Does XBRL Adoption Constrain Earnings Management? Early Evidence from Mandated U.S. Filers*

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ABSTRACT

We examine whether the use of eXtensible Business Reporting Language (XBRL) for financial reporting (i.e., interactive data submissions) reduces earnings management during the period of XBRL implementation by the SEC. Using a sample of mandated XBRL filers, we compare the magnitude of absolute discretionary accruals in the XBRL adoption quarters with that in the non-adopting quarters. We also take advantage of staggered (three-stage phase-in) XBRL implementations to perform difference-in-differences analyses. Our results show that absolute discretionary accruals decrease significantly from the pre- to the post-XBRL period, suggesting that XBRL adoption constrains earnings management via discretionary accrual choices. Our analyses further reveal that the use of standardized official XBRL elements significantly reduces the levels of discretionary accruals, while the use of customized extension elements does not, suggesting that the former discourages accrual-based earnings management, while the latter does not. Our results are robust to a variety of sensitivity checks.

L'adoption du XBRL freine-t-elle la gestion du résultat? Premières données provenant de sociétés tenues de produire leurs déclarations en format XBRL aux États-Unis

RÉSUMÉ

Les auteurs se demandent si l'utilisation du eXtensible Business Reporting Language (XBRL) (dépôt de données interactives) réduit la gestion du résultat au cours de la période d'instauration du XBRL par la SEC. À l'aide d'un échantillon de sociétés tenues de produire leurs déclarations en format XBRL, ils comparent l'importance en valeur absolue des régularisations discrétionnaires au cours des trimestres d'adoption et de non-adoption du XBRL. Les auteurs profitent également de la mise en œuvre échelonnée (intégration en trois étapes) du XBRL pour procéder à des analyses de l'écart dans les différences. Les

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résultats qu'ils obtiennent montrent que la valeur absolue des régularisations discrétionnaires diminue sensiblement de la période antérieure à la période postérieure à l'adoption du XBRL, ce qui semble indiquer que l'adoption du XBRL freine la gestion du résultat au moyen des choix relatifs aux régularisations discrétionnaires. Les analyses des auteurs révèlent au surplus que l'utilisation des éléments officiels normalisés du XBRL réduit de manière appréciable le niveau des régularisations discrétionnaires, ce qui n'est pas le cas de l'utilisation des éléments d'extension personnalisée, ce qui porte à conclure que les premiers découragent la gestion du résultat fondée sur les régularisations, contrairement aux seconds. Ces résultats résistent à divers contrôles de sensibilité.

1. Introduction

In April 2009, the SEC required all SEC registrants to adopt eXtensible Business Reporting Language (XBRL) for corporate filings over three phase-in periods, starting June 2009 (SEC 2009). By mandating XBRL, the SEC aimed to replace the EDGAR filing system with the XBRL-tagged interactive reporting system, claiming that the XBRL system allows intermediate and/or end users of accounting information to acquire, process, compare, and analyze financial statement information in a more timely and accurate manner.

Previous research finds that the use of XBRL yields several benefits: reduced information asymmetry between corporate insiders and outside stakeholders (J. W. Kim et al. 2012), enlarged investor base or breadth of ownership (J.-B. Kim et al. 2018), improved analyst forecast quality (Liu et al. 2014), decreased cost of capital (Li et al. 2013), increased firm-specific information capitalized into stock prices (Dong et al. 2016), and decreased credit default swap spreads (Griffin et al. 2014). The focus of this research has been largely on the capital market consequences of XBRL adoption from the perspective of outside investors.[1] Our study extends prior research by analyzing the impact of XBRL adoption on managers' reporting behavior, particularly their discretionary accrual choices.

Specifically, we investigate whether and to what extent the SEC's XBRL mandate led to a reduction in earnings management via discretionary accrual choices. Standardized XBRL-tagged information facilitates the processing and analysis of financial information, and toolkits such as XBRL US (2009) provide templates that users can customize to extract and analyze data from SEC filings. As such, XBRL adoption reduces information processing costs for users of financial statement information and allows them to more effectively monitor managerial behavior (e.g., Berger and Hann 2007; Hope and Thomas 2008). Further, evidence shows that reporting formats are associated with earnings management, and firms identified as potential earnings manipulators tend to provide more complex disclosures (e.g., Lee et al. 2006). Moreover, Hodge et al. (2004) provide (experimental) evidence that investors who use a search-facilitating technology such as XBRL are better able to acquire and interpret financial statement information and subsequently make better investment decisions than investors who do not use such a technology.

One implication of prior research is that although XBRL has no impact on GAAP, the SEC's requirement to use XBRL might improve accessibility, timeliness, and comparability in data analysis and thus reduce the cost of acquiring and processing financial statement information.[2] External users of financial statements are, therefore, in a better position to decipher managerial reporting opportunism in general and to uncover abnormal accrual choices in particular. As a result, managers are likely to face more effective monitoring and scrutiny, which should in turn reduce their ability to manage earnings (e.g., Bushman and Smith 2001; Jo and Kim 2007; Cohen et al. 2008; Huang and Zhang 2012). In the post-XBRL period, we therefore expect less earnings management via discretionary accrual choices. This argument presumes that the XBRL-induced reduction in information processing, although not directly observed, is a key channel through which XBRL adoption constrains accrual-based earnings management (AEM).

1. An exception is Blankespoor (2012), who provides evidence suggesting that an XBRL-induced reduction in information processing costs encouraged firms to increase footnote disclosures.
2. The accounting information system literature argues that XBRL adoption motivates managers to prepare updated reports with corrected information in a timelier fashion, thereby allowing timelier external monitoring by outside stakeholders (Pinsker and Li 2008; Premuroso and Bhattacharya 2008; Gray and Miller 2009; Alles and Piechocki 2012).

The XBRL taxonomy includes both standardized official elements and customized extension elements. As explained in section 2, the former facilitates comparability, though it may limit faithful representation, while the latter allows for greater reporting options but may impair comparability. In the extreme case of entirely customized extensions, investors would have to reconcile XBRL-based data across different firms. That is, some positive impacts of standardized XBRL elements (e.g., enhancing comparability in data analysis and reducing information processing costs) are likely to be offset by the negative impact of extensive use of customized XBRL extensions. We propose and test the prediction that the effect of XBRL adoption in reducing earnings management is more (less) pronounced when XBRL-formatted financial statements contain more standardized official elements (more customized extension elements).

Our main finding is that during the first two years of mandated XBRL filings, absolute discretionary accruals decrease from the pre- to the post-XBRL period, suggesting that mandatory XBRL adoption leads to a decrease in earnings management. This finding is consistent with the view that the XBRL-induced information environment facilitates monitoring by users of financial statement information, which in turn constrains earnings management. We also find that the effect of XBRL on earnings management is more (less) pronounced for firms that use more standardized official elements (customized extension elements). This finding supports the view that standardized official elements of XBRL governed by the SEC are more effective than customized XBRL extensions in constraining earnings management.

We perform additional analyses to rule out alternative explanations. First, the results of a multiperiod dynamic analysis, following Bertrand and Mullainathan (2003) and J.-B. Kim et al. (2018), reveal that XBRL-adopting firms experience a decrease in absolute discretionary accruals in the post-XBRL period but not in the pre-XBRL period, a finding that buttresses our inference of a causal relation between XBRL adoption and reduced earnings management. Second, using a standard difference-in-differences (DiD) design, we find that absolute discretionary accruals decrease for XBRL-adopting firms (treatment samples) from the pre- to the post-XBRL period, as compared to the change observed in non-adopting firms (control samples) for the same period. Third, we provide evidence that XBRL adoption increases real earnings management (REM) measured by abnormal production costs and discretionary expenditures such as R&D (Roychowdhury 2006). This evidence corroborates the view that managers resort to REM when AEM becomes less feasible, perhaps because of greater detection risk in the post-XBRL environment (Cohen et al. 2008).

Our study contributes to existing literature by presenting systematic evidence on an unrecognized benefit of XBRL adoption, namely reduced earnings management. We contribute to the XBRL literature by documenting the influence of the SEC's XBRL mandate on reporting strategies chosen by financial statement preparers, rather than on investment decisions made by external users of XBRL-formatted disclosures. Finally, we contribute to the disclosure choice literature by providing evidence that managers take into account differences in users' responses to different disclosure formats (e.g., standardized official elements versus customized extension elements) when making discretionary accrual choices.

Our study provides additional insights into the consequences of XBRL implementation from the perspectives of both users and preparers of financial statements. Our results suggest that XBRL reduces users' information processing and monitoring costs, making it easier to detect earnings management. This in turn reduces earnings management.

The paper proceeds as follows. Section 2 provides the background and hypothesis development. Section 3 describes the sample, data sources, and empirical specifications. Section 4 reports results. The final section offers concluding remarks.

2. Background and hypothesis development

Background

In April 2009, the SEC mandated the use of an interactive data format, XBRL (SEC 2009), and required that XBRL-formatted financial statements and related schedules be submitted as an exhibit to certain periodic filings, registration statements, and transition reports containing financial reports. XBRL makes SEC filings interactive and improves the ability of financial statement users to extract, process, and analyze financial data.[3] As the SEC's website states:[4]

> Interactive data allows the creation of documents that are machine-readable, so that computers can quickly extract the desired data. Think of every fact in an annual report, every number in a firm's financial statements, as having a unique barcode that tells standard software what the item represents and how it relates to other items in the report. Interactive data "tags" all of the key facts in these large documents, so that software can instantaneously recognize them and serve them up to the investor. . . . [With this interactive data], investors can immediately pull out exactly the information they want, and instantly compare it to the results of other companies, performance in past years, industry averages.

The format consistency of XBRL-based financial reporting improves comparability and reduces reporting errors for each individual item of data. For example, by using machine-readable XBRL elements defined in its taxonomies, XBRL-tagged information can be "rendered" for a variety of purposes and different user groups, and in different forms, such as a printed financial statement, an HTML document, an EDGAR filing document, a raw XML file, or a specialized reporting format. XBRL can ensure that information is properly classified at each step. Moreover, the use of XBRL-standardized taxonomies shortens processing time and enhances information exchange, thereby increasing timeliness and comparability in data analysis (Hoffman and Strand 2001; XBRL International 2007; XBRL US 2009), which in turn reduces information processing costs. XBRL-induced standardization also facilitates the SEC's role as a market watchdog.[5] On March 26, 2006, Christopher Cox, former chairman of the SEC, stated that the use of XBRL for financial reporting helps the Division of Enforcement detect abnormal reporting behaviors (Cox 2006). McNamar (2003) claims that if Enron had filed its financial statements in XBRL, its revenues, cash flows from operations, and profits could have been promptly compared against amounts reported by industry peers, and its high earnings growth and the growth rate of its purported cash flows from operations might have been flagged for SEC staff review.

Recent research on mandatory XBRL adoption

Research on the capital market consequences of the 2009 XBRL mandatory adoption reports that the use of XBRL has reduced information asymmetry in the equity market (J. W. Kim et al. 2012), decreased post-earnings announcement drift for good news portfolios (Efendi et al. 2014), decreased the cost of equity, increased analyst coverage, decreased analyst forecast error and dispersion, and increased liquidity (Li et al. 2013). Liu et al. (2014) report that the association between XBRL use and analyst forecast quality is stronger in the second year than in the first year for Phase 1 filers,[6] suggesting that the benefits of XBRL adoption increase with user experience. Further, Dong et al. (2016) find that an XBRL-induced reduction in information processing costs improves firm-specific information flows, thereby decreasing stock price synchronicity, with the effect more pronounced for firms with greater information supply (proxied by larger analyst

3. According to the SEC (2009), the U.S. GAAP taxonomies during the mandated period have approximately 13,000 standard official elements.
4. See http://www.sec.gov/spotlight/xbrl/interactivedata.htm.
5. See www.sec.gov/news/speech/spch030306cc.htm.
6. The SEC adopted a phase-in approach to mandatory XBRL adoption. In Phase 1, XBRL adoption was required for large domestic and foreign accelerated filers using U.S. GAAP and having a worldwide public float greater than $5 billion for fiscal periods ending on or after June 15, 2009. In Phase 2, XBRL adoption was required for all other large domestic and foreign accelerated filers using U.S. GAAP and having a worldwide public float of at least $700 million for fiscal periods ending on or after June 15, 2010. For more details, refer to discussions in SEC 2009 (20–29).

coverage) and higher information demand (proxied by financial distress and low institutional ownership). J.-B. Kim et al. (2018) show that XBRL adoption helps firms attract more investors or enlarge their investor base or breadth of ownership, and that this effect is greater for more complex firms with higher information processing costs.

In a different context, Blankespoor et al. (2014) examine trading behavior during the first year of 10-K XBRL filings. They find higher abnormal bid–ask spreads, lower abnormal liquidity, and lower abnormal trading volumes for XBRL firms than for others. The decline in abnormal trading volume is greater for smaller traders. Blankespoor et al. (2014) conclude that XBRL adoption may not reduce information asymmetry during the initial year.[7] Blankespoor (2012) finds that XBRL adoption increases footnote disclosures, suggesting that XBRL adoption encourages firms to disclose more information, presumably because reduced information processing costs increase the benefits from more disclosure.

Another strand of research examines the economic and informational consequences of XBRL adoption from a creditor perspective. Chen et al. (2018) indicate that the use of XBRL helps lenders detect warning signs of problematic loans because it enhances comparability across borrowers and reduces the cost to outside users of processing financial statement information.[8] For instance, compliance with loan covenants is identified in the U.S. GAAP XBRL taxonomy, allowing lenders to identify violations. Griffin et al. (2014) find that XBRL adoption leads to a decrease in credit default swap (CDS) spreads of firms referenced in CDS contracts.[9]

To summarize, previous XBRL research has evaluated the effects of XBRL adoption from the perspective of *external users* of accounting information, such as equity investors and creditors, with the exception of Blankespoor (2012). We consider XBRL adoption from the perspective of financial statement preparers and investigate how the XBRL mandate reduces earnings management via discretionary accrual choices.

Impact of XBRL adoption on earnings management

Information asymmetry between managers and users of financial statements is a necessary condition for earnings management.[10] XBRL-formatted financial reports do not provide new information, but the use of XBRL for SEC filings does make the information environment more user-friendly (SEC 2009). The use of XBRL-standardized information items, based on official taxonomies, reduces information processing costs by eliminating the need for manual search and compilation of financial amounts, enabling easier comparison across firms and over time, and highlighting contextual information about data items. Moreover, the availability of open-source XBRL tools and software facilitates user-friendly financial analysis services using XBRL data. These XBRL tools include

7. You and Zhang (2009) show that investors are sluggish to incorporate 10-K information into prices. Blankespoor et al. (2014) study the initial year of the Phase 1 implementation using a short window around 10-K filings and find no reduction in information asymmetry following XBRL adoption, suggesting that investors need time to learn how to use XBRL.
8. As mentioned earlier, we do not have direct, systematic evidence on the XBRL-induced reduction in information processing costs to financial statement users, though we provide anecdotal evidence (as in footnote 2). Information processing costs are not directly observable by researchers; we use the presumed reduction in information processing cost as a key channel or path through which XBRL adoption constrains earnings management via discretionary accrual choices, though we do not have direct evidence on it.
9. As modeled by Duffie and Lando (2001), Griffin et al. (2014) provide evidence that the drop in CDS spreads following mandatory XBRL comes from (i) a reduction in firm default risk from improved outside monitoring and (ii) an increase in the quality of information about firm default risk from reduced information processing costs in the post-XBRL-adoption period.
10. In a world of no information asymmetry, outside users of accounting information would be able to detect earnings management, so managers would have no incentive to manipulate earnings numbers.

Calcbench, 9Wsearch, and SQL Power XBRL Analytics, among others.[11] All these tools help outside users analyze XBRL-tagged financial data at minimal additional cost.[12]

The reduction in information processing costs also increases detection risk, thus discouraging earnings management via discretionary accrual choices (e.g., Lee et al. 2006; Huang and Zhang 2012). Stated another way, the (XBRL-induced) user-friendly information environment enables market participants to detect earnings management at a lower cost. Experimental evidence shows that the use of search-facilitating technology such as XBRL improves financial statement users' ability to acquire and analyze financial information (Hirst and Hopkins 1998; Hodge et al. 2004; Lee et al. 2006). In particular, this evidence suggests that format consistency across firms not only makes managers' financial reporting choices more readily comparable by users but also makes cross-sectional differences in those choices more readily visible.

To the extent that XBRL formatting reduces information processing costs for users of financial statements, we predict that XBRL adoption increases the cost associated with AEM, thereby reducing the net benefit from earnings management. To provide evidence on this issue, we test the following hypothesis, stated in alternative form:

Hypothesis 1. *Accrual-based earnings management decreases from the pre- to the post-XBRL adoption period, all else equal.*

Standardized official elements versus customized extensions elements

Under the SEC's XBRL mandate, each piece of data is tagged using a standardized, machine-readable, official element (or tag) out of about 13,000 agreed-upon taxonomies (i.e., the official elements). The content and structure of the information are defined by the SEC. Compared with the use of customized extension elements, the use of standardized official elements for XBRL filings should reduce investors' information acquisition costs and improve their ability to detect earnings management. First, standardized XBRL elements decrease the time needed to extract relevant information, thus facilitating the acquisition and evaluation of firm-specific information without the laborious and costly process of manual reentry (Hoffman and Strand 2001; XBRL US 2009; SEC 2010a). Second, standardized XBRL elements improve comparability across firms and over time.

However, standardized XBRL elements limit firms' faithful representation and do not cover all items (SEC 2010b; XBRL US 2010). If a requisite tag does not exist, customized extensions are allowed, within a well-defined framework, so that the use of customized extension elements does not corrupt relations among other financial statement items. However, the widespread use of customized extension elements decreases comparability (Chen et al. 2018; Hoitash and Hoitash 2018). Debreceny et al. (2011) analyze the quality of extensions to the 2009 U.S. GAAP taxonomy in the first year of mandatory XBRL filings and find that more than 40 percent of extensions were unnecessary. The unrestricted use of customized extensions would impair automated comparability, requiring investors to manually reconcile the tagged data (Boritz and No 2009; Debreceny et al. 2010).

To summarize, the benefits of using standardized XBRL elements for SEC filings (e.g., improved comparability, more effective disciplining of earnings management) decrease with the use of customized extensions. Because customized extension elements are not provided by the SEC or the FASB, their use for financial reporting might even increase information processing costs. To provide evidence on this issue, we test the following hypothesis stated in alternative form:

11. The following links provide more details on these XBRL tools: http://www.calcbench.com/, http://www.9wsearch.com/, and http://www.sqlpower.ca/xbrlpower/page/xbrl-analytics-appliance.
12. These XBRL tools are relatively inexpensive, ranging from several dollars to hundreds of dollars per month, depending on their functions (J.-B. Kim et al. 2018). Even Microsoft Office offers capabilities to analyze XBRL-tagged data.

HYPOTHESIS 2. *Accrual-based earnings management decreases with the number of standardized official XBRL elements and increases with or is insensitive to the number of customized XBRL extensions, all else equal.*

3. Research methods

Sample and data

We extract all XBRL filings submitted to the SEC from the EDGAR database of Interactive Data Filing and the monthly Really Simple Syndication (RSS) feeds archived from EDGAR, the program used for interactive data submitted to the SEC, for the period June 15, 2009, to June 14, 2011. We restrict our sample to mandatory XBRL adopters for the Phase 1 and Phase 2 implementation periods. We obtain an initial sample of 7,777 interactive data submissions using XBRL from 1,712 firms. From this initial sample, we exclude 226 submissions that are not qualified as Phases 1 and 2 filings;[13] 2,051 filings from the financial service industry (SIC codes 6000–6999) and utility industry (SIC codes 4900–4949), because the utilities industries are subject to specific regulations and firms' accruals in the financial industries are not comparable with those in other industries; and 2,990 submissions with missing COMPUSTAT or I/B/E/S data. We also exclude 783 observations (126 firms) with discretionary accruals less than 1 percent of total assets (Balsam et al. 2002).[14] Our final sample contains 1,727 firm-quarter observations (674 public XBRL-adopting firms) whose discretionary accruals exceed 1 percent of total assets. Panel A of Table 1 summarizes our data sources and sample selection procedure.

Panel B of Table 1 summarizes the sample distribution by 2-digit SIC code. Our sample firms come predominantly from four different industry groups: Metal, Machinery and Equipment (39.63 percent); Business Services, Auto Repair, and Recreation (13.97 percent); Chemical, Petroleum and Coal, Rubber and Plastics (11.23 percent); and Wholesale and Retail (10.10 percent). Panel C of Table 1 shows the distribution of our final sample of both first-year and second-year submissions by quarter.[15] Our sample contains 377 firm-quarter observations (234 from 10-Q and 143 from 10-K) from the first-year interactive data submissions (Phase 1 adopters) and 1,350 firm-quarter observations (820 from 10-Q and 530 from 10-K) from the second-year interactive data submissions (both Phase 1 and Phase 2 adopters).[16]

To control for firm characteristics, we match the quarterly or annual reporting periods of each interactive data submission to a firm's corresponding periods two years prior to the date of XBRL adoption. Thus, we are comparing the XBRL filing effect on AEM between XBRL adoption quarters (i.e., 1,727 XBRL submissions in the post-XBRL period from June 15, 2009, to June 14, 2011) and non-adopting quarters (i.e., 1,727 matched firm-quarters in the pre-XBRL period).

Model specification and variable definitions

Hypothesis 1 concerns the effects of mandatory XBRL adoption on earnings management in the post-XBRL period versus the pre-XBRL period (the corresponding non-adopting quarters two

13. For example, other filings (i.e., 6 K, 8 K, 20-F, and 40-F), Voluntary Filing Program filings, and unqualified public floats for Phase 1 and 2 submissions (i.e., market floats below \$5 billion and below \$700 million for the Phase 1 and 2 samples, respectively) do not meet the criteria for this study.
14. We use this 1 percent restriction following Balsam et al. (2002). To examine the possibility that these 783 observations reflect the transition from high discretionary accruals to low discretionary accruals around XBRL adoption, we rerun our tests with these observations included. Untabulated results reveal that the inclusion of these (initially deleted) 783 observations produces qualitatively identical results with those reported.
15. As shown in Table 1, panel C, our sample observations come from all four quarters, with data for the first three quarters from 10-Q and the fourth quarter from 10-K.
16. We focus on 10-Q and 10-K in Phases 1 and 2 implementations because there are limited numbers of submissions in Phase 3 (at the time of our data collection). Examining Phase 3 eliminates our ability to use a control group of non-XBRL adopters, as explained later in section 5 in relation to our DiD analysis. For brevity, investigations of individual 10-Q versus 10-K filings are discussed together.

TABLE 1
Sample selection and industry composition

Panel A: Sample selection procedure

	Details	Filings	Firms
Step 1	Starts from 10-Q or 10-K XBRL filings collected from EDGAR RSS feeds (June 15, 2009, to June 14, 2011)	7,777	1,712
	a. Not qualified for Phase 1 or 2 filings (see footnote 14)	(226)	(37)
	b. Exclude the financial and utility industries (SIC codes 6000–6900 and 4900–4949, respectively)	(2,051)	(463)
	Subtotal	5,500	1,212
Step 2	Exclude observations with missing COMPUSTAT and I/B/E/S data	(2,990)	(412)
Step 3	Delete observations with discretionary accruals less than 1% of total assets	(783)	(126)
	Total	1,727	674

Panel B: Sample distribution by 2-digit SIC

2-digit SIC	Industry	No.	%
01–09	Agricultural and Forestry	3	0.17
10–19	Mining, Oil and Gas, and Others	77	4.35
20–27	Food, Printing, and Publishing	164	9.40
28–29	Chemicals, Petroleum and Coal, Rubber and Plastics	194	11.23
30–39	Metal, Machinery, and Equipment	686	39.63
40–49	Transportation	121	6.88
50–59	Wholesale and Retail	176	10.10
70–79	Business Services, Auto Repair, and Recreation	232	13.97
80–89	Health, Engineering, and Management Service	70	4.05
99	Others	4	0.22
Total		1,727	100

Panel C: Pre- versus post-XBRL period

	Filings	Firms
Post-XBRL period: Interactive data submissions by Phase 1 and Phase 2 filers	1,727	674
First-year interactive data submissions (from Phase 1 adopters)	377	
First quarter (10-Q)	83	
Second quarter (10-Q)	67	
Third quarter (10-Q)	84	
Fourth quarter (10-K)	143	
Second-year interactive data submissions (from both Phase 1 and Phase 2 adopters)	1,350	
First quarter (10-Q)	271	
Second quarter (10-Q)	275	
Third quarter (10-Q)	274	
Fourth quarter (10-K)	530	
Pre-XBRL period: Corresponding quarter two years prior to each submission	1,727	674

years prior to the XBRL quarters). To test this hypothesis, we specify the following regression model:

$$\begin{aligned} EM_t = {} & \alpha_1 + \alpha_2 DXBRL_t + \alpha_3 LOSS_t + \alpha_4 BIG_t + \alpha_5 OPNIC_t + \alpha_6 SIZE_t + \alpha_7 MB_t \\ & + \alpha_8 CSALES_t + \alpha_9 LEV_t + \alpha_{10} CASH_t + \alpha_{11} SUR_t + \alpha_{12} BEAR_t \\ & + \alpha_{13} \sum Industry + \varepsilon_t, \end{aligned} \tag{1}$$

where, for each quarter t, *EM* refers to earnings management measured as either (i) absolute discretionary accruals estimated by the modified Jones model as proposed by Dechow et al. (1995), denoted *DACMJ*, or (ii) absolute discretionary accruals estimated using the ROA-adjusted approach of Kothari et al. (2005), denoted *DACROA*. The Appendix explains how we compute *DACMJ* and *DACROA*. *DXBRL* is an indicator variable that equals one for an XBRL filing quarter t when firms use XBRL, and zero otherwise. Hypothesis 1 implies a negative coefficient for *DXBRL* ($\alpha_2 < 0$); that is, mandatory XBRL adoption leads to a decrease in earnings management during the post-XBRL-adoption period.

We include firm-specific variables shown in previous research to be related to earnings management. To control for potential differences in earnings management between loss and profit firms (e.g., DeFond and Jiambalvo 1991),[17] we include *LOSS*, an indicator variable that equals one for firms with income before extraordinary items less than zero, and zero otherwise. Several studies show that Big 4 auditors are more effective in constraining earnings management (Becker et al. 1998; J.-B. Kim et al. 2003; Krishnan 2003). We include an indicator variable *BIG* that equals one for firms with Big 4 auditors, and zero otherwise. To separate the impact of XBRL adoption from the effect of internal control effectiveness on earnings management, we include *OPNIC,* an indicator variable that equals one for firms with no material weakness in internal controls under the Sarbanes-Oxley Act (SOX) Section 404 disclosures, and zero otherwise. To control for firm size (e.g., Dechow 1994; Dechow and Dichev 2002; Kothari et al. 2009), we include *SIZE*, the natural log of market capitalization at the end of the quarter. *MB* and *CSALES* are included to control for growth: *MB* is the market-to-book ratio at the end of each quarter, and *CSALES* is the change in sales in period t divided by sales in period $t-1$. *LEV* (the ratio of long-term liabilities to assets) is included because highly levered firms may have greater incentives for earnings management to avoid debt covenant violations (DeFond and Jiambalvo 1994; Becker et al. 1998). To control for the potential correlation between accruals and cash flows (Kothari et al. 2005), we include *CASH,* the ratio of cash flow from operations to beginning total assets. We also include *SUR,* earnings surprise, actual earnings per share (EPS) minus the mean analysts' forecast divided by the stock price at the end of the fiscal quarter. To the extent that firms with lower discretionary accruals tend to experience larger earnings surprise, we expect the coefficient on *SUR* to be negative. *BEAR* is an indicator variable that equals one if observations are from down market years, such as 2008, 2010, or 2011, and zero otherwise. Finally, we include an industry indicator (based on 2-digit SIC), *Industry*, to control for industry fixed effects.

Hypothesis 2 concerns the effect of XBRL on earnings management, conditioned on the use of standardized versus customized elements. To test this hypothesis, we estimate the following regression:

$$\begin{aligned} EM_t = {} & \alpha_1 + \alpha_2 DXBRL_t + \alpha_3 OFFE_t + \alpha_4 EXTE_t + \alpha_5 LOSS_t \\ & + \alpha_6 BIG_t + \alpha_7 OPNIC_t + \alpha_8 SIZE_t + \alpha_9 MB_t + \alpha_{10} CSALES_t + \alpha_{11} LEV_t \\ & + \alpha_{12} CASH_t + \alpha_{13} SUR + \alpha_{14} BEAR + \alpha_{15} \sum Industry + \varepsilon_t, \end{aligned} \tag{2}$$

17. We also reestimate equations (1) and (2) after adding *ROA* (net income before extraordinary items divided by total assets) as an additional control variable. We find that the statistical inferences on our test variables, *DXBRL*, remain unaltered.

TABLE 2
Descriptive statistics

	DXBRL = 0			*DXBRL* = 1			Tests for differences			
	Pre-XBRL (*N* = 1,727)			Post-XBRL (*N* = 1,727)						
	Mean	Median	SD	Mean	Median	SD	*t*-statistic for mean		*z*-statistic for median	
Phase 1 submissions										
DACMJ	0.050	0.033	0.041	0.043	0.028	0.042	2.10	**	3.61	***
DACROA	0.049	0.033	0.041	0.043	0.028	0.042	2.17	**	3.65	***
Phase 2 submissions										
DACMJ	0.055	0.041	0.042	0.040	0.026	0.039	9.20	***	13.06	***
DACROA	0.053	0.039	0.042	0.040	0.027	0.039	8.42	***	11.06	***
OFFE	0	0	0	432.5	318	364.3	n/a		n/a	
EXTE	0	0	0	72.3	25	129.4	n/a		n/a	
LOSS	0.181	0	0.385	0.102	0	0.303	6.63	***	6.59	***
BIG	0.973	1	0.137	0.973	1	0.161	0.10		0.10	
OPNIC	0.981	1	0.137	0.987	1	0.112	1.49		1.49	
SIZE	8.076	7.990	1.235	8.338	8.306	1.059	6.69	***	6.73	***
MB	3.162	2.278	3.188	3.066	2.425	2.597	0.97		3.32	***
CSALES	−0.004	0.005	0.471	0.131	0.034	3.201	1.73	*	10.37	***
LEV	0.292	0.284	0.187	0.289	0.282	0.181	0.46		0.39	
CASH	0.012	0.028	0.062	0.011	0.026	0.059	0.53		1.14	
SUR	−0.002	0.001	0.035	0.001	0.001	0.006	2.79	***	4.10	***
BEAR	0.635	1	0.481	0.835	1	0.371	13.65	***	13.30	***

Notes: DXBRL equals one for the XBRL filing quarter *t* during which firms are mandated to compile their financial statements in XBRL, and zero otherwise. *DACMJ* is the absolute value of discretionary accruals as a percentage of the beginning balance of total assets computed by the modified Jones model as proposed by Dechow et al. (1995). *DACROA* is the absolute value of discretionary accruals as a percentage of the beginning balance of total assets computed by the model of Kothari et al. (2005), which adjusts by return on assets (*ROA*). *OFFE* is the number of standardized official elements used in the XBRL filings in quarter *t*; *EXTE* is the number of customized extensions elements used in the XBRL filings in quarter *t*. *LOSS* is an indicator variable equal to one for firms with income before extraordinary items less than zero, and zero otherwise. *BIG* is an indicator variable equal to one for firms with Big 4 auditors, and zero otherwise. *OPNIC* is an indicator variable equal to one for firms with no material weakness in internal controls under the SOX Section 404 disclosures, and zero otherwise. *SIZE* is the natural log of market capitalization at the end of the quarter. *MB* is the market-to-book ratio at the end of the quarter. *CSALES* is change in sales in period *t* divided by sales in period $t - 1$. *LEV* is long-term liabilities divided by total assets. *CASH* is the ratio of cash flow from operations to beginning total assets. *SUR* is earnings surprise estimated by actual EPS minus the mean value of analysts' forecasts divided by stock price at the end of the fiscal quarter. *BEAR* equals one if observations are from down market years, such as 2008, 2010, and 2011, and zero otherwise. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively, using a two-tailed *t*-test.

where *OFFE* and *EXTE* are the numbers of standardized official elements and customized extension elements, respectively, used in the XBRL filings in quarter *t*.[18] Note here that these two variables take the value of 0 in the pre-XBRL period. All other variables are as explained in relation to equation (1).[19] Hypothesis 2 translates as $\alpha_3 < 0$ and $\alpha_4 > 0$ or $\alpha_4 = 0$.

18. We also use the 2-digit SIC industry mean-adjusted values of *OFFE* and *EXTE*. For a more detailed discussion, refer to section 5.
19. In estimating equations (1) and (2), we winsorize all continuous variables at the 1st and 99th percentiles.

4. Main empirical results

Univariate tests

Table 2 reports descriptive statistics, separately, for the non-adopting quarters ($N = 1{,}727$ in the pre-XBRL period) and XBRL-adopting quarters ($N = 1{,}727$ in the post-XBRL periods). Both the mean and median values of *DACMJ* and *DACROA* are, overall, lower in the post-XBRL period than in the pre-XBRL period ($p < 0.01$).

With respect to control variables, we find that in the post-XBRL period, firms tend to be larger (*SIZE*) and have higher growth potential (*MB*), higher sales growth (*CSALES*), larger earnings surprises (*SUR*), and fewer losses. They face less favorable market conditions (*BEAR*) compared with those in the pre-XBRL period. We find no significant change from the pre- to the post-XBRL period with respect to the other control variables.

Panel A (B) of Figure 1 illustrates trends for the mean (median) values of our measures of absolute discretionary accruals (*DACMJ* and *DACROA*) and absolute cash flows from operations deflated by total assets (*ABSCFO*). Consistent with results presented in Table 2, we observe a decreasing trend in *DACMJ* and *DACROA* from the pre- to the post-XBRL period and no clear trend from the pre- to the post-XBRL period in the mean and median of *ABSCFO*.

Multivariate tests

Panel A of Table 3 presents the regression results for equation (1) using 3,454 firm-quarter observations of XBRL adopters for the pre-XBRL period (June 15, 2007, to June 14, 2009) and the post-XBRL period (June 15, 2009, to June 14, 2011). As shown in columns (1) and (2), where earnings management is measured by *DACMJ* and *DACROA*, respectively, the coefficients on *DXBRL* are negative (-0.01229 with $p < 0.01$ and -0.01147 with $p < 0.01$, respectively). This finding is consistent with the prediction in Hypothesis 1 that mandatory XBRL adoption leads to a reduction in absolute discretionary accruals. The magnitude of the effect is in the range of 1.1 to 1.2 percent of total assets at the beginning of each quarter, using *DACROA* and *DACMJ,* respectively.[20] This magnitude is economically significant, given that the unconditional means of *DACMJ* and *DACROA* in the pre-XBRL period are 5.0 and 4.9 percent, respectively, of total assets for Phase 1 submissions; the corresponding statistics for Phase 2 submissions are 5.5 and 5.3 percent (as reported in Table 2). Overall, the results in panel A of Table 3 support the view that XBRL adoption discourages AEM.[21]

With respect to the estimated coefficients on control variables, we find that the coefficient on *LOSS* is positive ($p < 0.01$) in both columns (1) and (2), suggesting that loss firms report larger absolute discretionary accruals. The coefficient on *BIG* is positive ($p < 0.01$) in both columns (1) and (2),[22] contrary to findings in prior research that large auditors constrain earnings management (e.g., Becker et al. 1998; J.-B. Kim et al. 2003; Krishnan 2003). The positive coefficient on *MB* indicates that high-growth firms report larger absolute abnormal accruals. The negative coeffi-

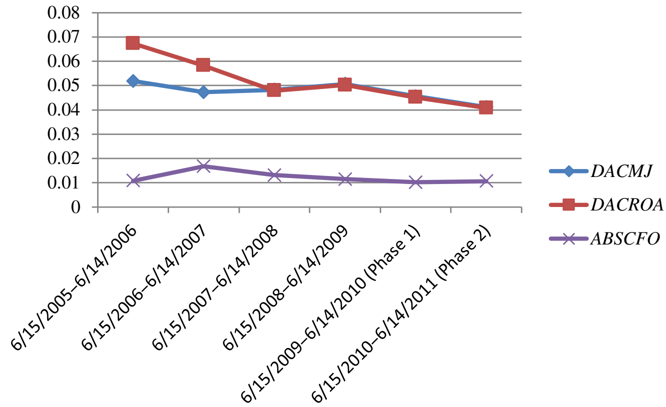
20. As shown in equation (8) in the Appendix, the dollar amount of accruals is deflated by the dollar amount of total assets at the beginning of each quarter. Thus, the estimated coefficients on *DXBRL* in Table 3 (i.e., -0.01229 and -0.01147 in columns (1) and (2), respectively), can also be interpreted in terms of the percentage of beginning total assets.

21. Untabulated results show the XBRL effect is much less significant for the Phase 1 sample than for the Phase 2 sample, consistent with results in Table 2. Because the SEC announced the mandatory XBRL adoption in the same year as Phase 1 implementation, Phase 1 filers may have had limited time to make significant changes in their disclosure policies in response to heightened monitoring and scrutiny by outside investors in the immediate post-XBRL period. The number of XBRL filers in the Phase 1 sample is relatively small, but it includes large firms with a public float of more than $5 billion.

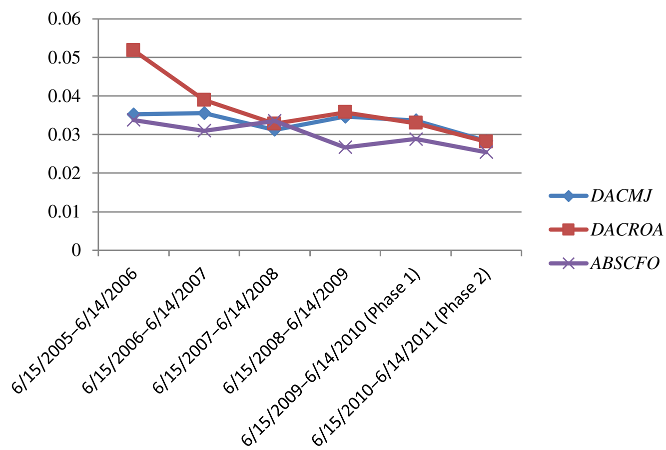
22. Table 2 shows that more than 97 percent of our sample observations have Big 4 auditors. A significantly positive coefficient on *BIG* could be observed due to uncontrolled self-selection bias associated with a firm's choice of a large versus small auditor. We do not address this potential bias because *BIG* is not a test variable.

Figure 1 Discretionary accruals and cash flow estimated before and after XBRL adoption (Unit: Discretionary accruals to total assets ratio or cash flows from operating activities to total assets ratio)

Panel A: Mean values of *DACMJ*, *DACROA*, and *ABSCFO*



Panel B: Median values of *DACMJ*, *DACROA*, and *ABSCFO*



Notes: Panel A (B) illustrates trends for the mean (median) values of two measures of absolute discretionary accruals (*DACMJ* and *DACROA*) and absolute cash flows from operations deflated by total assets (*ABSCFO*) for the five-year period from June 15, 2006, to June 15, 2011. *DACMJ* is estimated using the modified Jones model, and *DACROA* is estimated using the model suggested by Kothari et al. (2005).

cients on *LEV*, *CASH,* and *SUR* suggest that high-leverage firms,[23] firms with higher operating cash flows, and firms with earnings performance better than analysts' expectations tend to report lower absolute abnormal accruals. Finally, the coefficient on *BEAR* is positive and significant ($p < 0.05$) only in column (1), providing weak evidence on the positive association between stock market conditions and earnings management.

23. The negative coefficient on *LEV* is inconsistent with the debt covenant hypothesis that high-leverage firms tend to engage in income-increasing discretionary accrual choices to avoid earnings-based covenant violations. It is consistent, however, with the signaling/bonding hypothesis that high-leverage firms voluntarily bond themselves to more transparent reporting strategies to convey a credible signal that they are less opportunistic in financial reporting (Call et al. 2014; Barton and Waymire 2004).

Panel B of Table 3 reports the results of estimating equation (2) using the same firm-quarter observations as in panel A ($N = 3{,}454$). Similar to the results in panel A of Table 3, we find that the coefficients of *DXBRL* are highly significant ($p < 0.01$), with expected negative signs. We also find that the coefficients of *OFFE* are negative and highly significant ($p < 0.01$), and the coefficients of *EXTE* are positive and significant ($p < 0.01$ and $p < 0.05$ in columns (1) and (2), respectively). These findings support the prediction in Hypothesis 2 that earnings management via discretionary accrual choices decreases with the number of standardized official elements (*OFFE*) used in XBRL submissions to the SEC and increases with the number of customized extension elements (*EXTE*) used in these XBRL submissions.

Investors generally require timeliness, comparability, and consistency of XBRL-based financial statement information (CFAI 2009). Our results in panel B of Table 3 suggest that the greater use of customized extension elements tends to make analysis more difficult and increases the cost to monitor and detect abnormal accrual choices (Chen et al. 2018; Griffin et al. 2014); in contrast, the use of standardized official elements makes it easier for external users to make automated peer group comparisons. Consequently, the use of standardized official elements versus customized extension elements improves the comparability and consistency of XBRL-based information and thus facilitates outside stakeholders' monitoring and detection of reporting opportunism.

Lead–lag analysis

To provide more evidence of a causal relation between mandatory XBRL adoption and earnings management, we extend our baseline models in equations (1) and (2) into the following multi-period models in equations (3) and (4), respectively[24]:

$$EM_t = \alpha_1 + \alpha_2 DXBRL_{t-1} + \alpha_3 DXBRL_t + \alpha_4 DXBRL_{t+1} + \alpha_5 \sum Controls + \alpha_6 \sum Industry + \varepsilon_t, \quad (3)$$

$$\begin{aligned} EM_t = {} & \alpha_1 + \alpha_2 DXBRL_{t-1} + \alpha_3 DXBRL_t + \alpha_4 DXBRL_{t+1} + \alpha_5 OFFE \times DXBRL_t \\ & + \alpha_6 EXTE \times DXBRL_t + \alpha_7 OFFE \times DXBRL_{t+1} + \alpha_8 EXTE \times DXBRL_{t+1} \\ & + \alpha_9 \sum Controls + \alpha_{10} \sum Industry + \varepsilon_t, \end{aligned} \quad (4)$$

which, following the spirit of Bertrand and Mullainathan (2003), includes three *DXBRL* variables: $DXBRL_{t-1}$, $DXBRL_t$, and $DXBRL_{t+1}$. The variable $DXBRL_t$ is an indicator variable that equals one for the first-time XBRL filing quarter *t*, and zero otherwise. Similarly, $DXBRL_{t-1}$ ($DXBRL_{t+1}$) is an indicator variable that equals one for one quarter prior to (subsequent to) the first-time submission quarter *t,* and zero otherwise. Including these three consecutive quarter-indicator variables allows us to evaluate the trend in earnings management around the initial submission quarter. If XBRL adoption causes a decrease in earnings management, we expect to observe its impact on reducing abnormal accruals in the quarter of adoption and thereafter (i.e., the post-XBRL period) and not prior to the initial adoption quarter year (i.e., the pre-XBRL period). All other variables in equations (3) and (4) are as explained above.

Panels A and B of Table 4 present the results of estimating equations (3) and (4), respectively. In panel A, the coefficients of $DXBRL_{t-1}$ are positive ($p < 0.05$) in both columns (1) and (2) and the coefficients of $DXBRL_t$ and $DXBRL_{t+1}$ are negative ($p < 0.01$) across both columns. In column (1), the coefficients of $DXBRL_t$ (−0.00938) and $DXBRL_{t+1}$ (−0.00825) show reductions in absolute discretionary accruals by about 0.93 percent of total assets in the XBRL adoption quarter and by 0.82 percent of total assets in the quarter following the XBRL adoption quarter. These decreases are economically significant, given that the unconditional mean (median) *DACMJ* of Phase

24. Note that in equation (4), $OFFE \times DXBRL_{t-1}$ and $EXTE \times DXBRL_{t-1}$ are not included because $OFFE = EXTE = 0$ in the pre-XBRL period.

TABLE 3
Effect of XBRL adoption on absolute abnormal accruals

Panel A: Hypothesis 1 test

	(1) Using *DACMJ*			(2) Using *DACROA*		
	Coefficient	*t*-statistic		Coefficient	*t*-statistic	
Constant	0.03703	4.72	***	0.08543	11.37	***
DXBRL	−0.01229	−11.69	***	−0.01147	−10.65	***
LOSS	0.01497	5.80	***	0.01084	4.22	***
BIG	0.00944	2.75	***	0.01093	3.50	***
OPNIC	0.00079	0.17		0.00073	0.16	
SIZE	0.00061	0.86		0.00064	0.90	
MB	0.00085	2.95	***	0.00086	3.07	***
CSALES	0.00010	0.85		−0.00013	−1.06	
LEV	−0.01245	−2.74	***	−0.01700	−3.70	***
CASH	−0.35512	−15.81	***	−0.35390	−16.40	***
SUR	−0.13929	−2.43	**	−0.13207	−2.43	**
BEAR	0.00285	2.10	**	0.00167	1.25	
Industry		Included			Included	
F-value		27.63	***		26.35	***
Adjusted R^2		0.324			0.313	
N		3,454			3,454	

Panel B: Hypothesis 2 test

	(1) Using *DACMJ*			(2) Using *DACROA*		
	Coefficient	*t*-statistic		Coefficient	*t*-statistic	
Constant	0.03756	4.67	***	0.08534	11.10	***
DXBRL	−0.00875	−5.48	***	−0.00778	−4.75	***
OFFE	−0.00001	−3.04	***	−0.00001	−2.94	***
EXTE	0.00003	2.68	***	0.00003	2.21	**
LOSS	0.01497	5.80	***	0.01087	4.24	***
BIG	0.00949	2.74	***	0.01095	3.50	***
OPNIC	0.00078	0.16		0.00074	0.16	
SIZE	0.00079	1.06		0.00088	1.20	
MB	0.00082	2.87	***	0.00084	2.98	***
CSALES	0.00008	0.70		−0.00014	−1.20	
LEV	−0.01186	−2.62	***	−0.01635	−3.58	***
CASH	−0.35084	−15.38	***	−0.34932	−15.94	***
SUR	−0.14032	−2.46	**	−0.13298	−2.46	**
BEAR	0.00304	2.18	**	0.00196	1.43	
Industry		Included			Included	
F-value		26.94	***		25.70	***
Adjusted R^2		0.324			0.314	
N		3,454			3,454	

Notes: Industry is an industry indicator based on 2-digit SIC codes. All other variables are defined in Table 2. *** and ** indicate significance at the 0.01 and 0.05 levels, respectively, using a two-tailed *t*-test. Two-sided *p*-values are calculated based on standard errors adjusted for heteroskedasticity (White 1980) and firm clustering (Petersen 2009).

1 submission is 5 percent (3.3 percent) of total assets in the pre-XBRL period. The corresponding statistics for Phase 2 submissions are 5.5 percent (4.1 percent) as shown in Table 2. In column (2), where *DACROA* is the dependent variable, we find similar, albeit somewhat smaller, effects.

We conclude that the decline in absolute abnormal accruals is observed *only* in the post-XBRL period, including the adoption quarter, and *not* in the pre-XBRL quarter. This result provides additional support for the predicted causal relation between the XBRL use and reduced earnings management.

In panel B of Table 4, we find that in the initial adoption quarter t, the coefficients of our variables of interest, $OFFE \times DXBRL_t$, are significant ($p < 0.01$) with an expected negative sign in both columns (1) and (2); the coefficients on $EXTE \times DXBRL_t$ are positive ($p < 0.05$) in both columns (1) and (2). We find similar results in the quarter after the initial submission—that is, quarter $t+1$: the coefficient of $OFFE \times DXBRL_{t+1}$ is negative ($p < 0.01$) for both columns (1) and (2), and the coefficient of $EXTE \times DXBRL_{t+1}$ is positive ($p < 0.01$ and $p < 0.05$, respectively) in both columns (1) and (2). These findings support the results in panel B of Table 3 that the use of standardized elements is associated with a larger decline in earnings management than the use of customized extension elements.

DiD analyses

To further address potential endogeneity concerns about the relation observed between XBRL adoption and a decline in earnings management, we next estimate the DiD regressions in equations (5) and (6):

$$EM_t = \alpha_1 + \alpha_2 POST_t + \alpha_3 TREAT_t + \alpha_4 POST \times TREAT_t + \alpha_5 \sum Controls + \alpha_6 \sum Industry + \varepsilon_t, \quad (5)$$

$$EM_t = \alpha_1 + \alpha_2 POST_t + \alpha_3 TREAT_t + \alpha_4 POST \times TREAT_t + \alpha_5 POST \times OFFE \times TREAT_t + \alpha_6 POST \times EXTE \times TREAT_t + \alpha_5 \sum Controls + \alpha_6 \sum Industry + \varepsilon_t, \quad (6)$$

where *POST* equals one for the post-XBRL period, and zero otherwise; *TREAT* equals one for a firm in the treatment sample of XBRL adopters, and zero for a firm in the control sample of non-adopting firms; all other variables are as defined earlier. In equation (5), the coefficient of $POST \times TREAT$ (α_4) captures the incremental change in *EM* for XBRL-adopting firms ($TREAT = 1$) versus non-adopting firms ($TREAT = 0$) from the pre- to the post-XBRL period.[25] In equation (6), the coefficients of $POST \times OFFE \times TREAT$ ($POST \times EXTE \times TREAT$) capture the incremental change in the effect of *OFFE* (*EXTE*) on earnings management for XBRL-adopting firms ($TREAT = 1$) from the pre- to the post-XBRL period, relative to the corresponding effect for non-adopting firms ($TREAT = 0$) for the same period.

In equations (5) and (6), we use the staggered (three-stage phase-in) XBRL implementation to identify treatment and control samples. As illustrated in Figure 2, for Phase 1 interactive data submissions, the treatment sample ($TREAT = 1$) consists of XBRL adopters in cell A1, while the control sample ($TREAT = 0$) consists of non-adopters in cells B1 and C1. For Phase 2 interactive submissions, the treatment sample includes XBRL adopters in cells A2 and B2, while the control sample includes non-adopters in cell C2. The treatment sample when combined refers to XBRL adopters in cells A1, A2, and B2, and the control sample refers to non-adopters in B1, C1, and C2.

Panel A of Table 5 reports the results of estimating equation (5) using the treatment sample of XBRL-adopter firm-quarter observations ($N = 3{,}454$) and the control sample of non-adopter firm-quarter observations ($N = 7{,}908$).[26] The coefficient of $POST \times TREAT$ is negative ($p < 0.01$)

25. The coefficient of *POST* (α_2) captures the change in *EM* for the control sample of non-adopters ($TREAT = 0$) from the pre- to the post-XBRL period. The coefficient of *TREAT* (α_3) captures the difference in earnings management between the treatment sample of XBRL adopters and the control sample of non-adopters in the pre-XBRL period ($POST = 0$).

26. As explained in panel C of Table 1, the treatment sample ($N = 3{,}454$) consists of 1,727 XBRL-adopter firm-quarter observations for the post-XBRL period plus the same number of non-adopter firm-quarter observations for the pre-

TABLE 4
Lead–lag analysis

Panel A: Hypothesis 1 test

	(1) Using *DACMJ*			(2) Using *DACROA*		
	Coefficient	*t*-statistic		Coefficient	*t*-statistic	
Constant	0.04194	8.84	***	0.07177	5.71	***
$DXBRL_{t-1}$	0.00232	2.05	**	0.00203	1.80	**
$DXBRL_{t}$	−0.00938	−8.92	***	−0.00870	−8.16	***
$DXBRL_{t+1}$	−0.00825	−4.63	***	−0.00777	−4.20	***
Controls		Included			Included	
Industry		Included			Included	
F-value		27.43	***		26.76	***
Adjusted R^2		0.131			0.128	
N		11,362			11,362	

Panel B: Hypothesis 2 test

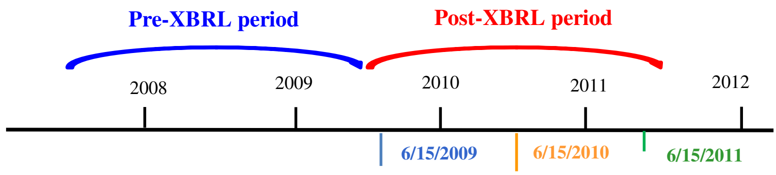
	(1) Using *DACMJ*			(2) Using *DACROA*		
	Coefficient	*t*-statistic		Coefficient	*t*-statistic	
Constant	0.03738	4.41	***	0.07388	5.13	***
$DXBRL_{t-1}$	0.00229	2.02	**	0.00199	1.76	*
$DXBRL_{t}$	−0.00235	−0.97		−0.00131	−0.53	
$DXBRL_{t+1}$	0.00355	1.19		0.00453	1.49	
$OFFE \times DXBRL_{t}$	−0.00002	−3.18	***	−0.00003	−3.31	***
$EXTE \times DXBRL_{t}$	0.00006	2.41	**	0.00006	2.61	**
$OFFE \times DXBRL_{t+1}$	−0.00002	−4.94	***	−0.00002	−4.37	***
$EXTE \times DXBRL_{t+1}$	0.00003	2.91	***	0.00002	1.85	**
Controls		Included			Included	
Industry		Included			Included	
F-value		26.21	***		25.61	***
Adjusted R^2		0.132			0.130	
N		11,362			11,362	

Notes: Following the spirit of Bertrand and Mullainathan (2003), we include three *DXBRL* variables—that is, $DXBRL_{t-1}$, $DXBRL_{t}$, and $DXBRL_{t+1}$. $DXBRL_{t}$ is a quarter-indicator variable that equals one for the first-time XBRL filing quarter t during which firms are mandated to compile their financial statements in XBRL, and zero otherwise. Similarly, $DXBRL_{t-1}$ ($DXBRL_{t+1}$) is a quarter-indicator variable that equals one when $DXBRL_{t}$ is a quarter prior to (subsequent to) the (first-time) initial submission quarter t, and zero otherwise. *Industry* is an industry indicator based on 2-digit SIC codes. All other variables are defined in Table 2. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively, using a two-tailed t-test. Two-sided p-values are calculated based on standard errors adjusted for heteroskedasticity (White 1980) and firm clustering (Petersen 2009).

in both columns (1) and (2). This finding is consistent with the prediction in Hypothesis 1, suggesting that earnings management decreases from the pre- to the post-XBRL period for the treatment sample of XBRL adopters, compared with the corresponding change for the control

XBRL period (two years prior to each submission). The control sample of non-adopter firm-quarter observations (N = 7,908) consists of 3,454 non-adopter firm-quarter observations for the post-XBRL period plus the same number of non-adopter firm-quarter observations for the pre-XBRL period.

Figure 2 Construction of the sample for the DiD design



Subsample structure:

	Phase 1 submissions	**Phase 2 submissions**	**Phase 3 submissions**
Phase 1 filers: Large accelerated filers for fiscal periods ending on or after June 15, 2009 (over $5B public float)	XBRL (A1)	XBRL (A2)	XBRL (A3)
Phase 2 filers: Other accelerated filers for fiscal periods ending on or after June 15, 2010 (between $5B and $700M public float)	non-XBRL (B1)	XBRL (B2)	XBRL (B3)
Phase 3 filers: All remaining filers for fiscal periods ending on or after June 15, 2011 (less than $700M public float)	non-XBRL (C1)	non-XBRL (C2)	XBRL (C3)

Notes: This figure illustrates how we construct the treatment sample (*TREAT* = 1) and control sample (*TREAT* = 0), and the pre-XBRL period (*POST* = 0) and the post-XBRL period (*POST* = 1). For Phase 1 interactive submissions, the treatment sample consists of XBRL adopters in cell A1, while the control sample consists of non-adopters in cells B1 and C1. For Phase 2 interactive submissions, the treatment sample includes XBRL adopters in cells A2 and B2, while the control sample includes non-adopters in cell C2. Combined, the treatment sample refers to XBRL adopters in cells A1, A2, and B2, while the control sample refers to non-adopters in B1, C1, and C2. The pre-XBRL period refers to the two-year period from June 15, 2007, to June 14, 2009, while the post-XBRL period refers to the two-year period from June 15, 2009, to June 14, 2011.

sample of non-adopters.[27] The insignificant coefficient on *TREAT* (*t*-statistic = 1.04 using *DACMJ* and *t*-statistic = 1.30 using *DACROA*)—that is, α_3 in equation (5)—suggests no meaningful difference in earnings management in XBRL-adopting firms and non-adopting firms in the pre-XBRL period (*POST* = 0). Taken together, these results support our previous inference that the XBRL use reduces earnings management.

Panel B of Table 5 reports the results of estimating equation (6). We find that the coefficient on *POST* × *OFFE* × *TREAT* is negative ($p < 0.01$) in both columns (1) and (2), and the coefficient on *POST* × *EXTE* × *TREAT* is positive ($p < 0.01$) in both columns (1) and (2). These results are consistent with the previous inference that the use of standardized official elements is associated with lower absolute discretionary accruals, while the use of customized extension elements has the opposite effect.

To examine whether and how Phase 1 submissions differ from Phase 2 submissions in terms of the impact of XBRL adoption on absolute discretionary accruals, we examine Phase 1 submissions (cells A1, B1, and C1 in Figure 2) and Phase 2 submissions (cells A2, B2, and C2 in Figure 2) separately. We replace the indicator variable *TREAT* in equations (5) and (6) with firm-fixed effects, and the indicator variable *POST* with *DXBRL*, or *DXBRL_Ph1* (Phase 1) and *DXBRL_Ph2* (Phase 2). As previously discussed, the Phase 1 submission period is June 15, 2009,

27. We reestimate equations (1) and (2) after adding *POST* × *CONTROLS*, where *CONTROLS* represents a set of control variables. Untabulated results with these additional interaction terms are, overall, consistent with the results presented in Table 5.

TABLE 5
DiD analysis

Panel A: Hypothesis 1 test

	(1) Using *DACMJ*			(2) Using *DACROA*		
	Coefficient	*t*-statistic		Coefficient	*t*-statistic	
Constant	0.04226	6.45	***	0.07880	6.43	***
POST	−0.00844	−9.36	***	−0.00806	−9.11	***
TREAT	0.00316	1.04		0.00168	1.30	
POST × *TREAT*	−0.00456	−3.41	***	−0.00430	−3.21	***
Controls		Included			Included	
Industry		Included			Included	
F-value		29.33	***		28.58	***
Adjusted R^2		0.139			0.136	
Observation		11,362			11,362	

Panel B: Hypothesis 2 test

	(1) Using *DACMJ*			(2) Using *DACROA*		
	Coefficient	*t*-statistic		Coefficient	*t*-statistic	
Constant	0.04325	5.65	***	0.07972	5.93	***
POST	−0.00844	−9.37	***	−0.00806	−9.12	***
TREAT	0.00115	0.89		0.00147	1.13	
POST × *TREAT*	0.00149	0.82		0.00182	0.98	
POST × *OFFE* × *TREAT*	−0.00002	−4.92	***	−0.00002	−4.55	***
POST × *EXTE* × *TREAT*	0.00004	3.92	***	0.00004	3.15	***
Controls		Included			Included	
Industry		Included			Included	
F-value		28.74	***		28.03	***
Adjusted R^2		0.140			0.137	
Observation		11,362			11,362	

Notes: POST equals one for the post-XBRL filing period, and zero otherwise. *TREAT* is an indicator variable that equals one for XBRL adopters in each treatment group, and zero otherwise. *Industry* is an industry indicator based on 2-digit SIC codes. All other variables are defined in Table 2. *** indicates significance at the 0.01 level, using a two-tailed *t*-test. Two-sided *p*-values are calculated based on standard errors adjusted for heteroskedasticity (White 1980) and firm clustering (Petersen 2009).

to June 14, 2010, and the Phase 2 submission period is June 15, 2010, to June 14, 2011. Accordingly, for Phase 1 submissions, *DXBRL_Ph1* is coded one for XBRL adopters in cell A1, and zero for non-adopters in B1 and C1. For Phase 2 submissions, *DXBRL_Ph2* is coded one for XBRL adopters in A2 and B2, and zero for non-adopters in C2.

Untabulated results show that the coefficient on *DXBRL* is negative ($p < 0.01$) when *DXBRL* is defined for both Phase 1 and Phase 2 submissions together; when *DXBRL* is defined separately for Phase 1 and Phase 2 submissions, the coefficients on both *DXBRL_Ph1* and *DXBRL_Ph2* are negative ($p < 0.01$). These results suggest that our DiD results are robust to defining *DXBRL* for Phase 1 and Phase 2 submissions combined or for Phase 1 and Phase 2 submissions separately.

The results also show that the coefficient on *OFFE* is negative ($p < 0.01$), while the coefficient on *EXTE* is positive ($p < 0.01$). When *DXBRL* is defined separately for Phase 1 and for Phase 2 submissions, the coefficients on both *OFFE* × *DXBRL_Ph1* and *OFFE* × *DXBRL_Ph2* are

TABLE 6
Impact of XBRL adoption on REM

	(1) Using *APC*			(2) Using *ADE*		
	Coefficient	*t*-statistic		Coefficient	*t*-statistic	
Constant	−0.03668	−0.75		−0.95242	−1.19	
$DXBRL_{t-1}$	−0.00376	−0.31		−0.09822	−1.14	
$DXBRL_t$	−0.03735	−0.32		2.70851	1.03	
$DXBRL_{t+1}$	0.01744	2.63	***	−0.32646	−5.71	***
Controls		Included			Included	
Industry		Included			Included	
F-value		13.19	***		23.22	***
Adjusted R^2		0.2103			0.2916	
N		3,756			3,756	

Notes. Following a recommendation of Roychowdhury (2006), our analyses rely on two *REM* measures: (i) abnormal production costs (*APC*) and (ii) abnormal discretionary expenditures (*ADE*). The Appendix explains in detail how we compute *APC* and *ADE.* As defined earlier, following the spirit of Bertrand and Mullainathan (2003), we include three *DXBRL* variables—that is, $DXBRL_{t-1}$, $DXBRL_t$, and $DXBRL_{t+1}$. *Industry* is an industry indicator based on 2-digit SIC codes. All other control variables are as defined in Table 2. *** indicates significance at the 0.01 level, using a two-tailed *t*-test. Two-sided *p*-values are calculated based on standard errors adjusted for heteroskedasticity (White 1980) and firm clustering (Petersen 2009).

negative ($p < 0.01$). The coefficient on $EXTE \times DXBRL\_Ph1$ is insignificant for Phase 1 submissions, while the coefficient on $EXTE \times DXBRL\_Ph2$ is significantly positive ($p < 0.01$) for Phase 2 submissions.

REM after XBRL adoption

Prior research suggests managers sometimes use REM as a substitute for AEM.[28] Drawing on prior research (e.g., Cohen et al. 2008; Zang 2012), we conjecture that XBRL adoption increases the cost of AEM, leading to a decrease in AEM and an increase in REM in the post-XBRL period. To test this conjecture, we estimate the following regression:

$$REM_t = \alpha_1 + \alpha_2 DXBRL_{t-1} + \alpha_3 DXBRL_t + \alpha_4 DXBRL_{t+1} + \alpha_5 \sum Controls + \alpha_6 \sum Industry + \varepsilon_t, \quad (7)$$

where *REM* refers to proxies for real earnings management, and the other variables are as defined above. Following Roychowdhury (2006), we calculate two REM measures: abnormal production costs (*APC*) and abnormal discretionary expenditures (*ADE*). The Appendix explains how we compute *APC* and *ADE.* In equation (7), we use the same control variables used in Roychowdhury (2006)—that is, firm size, market-to-book ratio, and ROA; we include *BEAR* to control for the potential impact of stock market conditions on REM.

As shown in Table 6, the coefficients of $DXBRL_{t-1}$ and $DXBRL_t$ are insignificant, with *t*-statistic = −0.31 and −0.32 in column (1) and *t*-statistic = −1.14 and 1.03 in column (2), suggesting that the XBRL mandate is not associated with *REM* in the pre-XBRL period (quarter $t-1$) and the initial adoption period (quarter *t*). We also find that the coefficient of $DXBRL_{t+1}$ is

28. For example, Cohen et al. (2008) show that firms engaged less in AEM after the passage of SOX. Zang (2012) shows that managers substitute REM for AEM when firms face an increase in potential legal liability costs. The above findings, taken together, suggest that, in general, REM increases.

positive ($p < 0.01$) in column (1), where abnormal production cost (*APC*) is the dependent variable, and is negative ($p < 0.01$) in column (2), where discretionary expenditure (*ADE*) is the dependent variable. These results suggest that in the quarter after XBRL adoption (quarter $t + 1$), managers increase production to decrease the cost of goods sold (by increasing the ending inventory) and thereby increase reported earnings; they also reduce discretionary spending such as R&D, advertising, and selling and general administration expenses to increase reported earnings. We believe that these results are in line with the view that in the quarter after initial XBRL adoption, managers substitute *REM* for *AEM*.

Analysis using samples with strong earnings management incentives

We perform additional tests using a subsample of firms with strong incentives for earnings management. For this purpose, we first identify 243 firm-quarter (i.e., 118 in the pre-XBRL period versus 125 in the post-XBRL period) observations with net income before extraordinary items deflated by total assets within the range (0–0.005). This sample of 243 firms is more likely to have managed earnings upward to avoid reporting a loss (e.g., Roychowdhury 2006). Our second reduced sample contains 386 firms (i.e., 205 in the pre-XBRL period versus 181 in the post-XBRL period) that just met or beat analysts' most recent consensus forecasts prior to the earnings announcement date, to avoid reporting earnings that fall short of expectations (Brown and Caylor 2005). We define the forecast error as the difference between actual EPS as reported by I/B/E/S less consensus EPS forecast from I/B/E/S. Our sample includes firms with forecast errors of 1 cent per share or less.

We investigate whether *DACMJ* and *DACROA* decrease from the pre- to the post-XBRL periods for the two subsamples of firms that just avoided losses and firms that just met or beat analyst forecasts. We find that for all four cases, our measures of earnings management decreased from the pre- to the post-XBRL period, with untabulated results significant at the 1 percent level. These results are in line with those reported in Table 3 and buttress our earlier finding that mandatory XBRL adoption discourages corporate managers from engaging in earnings management.[29]

10-Q versus 10-K filings

To provide insight into whether our results are sensitive to 10-Q or 10-K filings, we reestimate equations (1) and (2), separately, for 10-Q and 10-K submissions (results not tabulated). We find the XBRL effect on earnings management is negative but insignificant at the 1 percent level for 10-Q filings, and negative and significant ($p < 0.01$) for 10-K filings. These results may be partly due to the fact that 10-K filings contain more information than 10-Q filings.

When we reestimate equation (2), we find that the coefficient of *OFFE* is negative for both 10-Q filings ($p < 0.05$) and 10-K filings ($p < 0.01$), and the coefficient of *EXTE* is positive ($p < 0.05$) only for 10-K filings. This result holds for both measures of earnings management.

Alternative time periods

To control for the potential confounding effect of the 2008 financial crisis, we change the benchmark (comparison) period. First, we choose the (two-year) pre-XBRL period from a period that does not overlap with 2008 (i.e., we choose eight quarters in the pre-XBRL and pre-crisis period

29. Evidence shows that firms tend to manage earnings prior to initial public offerings (IPOs) or seasoned equity offerings (SEOs). Once the post-XBRL period becomes long enough, one can also examine whether and how the impact of XBRL adoption on the extent of earnings management differs systematically between firms with heightened incentives for earnings management (e.g., IPOs or SEOs firms) and firms without them, and whether and how this difference changes over time from pre-IPOs (or pre-SEOs) to post-IPOs (or post-SEOs). In the future, reexamining our regression results using a sample of firms with heightened incentives for earnings management would certainly help to strengthen our findings. We thank an anonymous reviewer who brought the point to our attention.

of 2005–2007 for both Phase 1 and 2 samples).[30] Untabulated results are in line with our earlier finding that XBRL adoption is associated with less AEM in the post-XBRL period, and the use of standardized elements has a stronger effect than the use of customized extension elements. Second, we also reestimate equation (5) using the one-year pre-XBRL period (June 15, 2008, to June 14, 2009).[31] Untabulated results show that the coefficient on $POST \times TREAT$ is negative ($p < 0.05$) for both earnings management proxies.

Alternative measures of test variables

As a sensitivity check, we reestimate equations (2) and (4) using demeaned measures of *OFFE* and *EXTE*, defined as the differences between the values and two-digit industry means (results not tabulated). When we reestimate the regression in equation (2), results are similar to those in panel B of Table 3: the coefficients on *OFFE* (*EXTE*) have negative (positive) signs for both measures of earnings management with weaker significance levels.[32] When we reestimate regressions in equation (4), the signs and significance levels for the coefficients on $DXBRL_{t-1,}$ $DXBRL_{t,}$ and $DXBRL_{t+1}$ and on the interactions of $DXBRL_{t,}$ and $DXBRL_{t+1}$ with the demeaned *OFFE* and *EXTE* remain qualitatively similar to those reported in panel B of Table 5.

Alternative measures of dependent variables

To alleviate the concern that measures of absolute discretionary accruals are affected by the accrual reversal phenomenon, following Hutton et al. (2009), we measure absolute discretionary accruals in period *t* as a three-period rolling sum of past discretionary accruals and reestimate equations (1) and (2). Untabulated results reveal that our inferences are not affected.

5. Conclusion

This study investigates whether the mandatory use of XBRL in financial reports is associated with a lower magnitude of discretionary accruals, our measure of earnings management. We find that the magnitude of discretionary accruals decreases from the pre- to the post-XBRL period, with a greater decrease when a firm's XBRL reporting relies more on standardized elements. We also provide evidence that the use of customized XBRL extensions, the taxonomies of which are not governed by the SEC or the FASB, is associated with an increase in absolute discretionary accruals.

Our results suggest that the sufficiency and completeness of XBRL taxonomies governed by the SEC should continue to be a concern for both early XBRL adopters and users of interactive data. In particular, our results suggest that the major benefits from mandatory XBRL adoption arise from the improved comparability that we believe is afforded by standardized official elements. In contrast, the use of customized extension elements may make financial data less comparable and thus costlier to process, thereby impeding one of the policy objectives of mandatory XBRL adoption.

30. This alternative matching process yields 2,902 firm-quarter filings (1,451 in the pre-XBRL period versus 1,451 in the post-XBRL period). Using this new control sample of matched non-adopters, we reestimate equations (1) and (2).

31. We thank an anonymous reviewer for this suggestion. In assessing the one-year pre-XBRL period (June 15, 2008, to June 14, 2009) as an alternative window, we lose 17 observations in the control sample of non-adopting firms because there are no matched non-adopters available. Thus, we use 653 filings (335 XBRL filings versus 318 non-XBRL filings) in the post-XBRL period. After obtaining 653 filings in the pre-XBRL period, we have a total of 1,306 observations.

32. The coefficients of *OFFE* and *EXTE* are not significant (*t*-statistic = −0.91 and 0.79 using *DACMJ,* and *t*-statistic = −1.34 and 1.00 using *DACROA*) when we run the models used for panel B of Table 3. When we run the multiperiod models used for panel B of Table 4, the coefficients of $OFFE \times DXBRL_t$ and $EXTE \times DXBRL_t$ are not significant. However, the coefficients of $OFFE \times DXBRL_{t+1}$ and $EXTE \times DXBRL_{t+1}$ using *DACMJ* are significant (*t*-statistic = −2.38 and 1.75, respectively). Using *DACROA*, the coefficient of $OFFE \times DXBRL_{t+1}$ is significant (*t*-statistic = −2.33) but the coefficient of $EXTE \times DXBRL_{t+1}$ is not significant (*t*-statistic = 1.35).

Appendix

Measurement of AEM

We measure earnings management using two alternative approaches: (i) the magnitude of absolute discretionary accruals estimated by the modified Jones model, as proposed by Dechow et al. (1995), denoted *DACMJ*, and (ii) the magnitude of absolute discretionary accruals estimated by the ROA-matched approach of Kothari et al. (2005), denoted *DACROA*.

In estimating *DACMJ* and *DACROA*, we deflate the unadjusted accounting amounts by total assets at the end of the previous quarter. For each 2-digit SIC industry and quarter with at least 10 observations, we estimate the cross-sectional version of the modified Jones model; that is,

$$TAC_{jt}/TA_{jt-1} = \alpha_1\left[1/TA_{jt-1}\right] + \alpha_2\left[\left(\Delta REV_{jt} - \Delta REC_{jt}\right)/TA_{jt-1}\right] + \alpha_3\left[PPE_{jt}/TA_{jt-1}\right] + \varepsilon_{jt-1}, \qquad (8)$$

where, for firm j and quarter t (or $t-1$), *TAC* denotes total accruals (income before extraordinary items minus cash flow from operations); *TA*, ΔREV, and *PPE* represent total assets, changes in net sales, and gross property, plant, and equipment, respectively; and ε is the error term. Our first measure of earnings management, denoted *DACMJ,* is the absolute value of the difference between actual total accruals deflated by lagged total assets and the fitted values of the above-modified Jones model.

Second, we estimate discretionary accruals using the performance-matched approach suggested by Kothari et al. (2005). We obtain the fitted values by estimating the model of Kothari et al. (2005), which adds lagged ROA to the modified Jones model in equation (8). We compute performance-adjusted abnormal accruals, *DACROA*, by taking the absolute value of the difference between actual total accruals deflated by lagged total assets and fitted values estimated Kothari et al.'s (2005) model.

Measurement of REM

Following Roychowdhury (2006), we estimate two *REM* measures: (i) abnormal production costs (*APC*) and (ii) abnormal discretionary expenditures (*ADE*). We separate *APC* and *ADE* from normal production costs and normal discretionary expenditures by estimating equations (9) and (10), respectively:

$$\frac{Prod_t}{A_{t-1}} = \alpha_0\frac{1}{A_{t-1}} + \alpha_1\frac{S_t}{A_{t-1}} + \alpha_2\frac{\Delta S_t}{A_{t-1}} + \alpha_3\frac{\Delta S_{t-1}}{A_{t-1}} + \varepsilon_t, \qquad (9)$$

$$\frac{DisExp_t}{A_{t-1}} = \alpha_0\frac{1}{A_{t-1}} + \alpha_1\frac{S_{t-1}}{A_{t-1}} + \varepsilon_t, \qquad (10)$$

where, for each sample year t, $Prod_t$ is the sum of $COGS_t$ and the change in inventory, and S_t and ΔS_t refer to sales dollars and their changes, respectively. The predicted value of equation (9) is viewed as normal production costs, while the residuals from equation (9) are considered abnormal production costs. In equation (10), $DisExp_t$ is discretionary expenses, including advertising and selling, general, and administrative expenses. The predicted value of and residuals from equation (10) are viewed as normal discretionary expenditures and abnormal discretionary expenditures (*ADE*), respectively.

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