{t-1}$	0.072	0.658	0.048	NA	NA	NA
Reporting Lag$_{t-1}$	NA	NA	NA	0.015	0.775	0.012
Loss	0.010	0.053	0.001	0.011	0.043	0.001
FX Transactions	0.012	0.028	0.000	0.012	0.019	0.000
Extreme Sales Growth	0.014	0.001	0.000	0.010	0.020	0.000
Restructuring Charge	-0.001	-0.007	0.000	-0.003	-0.050	0.000
Altman Z	-0.010	-0.014	0.000	-0.008	-0.025	0.000
ROA	-0.012	-0.001	0.000	-0.013	-0.017	0.000
Log Num. Segments	-0.040	0.025	-0.001	-0.038	0.042	-0.002
Size	0.051	-0.018	-0.001	0.049	-0.049	-0.002
Log Firm Age	0.054	-0.024	-0.001	0.051	-0.033	-0.002
Big 4	0.036	-0.042	-0.002	0.031	-0.038	-0.001

This table assess the impact of potential unobservable confounding variables on the results from Table 8 columns 2 and 4. The bias to invalidate is the percentage of observations that need to be replaced with an effect of zero to make the coefficient on $Post\ IS\ Investment$ insignificant at a 5% significance level. The impact threshold for a confounding variable reports the partial correlations between the dependent and independent variable and an omitted variable needed to make the coefficient on $Post\ IS\ Investment$ insignificant at a 5% significance level. For example, an omitted variable must have a correlation of 0.135 with $Post\ IS\ Investment$ and -0.135 with $Material\ Weakness$ (0.135 × -0.135 = -0.018) to overturn the result (signs interchangeable). In the bottom of the table, I report the partial correlations between the observable control variables and the dependent and independent variables as a benchmark to evaluate the impact threshold for a confounding variable. The impact column reports the product of the partial correlations between the control variable and $Post\ IS\ Investment$ and the dependent variable (e.g., $Material\ Weakness_{t-1}$ is 0.072 × 0.658 = 0.048). For an omitted variable to affect my inferences, it must have an impact on $Material\ Weakness$ that is approximately the same magnitude as the impact of $Material\ Weakness_{t-1}$.

Table 10: Instrumental Variables Test of IS Investment on Treated Firms' Internal Information Environments

		(1)	(2)	(3)	(4)	(5)	(6)
Stage:		1st Stage	2nd Stage	2nd Stage (Rest. Sample)	1st Stage	2nd Stage	2nd Stage (Rest. Sample)
Dependent Variable:	Pr. Sign	Post IS Investment	Material Weakness	Material Weakness	Post IS Investment	Reporting Lag	Reporting Lag
GAAP Exposure	+	0.061***			0.061***		
		(4.490)			(4.272)		
Post IS $\widehat{\text{Investment}}$	–		-0.351***	-0.395***		-10.523*	-6.519
			(-2.769)	(-2.704)		(-1.845)	(-1.276)
ROA		-0.008	0.004	-0.001	-0.007	-3.101***	-2.010**
		(-0.471)	(0.263)	(-0.054)	(-0.440)	(-3.425)	(-2.258)
Size		0.010	0.004	0.003	0.010	-0.174*	-0.158
		(1.615)	(1.266)	(1.036)	(1.537)	(-1.748)	(-1.624)
Log Firm Age		0.027**	-0.003	-0.000	0.023**	-0.092	-0.203
		(2.232)	(-0.457)	(-0.021)	(2.078)	(-0.403)	(-1.083)
Loss		0.005	0.036***	0.027***	0.010	0.734*	0.544*
		(0.385)	(4.567)	(3.489)	(0.766)	(1.778)	(1.698)
Altman Z		0.000	-0.001	-0.000	0.000	0.022	0.011
		(0.104)	(-1.016)	(-0.895)	(0.090)	(1.082)	(0.702)
Log Num. Segments		-0.015	-0.001	-0.001	-0.015	1.303***	1.066***
		(-1.003)	(-0.075)	(-0.175)	(-0.940)	(5.440)	(5.500)
FX Transactions		-0.016	0.000	-0.006	-0.016	-0.339	-0.342
		(-1.081)	(0.062)	(-0.737)	(-1.037)	(-1.261)	(-1.280)
Extreme Sales Growth		0.006	-0.002	-0.003	0.006	0.639	0.493
		(0.504)	(-0.175)	(-0.249)	(0.480)	(1.157)	(1.027)
Restructuring Charge		0.064*	0.035	0.084***	0.064*	-2.860	-0.287
		(1.772)	(0.689)	(3.121)	(1.745)	(-0.575)	(-0.071)
Big 4		0.049***	-0.015	-0.010	0.043***	-0.283	-0.235
		(3.770)	(-1.287)	(-0.779)	(3.261)	(-0.638)	(-0.544)
Material Weakness$_{t-1}$		0.088***	0.696***	0.674***			
		(4.803)	(23.742)	(21.515)			
Reporting Lag$_{t-1}$					0.000	0.858***	0.888***
					(0.789)	(37.595)	(45.193)
Year-Event FE		Yes	Yes	Yes	Yes	Yes	Yes
Ind.-Event FE		Yes	Yes	Yes	Yes	Yes	Yes
1st Stage Partial F			20.16	19.43		18.25	17.59
N		5,100	5,100	4,903	5,113	5,113	4,914
Adj. R-Squared			0.38	0.30		0.66	0.72

This table examines the relation between GAAP IS investments and firms' internal information environments using an IV. This table reports coefficients and t-statistics (in parentheses) from the two-stage linear regressions of Equation (2):

$$IIE_{itg} = \beta Post\ IS\ \widehat{Investment}_{itg} + \boldsymbol{\Gamma Controls\ IIE_{itg}} + \alpha_{jg} + \alpha_{tg} + \epsilon_{itg}$$

where IIE_{itg} is a proxy for firms' internal information environments (material control weakness or reporting lag), α_{jg} are industry-event fixed effects; α_{tg} are year-event fixed effects. I cannot use firm-event fixed effects because they would absorb the instrument. $Post\ IS\ \widehat{Investment}_{itg}$ is the main variable of interest calculated from the first-stage regression (columns 1, 4) using $GAAP\ Exposure_{ig}$ as an instrument to isolate the variation in IS Investment attributable to GAAP changes. A negative β indicates that on average firms have fewer material control weaknesses (column 2) and more quickly issue earnings (column 5) subsequent to an IS investment. Columns 3 and 6 repeat the analysis after dropping observations with revenue and lease material control weaknesses. $\boldsymbol{Controls\ IIE}$ is a vector of firm control variables. The sample includes observations from the three event-years after the ASU issuance. See Appendix A for variable definitions. Standard errors are clustered by industry. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 11: Variables Explaining Capital Expenditures Following Treated Firms' IS Investment

	Pr. Sign	(1) Net Investment$_{t+1}$	(2) Gross Investment$_{t+1}$	(3) Segment Allocation$_{t+1}$
Post IS Investment	+	0.026*	0.040**	0.008
		(1.686)	(2.278)	(0.837)
Post IS Investment × MB Rank	–	-0.003*	-0.005**	
		(-1.804)	(-2.254)	
Post IS Investment × Change in Profitability	+	0.006*	0.002	
		(1.734)	(0.449)	
Post IS Investment × Segment Allocation	+			0.192*
				(1.972)
Post × MB Rank		0.001	0.001	
		(0.834)	(0.733)	
Post × Change in Profitability		0.003	0.003	
		(0.789)	(0.770)	
Post × Segment Allocation				-0.179***
				(-3.275)
MB Rank		-0.000	0.002**	
		(-0.290)	(2.276)	
Change in Profitability		-0.007	-0.007	
		(-1.170)	(-1.117)	
Net Investment		0.226***		
		(6.932)		
Gross Investment			0.135**	
			(2.577)	
Segment Allocation				0.376***
				(5.871)
Controls		Yes	Yes	Yes
Year-Event FE		Yes	Yes	Yes
Ind-Event FE		Yes	Yes	Yes
N		6,283	6,283	6,282
Adj. R-Squared		0.09	0.11	0.30

This table examines how IS Investments affect the weight placed on internal and external sources of information when making investment decisions. This table reports coefficients and t-statistics (in parentheses) from linear regressions of Equation (3):

$$Investment_{i,t+1,g} = \beta Post\ IS\ Investment_{itg} + \boldsymbol{\gamma Info.Sources_{itg}} + \boldsymbol{\delta Post\ IS\ Investment_{itg}} \times \boldsymbol{Info.Sources_{itg}} + \boldsymbol{\varphi Post_{tg}} \times \boldsymbol{Info.Sources_{itg}} + \boldsymbol{\Gamma Controls\ Investment_{itg}} + \alpha_{jg} + \alpha_{tg} + \epsilon_{itg},$$

where $Investment_{i,t+1,g}$ is a measure of firms' future investment and $\boldsymbol{Info.Sources_{itg}}$ is a vector of internal ($Change\ in\ Profitability$ and $Segment\ Allocation$) and external ($MB\ Rank$) information sources. The main variables of interest are $Post\ IS\ Investment_{itg}$ and $\boldsymbol{Post\ IS\ Investment_{itg}} \times \boldsymbol{Info.Sources_{itg}}$, which captures the incremental effect of the information sources on future investment following an IS investment. A positive (negative) δ suggests that following GAAP-inspired IS investments, on average future investment is more (less) sensitive to the information source. $\boldsymbol{Controls\ Investment_{itg}}$ is a vector of control variables that have been shown to explain firms' internal information environments (Shroff 2017): market to book (MB), future cash flow from operations (CFO), cash ($Cash$), asset growth ($Asset\ Growth$), firm age ($Log\ Firm\ Age$), book leverage ($Book\ Leverage$), $Size$, and current investment. α_{jg} are industry-event fixed effects, and α_{tg} are year-event fixed effects. The sample includes only treated firms. See Appendix A for variable definitions. Standard errors are clustered by industry. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 12: Alternative Windows around ASU Issuance

Subsample:		(1) Plus or Minus One-Year	(2) Plus or Minus One-Year	(3) Plus or Minus Two-Years	(4) Plus or Minus Two-Years
Dependent Variable:	Pr. Sign	IS Investment	IS Investment Count	IS Investment	IS Investment Count
Post × GAAP Exposure	+	0.009	0.008**	0.016**	0.012**
		(1.198)	(2.227)	(2.153)	(2.476)
Size		0.014	0.014*	-0.004	0.008
		(1.303)	(1.918)	(-0.712)	(1.292)
ROS		0.000	0.000	0.000**	-0.000
		(1.249)	(0.866)	(2.532)	(-0.479)
Sales Growth		-0.001	-0.001	-0.001*	-0.001
		(-0.447)	(-0.628)	(-1.713)	(-0.683)
Book Leverage		0.007	0.006	-0.001	-0.003
		(0.555)	(0.559)	(-0.063)	(-0.293)
Ind. Concentration		0.077	-0.140**	0.053	0.005
		(0.754)	(-2.022)	(0.799)	(0.120)
Profit Volatility		0.003	-0.000	-0.000	-0.000
		(1.097)	(-0.572)	(-0.183)	(-0.546)
Year-Event FE		Yes	Yes	Yes	Yes
Firm-Event FE		Yes	Yes	Yes	Yes
N		3,692	3,692	7,234	7,234
Adj. R-Squared		0.34	0.41	0.27	0.33

This table examines investments in IS around alternative windows surrounding the GAAP changes. This table restricts the sample event-window to plus or minus one or two event-years and reports coefficients and t-statistics (in parentheses) from linear regressions of Equation (1):

$$IS\ Investment_{itg} = \beta Post_{tg} \times GAAP\ Exposure_{ig} + \boldsymbol{\Gamma Controls\ IS_{itg}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}$$

where $IS\ Investment_{itg}$ is the measure for investment in IS per SOX §302, α_{ig} are firm-event fixed effects; α_{tg} are year-event fixed effects. $Post_{tg} \times GAAP\ Exposure_{ig}$ is the main variable of interest. The fixed effects absorb the main effects of the interaction. A positive β indicates that following the issuance of the GAAP standard, firms significantly affected by the GAAP change invest more in IS relative to the control group that was not significantly affected by the GAAP change. $\boldsymbol{Controls\ IS}$ is a vector of firm control variables. See Appendix A for variable definitions. Standard errors are clustered by industry. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 13: Alternative Methods of Aggregating IS Investment

Dependent Variable:	Pr. Sign	(1) IS Investment (I)	(2) IS Investment2 (Require no Material Weaknesses in previous period)	(3) IS Investment3 (Not conditional on disclosed Material Weaknesses)	(4) IS Investment (1st)
Post × GAAP Exposure	+	0.028**	0.016**	0.018**	0.006***
		(2.467)	(2.021)	(2.144)	(2.708)
Controls		Yes	Yes	Yes	Yes
Year-Event FE		Yes	Yes	Yes	Yes
Firm-Event FE		Yes	Yes	Yes	Yes
N		10,214	10,214	10,214	10,214
Adj. R-Squared		0.20	0.26	0.23	0.06

This table examines investments in IS around GAAP changes using alternative measures of IS investment. This table reports coefficients and t-statistics (in parentheses) from linear regressions of Equation (1):

$$IS\ Investment_{itg} = \beta Post_{tg} \times GAAP\ Exposure_{ig} + \boldsymbol{\Gamma Controls\ IS_{itg}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}$$

where $IS\ Investment_{itg}$ are alternative measures for investment in IS, α_{ig} are firm-event fixed effects; α_{tg} are year-event fixed effects. $Post_{tg} \times GAAP\ Exposure_{ig}$ is the main variable of interest. The fixed effects absorb the main effects of the interaction. A positive β indicates that following the issuance of the GAAP standard, firms significantly affected by the GAAP change invest more in IS relative to the control group that was not significantly affected by the GAAP change. $IS\ Investment\ (I)$ is an indicator variable equal to 1 if at any time during the event-year the firm discloses an IS investment in a quarter when the disclosure controls are effective with no material control weaknesses. $IS\ Investment2$ is calculated following the IS Investment variable but the quarterly SOX §302 disclosure indicator variable also requires that no material weaknesses were disclosed in the prior quarter. IS Investment3 is calculated following the IS Investment variable but the quarterly SOX §302 disclosure indicator variable does not require there are no material weaknesses disclosed in the current quarter. $IS\ Investment\ (1st)$ is the average of quarterly SOX §302 disclosures during the firm-event-year level. The quarterly SOX §302 disclosure is an indicator variable equal to 1 the first time that a firm (1) discloses an IS investment, (2) effective internal controls, and (3) no material weaknesses. This variable used to mitigate concern of high autocorrelation in IS investment and GAAP Exposure. Where the first time is reset after the firm does not disclose an IS investment in a quarter. See Appendix C for example calculation of variables. $\boldsymbol{Controls\ IS}$ is a vector of firm control variables. The sample includes observations from plus or minus three event-years surrounding the ASU issuance. See Appendix A for variable definitions. Standard errors are clustered by industry. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 14: Alternative Proxies for Firms' Internal Information Environment

Dependent Variable:	Pr. Sign	(1) Material Weakness (I)	(2) Reporting Lag (FYE)	(3) Restatement	(4) Num. Acct. Issues (Excluding Rev. and Leases)	(5) Num. Other Issues (Excluding IS)
Post IS Investment	–	-0.036*	-1.428***	-0.020**	-0.096**	-0.186**
		(-1.890)	(-3.757)	(-2.187)	(-2.626)	(-2.504)
Controls		Yes	Yes	Yes	Yes	Yes
Lag Dependent Variable		Yes	Yes	Yes	Yes	Yes
Year-Event FE		Yes	Yes	Yes	Yes	Yes
Ind.-Event FE		Yes	Yes	Yes	Yes	Yes
N		6,802	6,690	6,892	6,802	6,802
Adj. R-Squared		0.39	0.85	0.34	0.52	0.52

This table examines the effect of IS investments on firms' internal information environments, conditional on being treated, using alternative measures of the internal information environment. This table reports coefficients and t-statistics (in parentheses) from linear regressions of Equation (2):

$$IIE_{itg} = \beta Post\ IS\ Investment_{itg} + \boldsymbol{\Gamma Controls\ IIE_{itg}} + \alpha_{jg} + \alpha_{tg} + \epsilon_{itg}$$

where IIE_{itg} are alternative proxies for firms' internal information environments, α_{jg} are industry-event fixed effects; α_{tg} are year-event fixed effects. $Post\ IS\ Investment_{itg}$ is the main variable of interest. A negative β indicates that on average firms' internal information environments improve, relative to treated firm-event-years without an IS investment. $Material\ Weakness\ (I)$ is an indicator variable equal to 1 if at any time during the event-year the firm discloses a SOX §302 material weaknesses. $Reporting\ Lag\ (FYE)$ is the number of days between fiscal year-end and the earnings release date during the firm-event-year. $Restatement$ is an indicator variable equal to 1 if the firm restated any portion of the event-year. Defined at the firm-event-year. $\boldsymbol{Controls\ IIE}$ is a vector of firm control variables. $Num.Acct\ Issues$ is the number of accounting issues disclosed per SOX §302 during the firm-event-year (e.g., Payroll/SG&A expense recording or related party transactions). The accounting issues are grouped based on whether the issue relates to revenue or leases. Issues identified by Audit Analytics. $Num.Other\ Issues$ is the number of other issues disclosed per SOX §302 during the firm-event-year (e.g., financial close process/policy/information accumulation & timeliness issues or personnel inadequacies or segregation of duty issues). The other issues are grouped based on whether the issue relates to information systems technology, software, or access/security issues. Issues identified by Audit Analytics. The sample includes observations from treated firms in the three event-years after the ASU issuance. See Appendix A for variable definitions. Standard errors are clustered by industry. *, **, *** indicate two-side statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 15: Placebo Tests

Panel A: Random Assignment of GAAP Exposure

Value	Count	Mean	Std. Dev.	25%	50%	75%	Percent of Iterations with Significant Coef.
Coefficient	200	0.001	0.008	-0.003	0.001	0.005	
t-value	200	0.133	1.134	-0.405	0.126	0.818	4.5%
p-value	200	0.511	0.309	0.258	0.512	0.771	

Panel A reports the result of a placebo test where I randomly assign $GAAP\ Exposure_{ig}$ to firms in the sample then estimate Equation (1):

$$IS\ Investment_{itg} = \beta Post_{tg} \times Placebo\ GAAP\ Exposure_{ig} + \boldsymbol{\Gamma Controls\ IS_{itg}} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}$$

where $IS\ Investment_{itg}$ is the measure for investment in IS, α_{ig} are firm-event fixed effects; α_{tg} are year-event fixed effects. $Post_{tg} \times Placebo\ GAAP\ Exposure_{ig}$ is the main variable of interest. The fixed effects absorb the main effects of the interaction. The random assignment and OLS estimation is repeated 200 times, and the table reports the distribution of coefficients, p-values, and t-statistics of β. The last column reports the percentage of regression iterations that resulted in a statistically significantly β coefficient at the 0.05 significance level. *, **, *** indicate two-side statistical significance for binomial tests at the 0.1, 0.05, and 0.01 levels, respectively. I expect the percent of significant β coefficients to not be statistically different from the significance level.

Panel B: Random Assignment of IS Investments

Value	Count	Mean	Std. Dev.	25%	50%	75%	Percent of Iterations with Significant Coef.
Coefficient	200	0.001	0.006	-0.003	0.001	0.005	
t-value	200	0.178	0.954	-0.503	0.146	0.874	3.0%
p-value	200	0.51	0.289	0.282	0.5	0.766	

Panel B reports the result of a placebo test where I randomly assign $IS\ Investment_{itg}$ to firms in the sample then estimate Equation (1):

$$Placebo\ IS\ Investment_{itg} = \beta Post_{tg} \times GAAP\ Exposure_{ig} + \Gamma Controls\ IS_{itg} + \alpha_{ig} + \alpha_{tg} + \epsilon_{itg}$$

where $Placebo\ IS\ Investment_{itg}$ is the measure for investment in IS, α_{ig} are firm-event fixed effects; α_{tg} are year-event fixed effects. $Post_{tg} \times GAAP\ Exposure_{ig}$ is the main variable of interest. The fixed effects absorb the main effects of the interaction. The random assignment and OLS estimation is repeated 200 times, and the table reports the distribution of coefficients, p-values, and t-statistics of β. The last column reports the percentage of regression iterations that resulted in a statistically significantly β coefficient at the 0.05 significance level. *, **, *** indicate two-side statistical significance for binomial tests at the 0.1, 0.05, and 0.01 levels, respectively. I expect the percent of significant β coefficients to not be statistically different from the significance level.

Appendix A Variable Definitions

Variable	Description
IS Investment Tests	
Book Leverage	Book leverage at the end of the event-year. Defined at the firm-event-year level using Compustat data: $\frac{dlcq + dlttq}{atq}$, where $dlcq$ is current debt, $dlttq$ is long-term debt, and atq is total assets.
ERP Investment	Calculated following the description for $IS\ Investment$ except the quarterly SOX §302 disclosure is an indicator variable equal to 1 only for firms that disclose an ERP-related IS investment as identified in the textual analysis performed for $IS\ Investment\ Count$.
GAAP Exposure	Indicator variable equal to 1 for firms significantly affected by a GAAP change (i.e., treated) and varies depending on the event. Firms with an above median level of deferred revenue scaled by revenue or disclose other affected revenue areas per SAB 74 are considered treated for the revenue GAAP change. Firms with non-zero minimum rental commitments to total assets are considered treated for the lease GAAP change (Christensen et al. 2021). Measured in event-year prior to GAAP change whenever possible.
Ind. Concentration	Industry sales concentration calculated as the percentage of market share from the four largest firms in the two-digit SIC at the end of the event-year. Defined at the industry-event-year using Compustat data: $\frac{\sum_4 revtq}{\sum_N revtq}$, where $revtq$ is total revenue and the numerator is summed over the four-largest firms by revenue and the denominator is summed over all firms within the industry.
IS Investment	The average of quarterly SOX §302 disclosures during the firm-event-year. The quarterly SOX §302 disclosure is an indicator variable equal to 1 for firms that (1) disclose an IS investment (as identified by Audit Analytics disclosure control taxonomy called "DC – Information technology, software, access/security issues"), (2) report effective disclosure controls, and (3) report no material weaknesses. Requirements (2) and (3) mitigate the concern that IS investments are made to remediate control weaknesses.
IS Investment Count	Alternative measure of IS investment to corroborate IS changes identified by Audit Analytics. Equals the log of 1 + the average mentions of IS investments in the quarterly SOX §302 disclosures during the firm-event-year. The quarterly mentions is a count variable that measures the number of times within a SOX §302 disclosure that an IS word is within 10 words of an investment verb. For example, the algorithm would identify "the implementation (investment verb) of a lease evaluation system (IS word)" as a mention of IS investment. See Appendix D for list of words used in text search. To mitigate the concern that IS investments are made to remediate material control weaknesses, this measure also requires that during the quarter the disclosure controls are effective and no material weaknesses are identified.
Post	Indicator variable equal to 1 for event-years after the ASU was issued. Post varies in the cross-section between the lease and revenue standards.
Profit Volatility	Volatility of profitability calculated as the 12-quarter rolling standard deviation of ROS. Defined at the firm-event-year.
ROS	Operating return on sales is defined at the firm-event-year using Compustat data: $\frac{\sum oibdpq}{\sum revtq}$ where $oibdpq$ operating income before depreciation and $revtq$ is total revenue. Summations are over all quarters in the firm-event-year.
Sales Growth	Sales growth is defined at the firm-event-year using Compustat data: $\frac{\sum revtq - \sum revtq_{t-1}}{\sum revtq_{t-1}}$, where $revtq$ is total revenue and summations are over all quarters in the firm-event-year. The lagged variable is summed over all quarters in the previous firm-event-year.

Variable	Description
Size	The natural log of 1 + book value of assets at the end of the event-year. Defined at the firm-event-year level using Compustat data: $\ln(1 + atq)$ where atq is total assets.
Internal Info. Environment Tests	
Altman Z	Altman Z score defined at the firm-even-year using Compustat data: $1.2 * NWC + 1.4 * RE + 3.3 * Operating\ ROA + 0.6 * Mkt\ Levg + 0.999 * Sales\ Turnover$, where NWC is net working capital scaled by total assets, RE is retained earnings scaled by total assets, $Mkt\ Levg$ is market value of equity scaled by long-term debt, and $Sales\ Turnover$ is total revenue scaled by total assets.
Big 4	Indicator variable equal to 1 if firm has a Big Four auditor during the event-year.
Extreme Sales Growth	The average during the firm-event-year of an indicator variable equal to 1 if the firm reports sales growth in the top quartile during the quarter.
FX Transactions	The average during the firm-event-year of an indicator variable equal to 1 if the firm reports any foreign currency adjustments during the quarter $\mathbf{1}(abs(fcaq) > 0)$. Defined using Compustat data where $fcaq$ is foreign exchange income/loss.
Log Firm Age	The natural log of 1 + age at the end of the event-year where age is the number of years since the firm first appeared in Compustat. Defined at the firm-event-year. $\ln(1 + age)$
Log Num. Segments	The natural log of 1 + (number of business and geographic segments) at the end of the event-year. Defined at the firm-event-year level. Data are from the Compustat segment table.
Loss	Indicator variable equal to 1 if the firm has a cumulative loss during the event-year. Defined at the firm-event-year using Compustat data: $\mathbf{1}(\sum niq < 0)$, where niq is net income and the summation is over all quarters in the firm-event-year.
Material Weakness	The average during the firm-event-year of quarterly indicator variables equal to 1 if the firm discloses a SOX §302 material weaknesses.
Post IS Investment	Indicator variable equal to 1 for all event-years following the disclosure of an IS investment made during the post period. Defined at the firm-event-year.
Reporting Lag	The average number of days between fiscal period-end and the earnings release date during the firm-event-year.
Restructuring Charge	Restructuring charges during the event-year. Defined at the firm-event-year using Compustat data: $\frac{\sum rcpq}{MVE}$, where $rcpq$ is pretax restructuring charge and MVE is the market value of equity ($MVE = \lvert prccq \rvert \times cshoq$) where $prccq$ is the quarter-end price and $cshoq$ is common shares outstanding. Summations are over all quarters in the firm-event-year.
ROA	Return on assets is defined at the firm-event-year using Compustat data: $\frac{\sum niq}{AVG(atq, atq_{t-1})}$, where niq is net income and atq is total assets. The summation is over all quarters in the firm-event-year and scaled by average total assets.
Investment Tests	
Asset Growth	Asset growth is defined at the end of the firm-event-year using Compustat data: $\frac{atq - atq_{t-1}}{atq_{t-1}}$, where atq is total assets the lagged variable is beginning total assets.
Cash	Cash is defined at the firm-event-year using Compustat data: $\frac{cheq}{AVG(atq, atq_{t-1})}$, where $cheq$ is cash and short-term investments and atq is total assets. The variable is scaled by average total assets.

Variable	Description
CFO	Cash flow from operations is defined at the firm-event-year using Compustat data: $\frac{\sum oancfq}{AVG(atq,atq_{t-1})}$, where $oancfq$ is net cash flow from operating activities and atq is total assets. The summation is over all quarters in the firm-event-year and scaled by average total assets.
Change in Profitability	Defined at the firm-event-year using Compustat data. Profitability is: $\frac{\sum oibdpq}{AVG(ceqq,ceqq_{t-1})}$, where $oibdpq$ operating income before depreciation and $ceqq$ is common equity. The summation is over all quarters in the firm-event-year. The change equals event-year t profitability minus event-year $t-1$ profitability.
Net Investment	Net investment is defined at the firm-event-year using Compustat data: $\frac{ppentq-ppentq_{t-1}}{atq_{t-1}}$, where $ppentq$ is net property plant and equipment and atq is total assets. The change in $ppentq$ is scaled by beginning total assets.
Gross Investment	Gross investment is defined at the firm-event-year using Compustat data: $\frac{Gross\ PPE - Gross\ PPE_{t-1}}{atq_{t-1}}$, where $Gross\ PPE$ the sum of net property plant and equipment and accumulated depreciation ($Gross\ PPE = ppentq + dpactq$). The change in $Gross\ PPE$ is scaled by beginning total assets.
MB	Market to book is defined at the firm-event-year using Compustat data: $\frac{MVE+dlcq+dlttq-txdbq}{atq}$, where MVE is the market value of equity ($MVE = \|prccq\| \times cshoq$) where $prccq$ is the quarter-end price and $cshoq$ is common shares outstanding. $dlcq$ is current debt, $dlttq$ is long-term debt, $txdbq$ is deferred taxes, and atq is total assets. $MB\ Rank$ is decile rank of MB.
Segment Allocation	Following Cheng et al. (2018), segment allocation is defined at the firm-event-year using Compustat segment data: $\sum_s CAPX_{ist} * HFP_{ist} - \sum_s CAPX_{ist} * LFP_{ist}$, where $CAPX$ is capital expenditures for business segment s for firm i in event-year t. HFP (LFP) is an indicator variable for business segments in a high (low) future profitability industry. HFP (LFP) equals 1 for business segments in an industry that has above (below) average future profitability, as determined by the one-year-ahead operating ROE of all firms in the same industry as the operating segment. A larger Segment Allocation means the firm invested more in their business segments whose industry is more profitable in the future.

Appendix B Example SOX §302 Information Sysetm Investment Disclosures

Example 1: Valero Energy Partners LP Form 10-Q for Quarter Ended March 31, 2018

ITEM 4. CONTROLS AND PROCEDURES

(b) Changes in internal control over financial reporting

There has been no change in our internal control over financial reporting that occurred during our last fiscal quarter that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

We continue the implementation process to prepare for the adoption of Topic 842, which we discuss in Note 1 of Condensed Notes to Consolidated Financial Statements. We expect that there will be changes affecting our internal control over financial reporting in conjunction with adopting this standard. The most significant changes we expect relate to the implementation of a lease evaluation system and a lease accounting system, including the integration of our lease accounting system with our general ledger and modifications to the related procurement and payment processes.

Example 2: Clean Energy Fuels Corp. Form 10-Q for Quarter Ended March 31, 2016

Item 4.—Controls and Procedures

Changes in Internal Control over Financial Reporting

We regularly review and evaluate our system of internal control over financial reporting and make changes to our processes and systems to improve controls and increase efficiency while ensuring that we maintain an effective internal control environment. Changes may include such activities as implementing new, more efficient systems, consolidating activities, and migrating processes.

Except as described below, there were no changes in our internal control over financial reporting that occurred during our most recently completed fiscal quarter that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

As stated in Note 1 of this report, effective January 1, 2016 we implemented a cost tracking system that provides for a detailed tracking of costs incurred on station construction projects. We use this tracking system to make estimates with respect to the percentage a project is complete and the corresponding amount of revenue that should be recognized. The implementation of this system resulted in certain changes to business processes and internal controls over financial reporting. The changes were not undertaken in response to any actual or perceived deficiencies in our internal control over financial reporting.

Appendix C Example Calculation of IS Investment Variables

Panel A: Quarterly SOX §302 Disclosures

Event-Quarter	Firm	(A) SOX §302 Disclosures	(B) SOX §302 Disclosures (1st)	(C) IS Investment Mentions	(D) log(IS Investment Mentions + 1)
0	101	0	0	0	0
1	101	0	0	0	0
2	101	0	0	0	0
3	101	1	1	2	1.10
4	101	1	0	1	0.69
5	101	1	0	1	0.69
6	101	0	0	0	0
7	101	0	0	0	0
8	101	1	1	1	0.69
9	101	1	0	4	1.61
10	101	0	0	0	0
11	101	0	0	0	0

Panel B: IS Investment Variables Aggregated to Event-Year

Panel A Source Col:		(A)	(A)	(B)	(D)
Event-Year	Firm	IS Investment	IS Investment (I)	IS Investment (1st)	IS Investment Count
0	101	0.25	1.00	0.25	0.28
1	101	0.50	1.00	0	0.35
2	101	0.50	1.00	0.25	0.58

This table provides an example of how I aggregate the quarterly SOX §302 disclosures to the event-year for one firm. The event-quarters of Panel A correspond to the event-years in Panel B (e.g., event-quarters 0,1,2,3 are aggregated to event-year 0). The column letter in Panel B correspond to the source column from Panel A. I included below example variable calculations for event-year 1.

$$IS\ Investment_{\{Event-Year\ 1\}} = mean(1, 1, 0, 0) = 0.50$$

$$IS\ Investment\ (I)_{\{Event-Year\ 1\}} = max(1, 1, 0, 0) = 1$$

$$IS\ Investment\ (1st)_{\{Event-Year\ 1\}} = mean(0, 0, 0, 0) = 0$$

$$IS\ Investment\ Count_{\{Event-Year\ 1\}} = mean(0.69, 0.69, 0, 0) = 0.35$$

Appendix D List of Words Used in Textual Analysis of SOX §302 Disclosures

Category	Words (with REGEX code)
IS Words	microsoft dynamics|netsuite|oracle|sap|sage |workday financial management|financialforce|unit4 |acumatica|intacct|ramco|epicor|peoplesoft|baan|hyperion|i2 |cdc software|lawson|visma|qad|global shop solutions |agresso|ifs|odoo|deltek|infor erp|syspro|ecount |priority software|epromis|e2 shop system|abas|deskera |plentymarkets|salesforce|zoho|orocrm|hubspot|act! |pipedrive|maximizer|insightly|apptivo|infusionsoft |sugarcrm|suitecrm|base crm|salesboom|bpm'online|unleashed |orderhive|ascendtms|verizon connect|appointmentplus |3pl warehouse manager|acctivate|quickbase|cleo|megaventory |halo supply chain|rapidresponse|hybrent|visco|rizepoint |avercast|magaya|tableau|qlik|ibm cognos|yellowfin|webfocus |tibco|sas|targit|izenda|microstrategy|board intelligence |sisense|statsbot|necto|inetsoft|birst|domo technologies |anypoint platform|zapier|process street|dell boomi|piesync |datix unity|appseconnect|pragmatic works task factory |broadpeak k3|tibco scribe|centerprise data integrator |uipath|skyvia|ssis powerpack|autofy|workato|ibm websphere |onesaas|informatica powercenter|acumatica|accountmate|yardi |denali|traverse|blackline|xero|jd edwards|freshbooks|orion |kinaxis|ramco| aptean|glovia|priority software|priority erp |exact global|workday|information technolog\w* |information system\w*|enterprise resource planning system\w* |supply chain management system\w* |customer relationship management system\w* |enterprise system\w*|business intelligence system\w* |enterprise resource planning |enterprise performance management |erp |key\W+(?:\w+\W+){0,2}?platform\w*|key\W+(?:\w+\W+){0,2}?system\w* |erp system\w*|erp software|accounting system\w* |accounts payable system\w* |order processing system\w* |supply chain system\w*|work management system\w* |financial\W+(?:\w+\W+){0,2}?platform\w* |financial\W+(?:\w+\W+){0,2}?system\w* |financial\W+(?:\w+\W+){0,2}?software\w* |accounting and financial reporting system\w* |accounting software|enterprise resource planning |general ledger|internal control software
IS Investment Verbs	upgrad\w*|implement\w*|install\w*|integrat\w* |invest\w*|acquir\w*|obtain\w*|design\w*|purchase\w* |buy|buying|bought |reconfig\w*|migrat\w*|convert\w* |configur\w*|plan\w*|adopt\w*|move to|moved to|moving|develop\w* |agreement|spend\w*|enhance\w*|enhancing|improve\w* |improving|expand\w*|modif\w*|capitaliz\w*|complet\w* |replac\w*|moderniz\w*|initiat\w*|chang\w*|advanc\w* |boost\w*|increas\w*|capital expenditure\w*|lease\w* |project\w*|commitment\w*|capital expense\w*|capital resource\w*

This table reports the IS words and IS investment verbs used to search SOX §302 disclosures for IS investments. I expand the word list reported in Ashraf and Sunder (2020) by searching for major accounting systems. The IS words contain generic systems (e.g., enterprise resource planning) and IS brands (SAP). A SOX §302 disclosure must contain at least one word from the IS words list that is within 10 words of a word from the IS investment verbs list to count towards IS Investment Count. The lists above report the REGEX code used to search the SOX §302 disclosures.