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Information Processing Costs and Corporate Tax Avoidance:

Evidence from the SEC's XBRL Mandate

Abstract

The IRS uses information contained in financial statements as well as tax returns to detect tax avoidance behavior. We examine the impact on corporate tax avoidance behavior of reductions in the IRS's information processing costs resulting from the mandatory adoption of XBRL for financial reporting. Motivated by the recent debate in the U.S. Congress over the cost-benefit of mandatory XBRL reporting for small firms, we pay particular attention to small firms, which inherently have relatively high information frictions. We find that adoption of XBRL for financial reporting results in a significant decrease in tax avoidance. However, the negative relationship between XBRL reporting and tax avoidance is less prominent for firms subject to more intense IRS monitoring in the pre-XBRL-reporting period. Overall, our results suggest that XBRL reporting reduces the cost of IRS monitoring in terms of information processing, which dampens managerial incentives to engage in tax avoidance behavior.

Keywords: XBRL reporting; tax avoidance; information processing costs; IRS monitoring; tax audit risk; tax accrual

1. Introduction

The U.S. Securities and Exchange Commission (SEC) has mandated all small-cap firms to file their 10-K and 10-Q reports in an interactive format using the eXtensible Business Reporting Language (XBRL) starting on June 15, 2011.[1] XBRL reporting lowers information processing costs by making financial statements machine readable and assists external users of financial statements in accessing, extracting, comparing, and screening financial information in a more accurate and efficient manner (Dong et al., 2016; Kim, Li, and Liu, 2019).[2] The mandatory adoption of XBRL reporting offers a unique opportunity to study the role of (unobservable) information processing costs in external monitoring, while holding the content of financial reporting constant.

Our main research question is whether the XBRL-induced reduction in information processing costs to the Internal Revenue Service (IRS) affects managerial decisions to engage in tax avoidance activities. Managers strive to invest in strategies that lower corporate taxes in order to increase value for shareholders (Mills, 1996; Mills et al., 1998; Rego and Wilson, 2012). However, non-tax costs, including information costs, agency costs, pricing discounts, reputational costs, and penalties if detected that are related to excessive tax avoidance strategies are substantial (Graham et al., 2014; Hasan et al., 2014). Several studies find that such costs may outweigh the benefits of tax savings for firms with high informational opacity (Chen et al., 2010; McGuire et al., 2013). As direct evidence of reputational costs, Graham et al. (2014) report that 69 percent of

[1] XBRL is an interactive data electronic application system in which a standardized format is used for preparing and communicating financial information. In the system financial data are tagged based on standard definitions. These standardized tags contain descriptive labels, definitions, and authoritative references to U.S. GAAP and SEC regulations. The SEC's ultimate objective is to use XBRL for all EDGAR filings (https://www.sec.gov/rules/final/2009/33-9002.pdf).

[2] For example, the SEC (2009, p. 128) states: "*Requiring companies to report interactive data should lower both the time and expense for investors to access this data. Since company financial data will be tagged and immediately downloadable into a larger, more comprehensive database that includes other filers, there will be no need for manual key entry of the data, eliminating this expense*."

surveyed corporate tax executives rate reputation as important in explaining why firms would not engage in a potential tax planning strategy. We conjecture that mandatory XBRL adoption reduces the information processing costs relating to financial statements, enhances the probability of the IRS detecting tax avoidance behavior, and thus, increases the cost of tax avoidance activities to firms.

The use of XBRL tags applies to a range of tax-related information contained in financial statements, including tax accruals, complex and technical tax notes, the reconciliation of the effective income tax rate to the federal statutory income tax rate, the deferred tax asset (DTA) or liability, the valuation allowance of the DTA, as well as income tax benefits from share-based compensation. XBRL reporting facilitates the IRS's access to such tax-related information and improves efficient comparison of a firm's tax liabilities against relevant benchmarks. Financial statements in XBRL format will reveal any abnormally high deviations in a firm's reported performance (e.g., book income or taxable income) from benchmark figures (e.g., the industry average or historical trends) to the IRS in a more accurate, timelier, and less costly manner than before the adoption of XBRL reporting.[3] As a result, XBRL reporting makes it easier for the IRS to detect excessive tax avoidance and penalize tax evaders. The increased costs associated with a higher detection risk reduce the incentive for managers to engage in tax avoidance activities. Consistent with this view, the IRS Research Bulletin (2008, p. 33) points out that "*…the eventual adoption of XBRL in SEC financial reporting will further allow efficient comparisons between financial and tax return information. The triangulation of data can greatly enhance the ability of*

[3] Specifically, Terry Lutes (Associate CIO at the IRS) and Eric Cohen (XBRL Technical Leader at PWC) suggest that XBRL enables automation of the reconciliation of book and tax difference and facilitates the tracking of permanent and timing differences between book and tax profit by means of its special tax functionalities (e.g., the XBRL Global Ledger framework incorporates FAS 109 and IAS 12):
http://www.xbrl.org/glkeyfeatures/gl_webseminar_lutescohen_051215.pdf

agents to properly and holistically analyze the economic enterprise, part of which is included on the U.S. tax return."

In our study, we focus on a sample of small-cap firms with a public float of less than $700 million and adopt a difference-in-differences (DiD) research design. Our identification strategy requires us to construct a control group over the sample period covering both the pre-XBRL-adoption and post-XBRL-adoption periods. We track sample firms' tax avoidance behavior over the five-year period 2009–2013, which includes the pre-adoption years of 2009–2010, the adoption year of 2011, and the post-adoption years of 2012–2013.

We focus on small-cap firms for the following reasons.[4] First, small-cap firms have more severe information opacity and users of their financial statements face higher information processing costs compared to large-cap firms and medium-cap firms. Small-cap firms also have strong incentives for tax avoidance (Zimmerman, 1983; Omer et al., 1993).[5] Thus, if information processing costs play a role in determining the effectiveness of IRS monitoring, we are likely to detect a stronger effect of the XBRL-induced reduction in information processing costs on tax avoidance for small-cap firms than for large-cap or medium-cap firms.

Second, based on large-cap firms that were part of the first phase of the introduction of XBRL reporting, Blankespoor et al. (2014) find evidence of higher abnormal bid-ask spreads around the dates of 10-K filings in the year after the mandate than prior years. Their results suggest that the intended benefit from XBRL reporting in terms of levelling the informational playing field

[4] In untabulated analyses, we investigated whether mandatory XBRL adoption influences corporate tax policies for large-cap and mid-cap firms. We find that the relationship between XBRL adoption and corporate tax avoidance is not statistically significant for these firms, supporting the view that large firms have rich information environments and thus the benefit of XBRL reporting to the IRS could be marginal relative to small-cap firms. These results are available upon request. For details on the SEC's three phased-in implementations of XBRL, refer to Kim et al. (2019).
[5] Zimmerman (1983) argues that small firms are less subject to government scrutiny and wealth transfers than large firms, and thus engage in more tax avoidance activities. However, Rego (2003) finds that large, multinational firms have lower worldwide ETRs than other firms, suggesting that the economies of scale can also influence firms' ability to reduce tax burden through strategic tax planning.

is not immediately observable after mandatory adoption for Phase 1 firms. Anecdotal evidence also suggests that in the initial years after mandatory adoption, firms make various mistakes in XBRL reporting and it takes time for both managers and external users to become familiar with and take advantage of XBRL reporting. Our focus on small-cap (Phase 3) firms allows sufficient time for these firms to learn from the earlier adoption of XBRL by their Phase 1 and Phase 2 counterparts in the same industry and offer necessary training to their accounting personnel.

Finally, there has been controversy from a policy perspective about whether small-cap firms should adopt XBRL for financial reporting. In 2014, the House Financial Service Committee overwhelmingly supported the bipartisan *Small Company Disclosure Simplification Act* that would exempt small public firms with less than $250 million in annual revenue (roughly 60% of U.S. public firms) from the XBRL requirement for five years. The bill died in that session of Congress but was reintroduced in 2015. The House of Representatives passed the bill in February 2016 but the White House responded immediately by issuing a veto threat.[6] Proponents of this bill believe that this is an example of a regulation where the costs of compliance outweigh the potential benefits for small, innovative firms. Opponents of the bill argue that small public firms have been filing in XBRL format for several years (since 2011), and so are in an advanced position on the learning curve, and that the bill could result in small firms losing equal access to the capital markets. Although we do not intend to resolve the policy debate by directly testing the cost-benefit trade-off for small-cap firms, our results shed light on a real consequence of XBRL reporting as reflected in their tax planning strategies.

We adopt three common measures of tax avoidance and a composite measure (*BTD_Factor*) that combines the three: (i) total book-tax differences (*BTD*); (ii) Desai-Dharmapala residual book-

[6] See https://obamawhitehouse.archives.gov/sites/default/files/omb/legislative/sap/114/saphr1675r_20160202.pdf for details.

tax differences (*DD_BTD*); and (iii) effective tax rate differentials (*ETR_Differential*) (Desai and Dharmapala, 2006; Frank et al., 2009). The results of our regression analyses with and without a control group are consistent with our prediction that XBRL reporting leads to a decrease in tax avoidance. The decrease is economically significant as we observe declines in *BTD, DD_BTD,* and *ETR_Differential* of 17.03%, 17.03%, and 20.78%, respectively, relative to their averages in the pre-XBRL period. Furthermore, we find that these results are weaker for firms that are subject to more intensive IRS monitoring before the XBRL mandate. Such firms are likely to have less incentive to engage in tax avoidance activities before the XBRL mandate; thus, the impact of XBRL reporting on their tax avoidance is limited. The cross-sectional results reinforce the notion that IRS monitoring is a viable mechanism through which XBRL reporting influences firms' tax avoidance behavior.

An implicit assumption in our study is that financial statements are an important source of information that the IRS uses to detect tax avoidance behavior. To check the validity of this assumption, we explore whether the adoption of XBRL for financial reporting affects how the IRS processes firms' 10-K information. Using Bozanic et al.'s (2017) data, we find a statistically and economically significant increase in IRS downloads of sample firms' 10-Ks from EDGAR in the post-XBRL period. This result suggests that XBRL reporting is likely to facilitate a broader and more structured approach to identifying firms that engage in tax avoidance activities by the IRS, leading to greater reliance on financial statement information for this purpose.

Our study contributes to the literature in two ways. First, we provide evidence suggesting that the IRS's information processing costs influence firms' tax avoidance activities. Compelling evidence on this link is scarce for the following three reasons. First, information processing costs are unobservable and difficult to measure. Second, because the level of information processing

costs and the extent of tax avoidance are both subject to managerial actions, their relationship could suffer from potential endogeneity. The observed association between the two may be spurious and influenced by unobservable firm characteristics such as growth opportunities, agency problems, and other risk-related factors. Finally, managers can intentionally increase the IRS's information processing costs by increasing financial obfuscation or reporting opacity in an effort to lower detection risk and/or to reduce the penalties associated with tax avoidance when detected. As such, the relationship between information processing costs and tax avoidance is subject to reverse causality. In our study, we attempt to mitigate these concerns by taking advantage of the SEC's XBRL mandate to study the impact of a shock to the IRS's information processing costs on corporate tax avoidance.

Second, our study extends the literature on the economic consequences of XBRL reporting. Whereas prior studies primarily focus on the stock market consequences of XBRL reporting, we examine its relationship with corporate tax behavior. If XBRL reporting reduces information processing costs and facilitates IRS monitoring, the cost of tax avoidance will increase due to higher detection risk, which in turn curbs managerial incentives to engage in such behavior. Our results point to an economic consequence of XBRL reporting in terms of real corporate decisions that has not yet drawn sufficient attention from the lawmakers who actively debated its cost-benefit trade-off for small firms.

2. Literature review and hypotheses development

2.1. Recent research on the economic consequences of mandatory XBRL adoption

Following the SEC's XBRL mandate, a growing body of research has investigated the economic consequences of financial reporting in XBRL format. Li et al. (2012) find that XBRL reporting leads to a decrease in the cost of equity capital, an increase in analyst coverage, a

decrease in analyst forecast error and dispersion, and an increase in market liquidity. A follow-up study by Liu et al. (2014) finds that the association between XBRL reporting and analyst forecast quality is stronger in the second year after introduction than in the first year for large-cap firms. This result implies that it takes time for the benefit of XBRL reporting to materialize because there is a steep learning curve for both preparers and users of financial statements to become familiar with this new information dissemination technology.

Dong et al. (2016) find that XBRL reporting facilitates the incorporation of firm-specific information into stock prices and lowers stock price co-movement. Kim, Li, and Liu (2019) document evidence that the investor base or breadth of share ownership increases in the post-XBRL-adoption period, and that these effects are stronger for firms with higher information processing costs. In contrast to these studies, Blankespoor et al. (2014) examine the market reaction to Phase 1 adopters in the initial year of XBRL reporting and, surprisingly, they find higher abnormal bid–ask spreads, lower abnormal liquidity, and lower abnormal trading volumes.

Whereas early studies primarily focus on stock market reactions to XBRL reporting, recent research has paid more attention to the implications for corporate behavior. For example, Kim, Kim, and Lim (2019) show that the XBRL mandate leads to a significant reduction in earnings management, suggesting that the reduction in information processing costs constrains managerial opportunism in financial reporting. Zhang et al. (2019) find that XBRL reporting reduces information opacity and bad news hoarding, thereby reducing the expected stock price crash risk perceived by options market participants. Finally, Blankespoor (2019) provides evidence that firms increase the use of quantitative footnote disclosures upon implementation of XBRL reporting. Our study extends this line of research by examining whether the XBRL-induced reduction in information processing costs is significant enough to influence corporate tax avoidance behavior.

2.2. Recent research on determinants of corporate tax avoidance

As reflected in an increasing trend in the size of book-tax differences (BTDs), corporate tax avoidance has become an important aspect of U.S. corporate policies in the last several decades (Desai, 2003; Graham, 2003; Boynton et al., 2005). A large body of tax research has investigated determinants of tax avoidance. For example, Gupta and Newberry (1997) find that a firm's capital structure, asset mix, and financial performance play meaningful roles in explaining effective tax rates. Rego (2003) documents evidence that multinational firms with more extensive foreign operations have greater incentives and resources to engage in tax avoidance activities. Lisowsky (2010) shows that BTD and contingent tax liabilities are associated with the usage of tax shelters, and in turn are shaped by firm characteristics such as foreign-source income, litigation losses, profitability, size, and leverage.[7]

Several studies focus on the role of IRS monitoring in corporate tax avoidance. Mills (1998) documents that larger BTD creates red flags for the IRS and weakens the firm's position in a tax audit. Hoopes et al. (2012) show that when tax enforcement is stricter, firms adopt less aggressive tax positions, suggesting that IRS audits are effective in deterring tax avoidance. Kubick et al. (2017) find that whereas the IRS is more likely to audit firms based nearby, on average those firms avoid more tax (possibly due to their proximity-induced information advantage over the IRS) unless they are close to an IRS industry specialist. Bozanic et al. (2017) provide direct evidence that, in addition to private tax filings, the IRS uses information in public financial disclosures in the enforcement process. Their results, based on FIN 48 disclosures pertaining to uncertain tax positions, indicate that changes in SEC disclosure requirements have a meaningful impact on the IRS's behavior with regard to public information acquisition. Extending

[7] Hanlon and Heitzman (2010) and Wilde and Wilson (2018) provide excellent reviews of the research on corporate tax avoidance.

this line of research, we examine whether the reduction in information processing costs for public financial disclosures, attributable to the SEC's XBRL mandate, affects IRS monitoring and corporate tax avoidance.

2.3. Hypothesis development

2.3.1. The impact of XBRL reporting on corporate tax avoidance

Public financial disclosures provide additional data for the IRS to use in the enforcement process and to supplement private information it obtains from firms' tax filings. However, the IRS enforcement process is subject to cost constraints. To the extent that the IRS seeks public information from firms' financial reports to corroborate its private information (Bozanic et al., 2017), information processing costs are likely to be a factor that influences the IRS's use of such information.

Several experimental studies find that the use of search-facilitating technology such as XBRL can improve the ability of financial statement users to process related financial information (Hirst and Hopkins, 1998; Hodge et al., 2004). Their results suggest that, by facilitating consistency in the format of data across firms, XBRL reporting not only makes financial data more comparable and timelier but also enables abnormally high deviations from benchmarks (e.g., the industry average or historical trends) in a firm's reported performance to be revealed to the public more efficiently. Consequently, we conjecture that IRS examiners are better able to monitor tax-related activities and identify audit issues in the post-XBRL information environment.

The XBRL mandate is not intended to provide new information beyond what has been reported in traditional financial statements. Rather, it is intended to create a more user-friendly, less costly search-facilitating information environment (SEC, 2009). With XBRL reporting, most items of a quantitative nature disclosed in financial statements are tagged in accordance with

standard taxonomies common to all firms. This not only facilitates the IRS's access to public tax information (contained in financial disclosures) in a more efficient and effective manner, but also enhances its ability to compare and track firms' tax strategies against relevant benchmarks. The IRS provides its staff with specific guidance to identify potential tax issues for firms with abnormal book-tax differences (Cloyd et al., 1996). Using proprietary tax return data, Mills and Sansing (2000) confirm that firms with larger book-tax differences are subject to higher audit risk. XBRL reporting facilitates comparison of firms' taxable income and book income and this phenomenon is likely to be stronger for small firms with greater informational frictions.

If tax avoidance is deemed by the IRS to be noncompliance, it may be disallowed, and the firm may face scrutiny that is more stringent in the future. Furthermore, IRS challenges may impose significant back taxes and substantial related fines, penalties, and interest, representing a significant cash flow risk for the firm. The mandatory adoption of XBRL for financial reporting reduces the IRS's information processing costs and enhances its tax monitoring. As such, facing a higher potential tax audit risk, managers may curb their tax avoidance behavior after the XBRL mandate. Based on the above discussion, we expect a negative relationship between XBRL reporting and tax avoidance. To provide systematic evidence on this unexplored issue, we test the following hypothesis, stated in alternative form:

H1: *Corporate tax avoidance decreases after the adoption of XBRL for financial reporting, all else being equal.*

The above hypothesis builds on the assumption that financial statements offer an important source of information that IRS examiners use to detect tax avoidance behavior. However, it is possible that under certain circumstances the IRS will place more weight on *private* tax disclosures

than on public financial statements to assess tax compliance.[8] If financial statements, as a major source of public information about firm performance, do not play a significant role in the IRS's tax monitoring activities, the reporting format of financial statements (i.e., the introduction of XBRL) should also be irrelevant.

2.3.2. The impact of XBRL reporting on tax avoidance conditional on pre-XBRL tax audit risk

In developing H1, we argue that the XBRL mandate reduces the cost to the IRS of acquiring and processing public tax-related information contained in financial reports, resulting in more effective monitoring. If H1 is descriptive and IRS monitoring is indeed a channel through which information processing costs affect firms' tax avoidance behavior, we expect that the effect of XBRL adoption on tax avoidance should vary with the intensity of IRS oversight before the mandate. To the extent that firms already attract intense IRS scrutiny before XBRL reporting, information asymmetry between firms and the IRS is low and firms may have taken account of IRS monitoring in selecting their tax avoidance level. Where intense IRS scrutiny is already in place, firms will be familiar with the agency's enforcement practices and their tax avoidance strategies are likely to reflect their understanding of high tax audit risk. Thus, the marginal effect

[8] For example, the IRS introduced Schedule UTP (to Form 1120) in 2010, which required firms to privately disclose to the IRS the uncertain tax positions that underlie their contingent tax liability. Bozanic et al. (2017) find that the IRS's acquisition of public financial statements decreased following Schedule UTP. They also show that subsequent to Schedule UTP, firms significantly increased the quantity and altered the content of their public tax-related disclosures. Because the introduction of Schedule UTP and the adoption of XBRL for financial reporting occurred at around the same time, it is possible that our results are driven by the change in IRS private disclosure requirements. As a sensitivity test, we attempt to isolate this effect by controlling for whether the firm filed Schedule UTP to the IRS in our regression analyses. The IRS has gradually reduced the asset threshold for the requirement to report uncertain tax positions on Schedule UTP: $100 million for tax years 2010 and 2011; $50 million for tax years 2012 and 2013; and $10 million after 2014. We include in our regression models a dummy variable that equals one if the firm satisfies the asset threshold for filing Schedule UTP and zero otherwise. Our results concerning the relationship between XBRL adoption and tax avoidance remain qualitatively unchanged.

of XBRL adoption for financial reporting on tax avoidance should be less prominent for firms subject to closer IRS monitoring before the adoption.

We use the level of risk of IRS audit that firms face before the XBRL mandate to capture the intensity of IRS scrutiny. Hoopes et al. (2012) find that firms subject to higher tax audit risk engage in less tax avoidance. They measure the risk of tax audit as the proportion of corporate tax return audits completed in the IRS's fiscal year *t* for an IRS asset size group to all corporate tax returns received in the previous year for the same IRS asset size group. Hoopes et al.'s (2012) results suggest that from the perspective of managers, stricter tax monitoring accompanied by a higher likelihood of IRS tax audits reduces managers' incentives to engage in tax avoidance behavior. From the IRS's perspective, intense tax monitoring reduces the information gap between the firm and the agency. Thus, if intense IRS monitoring is already in place, the adoption of XBRL for financial reporting is expected to be less likely to change corporate tax avoidance behavior. The above discussion leads to our second hypothesis, stated below in alternative form:

> **H2:** *The relationship between corporate tax avoidance and the adoption of XBRL for financial reporting is less pronounced for firms that were subject to higher tax audit risk before the XBRL mandate, all else being equal.*

3. Data and research design

3.1. Sample and data sources

To construct our sample, we extract all XBRL filings submitted to the SEC from the EDGAR database of Interactive Data Filings and Really Simple Syndication feed files. We obtain financial statement data from COMPUSTAT. As mentioned in Section 1, the SEC introduced XBRL for financial reporting in three phases. This phased approach took place over a three-year implementation period, whereby large-cap firms with a public float greater than $5 billion (Phase 1 firms), medium-cap firms with a public float between $700 million and $5 billion (Phase 2 firms),

and small-cap firms with a public float less than $700 million (Phase 3 firms) were required to adopt XBRL for financial reporting for periods ending on or after June 15, 2009, 2010, and 2011, respectively. In our study, we focus only on Phase 3, small-cap firms. Our sample covers the five-year period from 2009 to 2013, and so includes two years before and two years after the mandatory XBRL adoption, in addition to the adoption year of 2011. Our choice of a relatively short sample period around 2011 allows us to isolate the effects of XBRL adoption with minimal likelihood of contamination by other confounding events.

We exclude financial institutions (SIC codes 6000–6999) from our sample because they are subject to different tax and financial reporting incentives, rules, and regulations. We further exclude observations for which we do not have sufficient data to compute our tax avoidance measures and a set of control variables in our main regression model (Eq. (1)). We winsorize at the top and bottom 3% of all continuous variables used in our main regression model (as specified in Eq. (1)) to mitigate the influence of outliers. The above selection criteria yield a final sample of 6,432 firm-year observations representing 1,705 unique Phase 3 firms. Panel A of Table 1 reports the distribution of observations across the Fama-French 48 industries (based on 4-digit SIC codes). Our sample spans a wide range of industries; the most represented is the Business Service industry (14.80%), followed by the Pharmaceutical Products industry (11.58%). Panel B reports the yearly distribution of our sample, which ranges from 1,210 observations in 2009 to 1,386 observations in 2011.

3.2. Measuring tax avoidance

To test our hypotheses we use three individual measures of tax avoidance and one composite measure combining the three. The first measure is total book-tax differences (*BTD*). *BTD* measures the total difference between pre-tax book income and estimated taxable income,

scaled by lagged total assets.[9] The measure is widely used in the prior literature as an indicator of tax avoidance behavior. Prior research suggests that firms with larger *BTD* are more likely to receive an IRS audit, are subject to larger adjustments in consequence of tax audits, and are positively associated with the incidence of tax sheltering (Mills, 1998; Wilson, 2009).

The second measure is the residual book-tax differences measure proposed by Desai and Dharmpala (2006) (*DD_BTD*). *DD_BTD* is the residual value from a regression of total book-tax differences scaled by lagged total assets (*BTD*) on total accruals scaled by lagged total assets after controlling for firm fixed effects. Using the residual value allows us to isolate the component of the book-tax differences that is unrelated to accruals. In other words, *DD_BTD* purges, at least partially, the book-tax differences caused by earnings management activities.

The third measure is the effective tax rate differential (*ETR_Differential*). This measures the difference between total book-tax differences and temporary book-tax differences, scaled by lagged total assets, and thus is likely to capture permanent book-tax differences. Relying on permanent, rather than total, book-tax differences is perhaps more consistent with anecdotal evidence concerning the nature of tax-sheltering activity (Frank et al., 2009).

Finally, to mitigate noise and potential bias associated with any individual proxy, we employ a factor analysis to extract the common factor from the above three individual measures (*BTD_Factor*). Prior studies have developed several proxies for tax avoidance but each proxy captures distinct but overlapping aspects of tax avoidance behavior (Hanlon and Heitzman, 2010). Chen et al. (2010) and Kim et al. (2011) suggest that the common factor extracted from a factor analysis provides a concise measure that captures a firm's tax reporting behavior. Following Kim et al. (2011), we use factor analysis to extract *BTD_Factor* from *BTD*, *ETR_Differential*, and

[9] For ease of reference, we provide the detailed definitions of all variables in Appendix A.

DD_BTD. *BTD_Factor* is estimated using the varimax orthogonal rotation. Eigenvalues for the first and second principal components are 2.04 and 0.15, respectively. Thus, our choice of the first factor as *BTD_Factor* is supported by the Kaiser criterion, which is to exclude all components with eigenvalues less than 1. Rotated factor loadings on *BTD*, *ETR_Differential*, and *DD_BTD* are 0.7825, 0.3932, and 0.8362, respectively.

3.3. Model specification

Hypothesis H1 predicts that tax avoidance decreases after the mandatory adoption of XBRL for financial reporting. We test this hypothesis using the following regression model:

$$Tax\_Avoidance_t = \alpha_0 + \alpha_1 XBRL\_Adoption_t + \sum_{q=2}^{m} \alpha_q \left(q^{th} Control_t\right) + \varepsilon_t, \quad (1)$$

where *Tax_Avoidance* refers to one of our four measures of tax avoidance. The variable of interest is *XBRL_Adoption*, an indicator variable that equals one for firm-years after mandatory adoption of XBRL, and zero otherwise. Hypothesis H1 predicts that α_1 should be negative.

We include a set of control variables in Eq. (1) to isolate the XBRL reporting effect from other firm-level and macro-level factors contributing to tax avoidance behavior. To control for economies of scale and firm complexity, we include firm size (*SIZE*), R&D investment (*RDEXP*), financial leverage (*LEV*), book-to-market ratio (*BTM*), and non-current assets (*PPE*) in Eq. (1) (Mills et al., 1998; Rego, 2003; Chen et al., 2010; McGuire et al., 2012). Firms with negative pre-tax income and/or significant net operating loss carryforwards have weaker incentives to engage in tax avoidance. Thus, we control for firm profitability (*ROA*), net operating loss carryforwards (*NOL*), and change in net operating loss carryforwards (Δ*NOL*) in the regression model (Rego, 2003; Frank et al., 2009; Chen et al., 2010; McGuire et al., 2012; Chyz et al., 2013). We also control for the level of firms' cash holdings (*CASHSIZE*) to account for firms' cash needs that might necessitate certain types of tax avoidance (McGuire et al., 2012). Prior research suggests

that tax rates are endogenously determined in response to the macroeconomic environment (Hanlon and Heitzman, 2010). To mitigate this concern, we include year dummies to capture time trends. Finally, the prior literature shows that firms' tax strategies are affected by industry characteristics and trends (McGuire et al., 2012; Cen et al., 2017; Kubick et al., 2017). We thus include industry dummies to control for the effects of the industry on a firm's tax avoidance strategy.[10,11]

Hypothesis H2 examines whether the effect of XBRL adoption on tax avoidance is less pronounced if firms are subject to intense IRS monitoring before the XBRL mandate. To test this hypothesis, we augment equation (1) by adding *PRE_IRSAUDIT* and its interaction with *XBRL_Adoption*. Following Hoopes et al. (2012), we define *PRE_IRSAUDIT* as the number of face-to-face corporate audits over the total number of Form 1120s filed in a certain asset class one year before XBRL adoption. A higher value of *PRE_IRSAUDIT* indicates that the firm is subject to higher tax audit risk and thus more intense IRS monitoring before XBRL reporting. Hypothesis H2 predicts that the coefficient on the interaction term should be positive.

4. Main results

[10] Smaller firms may also engage in tax avoidance in relation to state, as opposed to federal, filing requirements. In an untabulated robustness test, we control for differences in states' filing requirements by including state fixed effects in the model. The results, which are available upon request, are consistent with our main findings.

[11] We include industry fixed effects rather than firm fixed effects because the within-firm variation in tax avoidance behavior is reasoned to be lower than across-firm variation. One limitation of firm fixed effects models is the possibility of fixed effects removing the theoretical cross-sectional variation of interest if firm characteristics change slowly over time (Zhou, 2001). We reason that slow-changing firm characteristics and/or overlapping measurement windows for our key variables contribute to lower within-firm variation in our key variables. Thus, a firm fixed effects model might be ill-suited to capture the theoretical cross-sectional variation of the effect that we study in this paper. Nevertheless, we perform a robustness test in which we control for firm fixed effects in place of industry fixed effects and rerun Eq. (1). Our results, which are available upon request, remain qualitatively unchanged.

4.1. Descriptive statistics

Table 2 reports descriptive statistics for all observations, after we separate them into the pre-XBRL (2009–2010) and post-XBRL periods (2011–2013). We find that, on average, tax avoidance decreases in the post-XBRL period for all measures of the behavior. The decline in *ETR_Differential* is marginally statistically significant but other tax avoidance measures are not statistically significant at the univariate level. We also note that the standard deviation is high for each tax avoidance measure, suggesting that our sample firms exhibit relatively large cross-firm variation in tax avoidance activities.

The mean and median of *SIZE*, *LEV*, *NOL*, and *ΔNOL* increase in the post-XBRL period, indicating that firm size, leverage, and tax loss carryforwards all grow following the adoption of XBRL reporting. The mean and median of *IRS_AUDITPROB* are higher in the post-XBRL period. This implies that the reduced information asymmetry after mandatory XBRL adoption helps the budget-constrained IRS to expand the number of tax investigations undertaken and increases firms' tax audit likelihood. However, the mean and median values of *BTM*, *CASHSIZE*, and *ROA* decrease following the adoption of XBRL reporting, suggesting that the increase in firm size may be driven by firms' growth opportunities and leverage, rather than retained earnings. Recall that the most represented industry in our sample of small firms is the Business Service industry.

4.2. Results for testing H1

Table 3 presents the results of estimating Eq. (1). Throughout the paper, reported t-values are calculated using robust standard errors that are clustered by firm and year (Petersen, 2009; Gow et al., 2010). As shown in Table 3, across all four measures of tax avoidance, we find strong and consistent evidence that the adoption of XBRL for financial reporting is associated with less tax avoidance activity. Specifically, when *BTD* is the dependent variable (column 1), the

coefficient on *XBRL_Adoption* is -0.0522 (*t* value = -1.99). After we remove the impact of earnings management on *BTD*, the effect of XBRL adoption on *DD_BTD* is still statistically significant in the predicted direction; the coefficient on *XBRL_Adoption* is -0.0302 (*t* value = -3.36) (column 2). Turning to permanent book-tax differences, we document a similar pattern, that tax avoidance decreases subsequent to the adoption of XBRL for financial reporting. As shown in column 3, where *ETR_Differential* is the dependent variable in Eq. (1), we find that the coefficient on *XBRL_Adoption* remains negative and highly significant (α_1 = -0.0996; *t*-value = -4.65). Finally, we extract a common factor of *BTD*, *DD_BTD*, and *ETR_Differential* and estimate Eq. (1) using *BTD_Factor* as the dependent variable (column 4). We continue to find a negative and statistically significant relationship between XBRL reporting and tax avoidance (α_1 = -0.0370; *t* value = -2.37). These results are consistent with hypothesis H1 and suggest that XBRL reporting reduces the IRS's information processing costs and facilitates its tax monitoring activities. As a result, managers have less incentive to engage in tax avoidance behavior.

The decrease in tax avoidance in the post-XBRL reporting period is economically significant. We estimate the economic significance by using the percentage change in tax avoidance relative to the average values of *BTD, DD_BTD,* and *ETR_Differential* for the pre-XBRL adoption period. Our results imply decreases in *BTD, DD_BTD,* and *ETR_Differential* of 17.03% (5.22 / 30.65), 17.03% (3.02 / 14.53), and 20.78% (9.96 / 55.89), respectively. However, we caution that the decrease in tax avoidance could also be attributable to concurrent macroeconomic shocks such as an improved economic environment after the financial crisis. We address this issue in subsection 4.3 using the DiD approach.

With respect to our control variables, the results are generally consistent with those reported in the prior literature. For instance, more profitable firms have higher levels of book-tax

differences. Cash-rich firms engage in less tax avoidance activities, presumably because their demand for additional cash savings via tax planning is relatively low. Although in theory we would expect a negative relationship between carryforward losses and incentives to engage in tax avoidance, we find mixed empirical evidence.[12,13]

4.3. Results for testing H2

Table 4 presents the results for testing hypothesis H2. The coefficient on *XBRL_Adoption* exhibits a negative sign regardless of the measure of tax avoidance used, but is not statistically significant for any of the measures. Consistent with our expectation, the coefficient on *PRE_IRSAUDIT* is negative and statistically significant when we measure tax avoidance using *DD_BTD*, *ETR_Differential*, and *BTD_Factor*, suggesting that in the pre-XBRL adoption period (i.e., *XBRL_Adoption* = 0), firms under more intense IRS monitoring and thus subject to higher tax audit risk engage in less tax avoidance activity. Of greater interest is the coefficient on the interaction term, *XBRL_Adoption* × *PRE_IRSAUDIT*, which captures cross-sectional variation in the relationship between XBRL reporting and tax avoidance with respect to firms' tax audit risk in the pre-XBRL adoption period. We show that the coefficient is positive and statistically

[12] Bruhne and Jacob (2019) perform a meta-analysis of determinants of corporate tax avoidance based on 114 studies. They find that 45% of those studies document a statistically significant positive association between tax avoidance and NOL, whereas 20% report a statistically significant negative association between tax avoidance and NOL. Thus, Bruhne and Jacob (2019) classify losses (NOL) as a determinant of corporate tax avoidance with unambiguous prediction but mixed empirical evidence. Our mixed results for NOL across different measures of tax avoidance are in line with this view.

[13] To strengthen our identification strategy, we also perform a pseudo-event analysis. In this analysis, we re-estimate our baseline regression in Eq. (1) with firms randomly assigned to an XBRL adoption year over the sample period. To compute the reliable statistical significance of the estimated coefficient and ensure that the pseudo-event analysis results do not arise from ad hoc assignment of the XBRL adoption year, we construct a distribution of estimated coefficients. Specifically, we randomly assign the XBRL adoption year and based on the uniform distribution of these random assignments we calculate average t-statistics using 1,000 randomly chosen samples of firm-year observations to calculate the standard errors of each coefficient (Horowitz, 2001; Larcker et al., 2013). The standard error of the 1,000 coefficient estimates is used to calculate average t-statistics. Untabulated results show that in none of our four models is the coefficient on *XBRL_Adoption* statistically significantly negative, as predicted by H1. The results of the pseudo analysis therefore reinforce the view that our main findings, reported in Table 3, are unlikely to be explained by other uncontrolled factors that can also affect tax avoidance behavior.

significant in all models except when we measure tax avoidance using *ETR_Differential* (*coeff.* = 1.3375, *t* = 2.43 in the *BTD* model; *coeff* = 1.4123, *t* = 3.10 in the *DD_BTD* model; *coeff* = 0.2084, *t* = 0.45 in the *ETR_Differential* model; *coeff* = 1.8591, *t* = 3.35 in the *BTD_Factor* model).

The above results indicate that the estimated marginal effect of XBRL reporting on tax avoidance comprises not only the coefficient on *XBRL_Adoption* but also a function of the coefficient on the interaction term and the value of *PRE_IRSAUDIT*. Thus, to measure the *average* marginal effect of XBRL reporting on tax avoidance, we add the coefficient on *XBRL_Adoption* and the coefficient on the interaction term multiplied by *PRE_IRSAUDIT*, where we set *PRE_IRSAUDIT* to its mean value (0.1449 in Table 2). Table 4 reports that the sums are -0.0753, -0.1350, -0.0720, and -0.0555 for the *BTD*, *DD_BTD*, *ETR_Differential*, and *BTD_Factor* models, respectively. All values are statistically significant except those for *ETR_Differential* as the dependent variable. Overall, our results suggest that the adoption of XBRL for financial reporting, on average, reduces tax avoidance incentives, and this effect is less prominent if the firm was under more intense IRS monitoring before the XBRL mandate, consistent with hypothesis H2.

4.4. Difference-in-differences analysis for testing H1

A potential concern about Eq. (1) is that *XBRL_Adoption* may be correlated with some other time-variant factors that contribute to the decline in tax avoidance over our sample period. In that case, we cannot rule out the possibility that the results in Table 3 are explained by correlated omitted variables. To address this issue, we extend our analyses using a DiD regression:

$$Tax\_Avoidance_t = \beta_0 + \beta_1 XBRL\_Adoption_t + \beta_2 Phase3_t + \beta_3 XBRL\_Adoption \times Phase3_t + \sum_{q=4}^{m} \beta_q (q^{th} Controls_t) + \varepsilon_t, \quad (2)$$

where *XBRL_Adoption* is an indicator variable that equals one for firm-years in the post-XBRL-adoption period (starting on June 15, 2011), and zero otherwise; *Phase3* is an indicator variable

that equals one for Phase 3 XBRL adopters and zero for non-XBRL adopters which do not report using XBRL in any of the three phases. The phase-in of mandatory adoption of XBRL offers a natural experiment setting in which both adopters (treatment group) and nonadopters (control group) exist over the same period of time. Specifically, we can compare the change in tax avoidance for Phase 3 adopters (treatment group) with that for nonadopters (control group) between 2009 and 2013. The DiD approach allows us to control for the impact on our results of market-wide, non-XBRL-related parallel factors that might have occurred during the Phase 3 implementation period. In Eq. (2), we are primarily interested in the coefficient on *XBRL_Adoption* × *Phase3* (β_3), which measures the incremental difference in tax avoidance for Phase 3 firms compared to nonadopters from the pre- to the post-XBRL period after controlling for all other factors.

To construct the control sample of non-adopter firms, we manually collect, from the SEC's Edgar website, data for 155 firms which had never adopted XBRL for financial reporting prior to 2014. Among these 155 firms, 88 are U.S. firms and 67 are international firms that are cross-listed in the U.S. Among the 88 U.S. firms, 66 firms are currently inactive and the total asset size of these inactive firms is generally larger than those of the active firms in the control sample. These control firms are listed in Appendix B. The active firms are exempt from XBRL reporting because they are very small firms, because they are foreign subsidiaries, or because they do not have any significant operations. Thus, we acknowledge the possibility that our control group could be different to our treatment group with respect to managerial incentives and tax strategies prior to the XBRL mandate. However, there is no compelling reason to believe that non-XBRL-related

parallel factors, if any, would affect Phase 3 firms and non-Phase 3 firms differently throughout our sample period.[14]

We report the results of estimating Eq. (2) in Table 5. We find that the coefficient on *Phase3* is not statistically significantly different from zero except when we measure tax avoidance using *BTD_Factor* (β_2 = 0.3255, t = 1.37 in the *BTD* model; β_2 = 0.1940, t = 1.03 in the *DD_BTD* model; β_2 = -0.1992, t = -1.60 in the *ETR_Differential* model; β_2 = 0.1471, t = 1.77 in the *BTD_Factor* model). This suggests that Phase 3 adopters and control firms had similar tax avoidance strategies in the period prior to the SEC's XBRL reporting mandate (i.e., when *XBRL_Adoption* = 0). Of primary interest to us is the coefficient on *XBRL_Adoption* × *Phase3*. We find that β_3 is negative and statistically significant for all measures of tax avoidance (β_3 = -0.6012, t = -2.36 in the *BTD* model; β_3 = -0.4065, t = -2.10 in the *DD_BTD* model; β_3 = -0.4552, t = -2.29 in the *ETR_Differential* model; β_3 = -0.2158, t = -2.35 in the *BTD_Factor* model). These results are consistent with hypothesis H1 and suggest that tax avoidance decreases from the pre- to the post-XBRL period for Phase 3 firms, relative to the corresponding change for non-adopting firms over the same period. The DiD results confirm that our baseline results reported in Section 4.2 are unlikely to be driven by non-XBRL-related parallel factors that affect managerial opportunism in both treatment and control firms during our sample period.[15]

5. Additional analyses

[14] We compare firm characteristics between Phase 3 (treatment) firms and control firms in the pre-XBRL period. The untabulated results (available on request) indicate that control firms are, on average, smaller, less profitable, less R&D intensive, and have lower book-to-market ratio than treatment firms.

[15] In untabulated analyses (available on request), we rerun the DiD regression for a matched sample based on firm size in the same industry-year. We match the treatment and control firms based on year and industry and then select the closest control firm in terms of total assets in the year before the XBRL adoption, allowing for matching with replacement. After matching, we find that in the pre-XBRL adoption period (2009–2010), the mean of firm size for treatment firms is 4.1517 whereas the mean of firm size for control firms is 4.2249, and the difference is not statistically significant (t value = 1.48). Our DiD regression results based on this matched sample are qualitatively the same as our main DiD results.

5.1. Dynamic analysis of the relationship between XBRL reporting and tax avoidance

To further enhance our confidence in the results for H1 and to address concerns of potential reverse causality, we perform a dynamic analysis of the relationship between XBRL adoption and tax avoidance, following Bertrand and Mullainathan (2003) and Kim, Li, and Liu (2019). Specifically, we replace *XBRL_Adoption* in Eq. (1) with three indicator variables that denote the relative years surrounding the initial adoption of XBRL. *One_Year_Before* is an indicator variable that equals one for observations in the year prior to the initial adoption, and zero otherwise; *Adoption_Year* is an indicator variable that equals one for observations in the initial adoption year, and zero otherwise; *One_Year_After* is an indicator variable that equals one for observations one the year after the initial adoption, and zero otherwise. We expect the coefficient on *One_Year_Before* not to be statistically significant, or to be less significant than the coefficient on *Adoption_Year* or *One_Year_After* if XBRL reporting causes a decrease in tax avoidance.

Table 6 presents the results of the dynamic analysis. The coefficient on *One_Year_Before* is positive and statistically significant in all models except when we measure tax avoidance using *BTD*, suggesting that tax avoidance is more pronounced in the year prior to the adoption of XBRL for financial reporting than later years. In contrast, the coefficients on *Adoption_Year* and *One_Year_After* are negative and statistically significant across all models with only one exception (the measure *ETR_Differential* for *Adoption_Year*). More importantly, the magnitude of the coefficient on *One_Year_After* is statistically significantly larger than that of the coefficient on *One_Year_Before*, suggesting that the decline in tax avoidance after the XBRL mandate is prevalent and statistically significant.[16] Overall, the dynamic analysis, along with the DiD analysis,

[16] We do not include year dummies in the dynamic analysis because *One_Year_Before*, *Adotpion_Year*, and *One_Year_After* are individual year dummies. As an alternative approach to controlling for the macroenvironmental effect on corporate tax avoidance, we follow Hoopes et al. (2012) and run the dynamic analysis by imposing a linear trend on tax avoidance over time with a control variable, *YEAR_C*, that takes a value from 2009 to 2013.

enhances our confidence in the conclusion that the adoption of XBRL for financial reporting leads to a reduction in tax avoidance.

5.2. The increase in the IRS's use of financial information in tax monitoring

A key assumption in our study is that firms' financial statements are an important source of information that the IRS uses to monitor tax avoidance behavior. If this assumption is valid, we expect to observe an increase in the IRS's use of financial statement information in tax scrutiny subsequent to XBRL reporting. When information processing costs are lower, IRS examiners can perform more accurate analyses based on (tax-related) financial data in a more efficient way. Thus, XBRL reporting helps expand the scope and depth of IRS analysis of financial data and detect high-risk areas related to tax avoidance activities. This, in turn, leads to greater use by the IRS of XBRL-formatted financial statements. To confirm our prediction, we rerun equations (1) and (2) after replacing *Tax_Avoidance* with *IRS 10-K DOWNLOADS* as the dependent variable.

Following Bozanic et al. (2017), we infer the IRS's use of financial statement information from *IRS 10-K DOWNLOADS*, the number of times in a year that a computer with an IRS IP address downloaded a 10-K from EDGAR for a given firm.[17] To be consistent with Bozanic et al. (2017) in the regression analyses, we include additional control variables: *MNE* (whether a firm has foreign operations), *SALESGROWTH* (sales growth), and *INTANGINT* (intangible assets scaled by lagged total assets). Table 7 reports the results of examining the relationship between *IRS 10-K DOWNLOADS* and *XBRL_Adoption*. In the first column, we estimate the model without control firms. Consistent with our expectation, we find that the coefficient on *XBRL_Adoption* is positive and statistically significant, suggesting that the IRS relies more on financial statement data when performing tax examinations for firms after they adopt XBRL reporting. Turning to other

[17] We thank the authors of Bozanic et al. (2017) for sharing their IRS 10-K download data, which are available at http://www.jeffreyhoopes.com/data/irsattentiondata.html..

firm characteristics, we show that larger and more profitable firms and firms with foreign operations are more likely to attract IRS attention. In the second column, we use our control firms as a benchmark against which we compare the impact of XBRL reporting on the IRS's downloads of 10-K data. The coefficient on *Phase3* is not statistically significant, suggesting that XBRL adopters and non-XBRL adopters have similar IRS 10-K downloads before 2011. We find that non-XBRL adopters experience a decline in IRS attention after 2011, because the coefficient on *XBRL_Adoption* is statistically significantly negative. Our main interest lies in the coefficient on the interaction between *XBRL_Adoption* and *Phase 3*, which indicates the difference in IRS downloads of 10-K data before and after 2011 for XBRL adopters relative to that for non-XBRL adopters. Consistent with our prediction, we find a positive and statistically significant coefficient on the interaction term. The main conclusion drawn from these results is that because XBRL reporting reduces information processing costs, the IRS increases its use of financial statement information in conducting tax scrutiny after 2011.

5.3. Alternative tax avoidance measures

In this section, we assess the robustness of our results to four alternative tax avoidance measures. The first, *ETR_Avg*, is the firm's average GAAP effective tax rate over the last three years. Effective tax rate is a frequently used summary measure of the firm's tax planning strategies that investors and regulators can monitor and evaluate. The second alternative measure, *TAETR*, is the firm's *ETR_Avg* adjusted by the three-year average GAAP effective tax rate of the firm's size and industry peers (that is, those in the same quintile of total assets in the same industry). According to Armstrong et al. (2015), benchmarking the firm's *ETR_Avg* against that of similar-

sized firms in the same industry allows a more effective cross-sectional comparison and evaluation of whether the firm is excessively aggressive in tax planning.

We also view unrecognized tax benefits (UTBs) as another alternative tax avoidance measure. FIN 48 requires firms to analyze and disclose income tax risks and accounting reserves for future tax contingencies. It became effective in 2007 for all public firms that prepare financial statements in accordance with U.S. GAAP. Under FIN 48, firms record liabilities for uncertain tax positions that meet the threshold for unrecognized tax benefits.[18] We calculate two UTB-based tax avoidance measures: *UTB_ETR* and *UTB_TOTAL*. *UTB_ETR* is the amount of total unrecognized tax benefits at the end of year *t* that will impact the effective tax rate, scaled by the total assets at the beginning of year *t*. *UTB_TOTAL* is the total unrecognized tax benefits at the end of year *t* scaled by total assets at the beginning of year *t*.

Table 8 reports the results of regression of these four alternative measures on *XBRL_Adoption*, after controlling for other determinants of tax avoidance. We find significantly positive coefficients on *XBRL_Adoption* in the *TAETR* and *ETR_Avg* models and significantly negative coefficients on *XBRL_Adoption* in the *UTB_TOTAL* and *UTB_ETR* models, consistent with hypothesis H1.[19]

5.4. Tax accrual quality analysis

As a robustness check, we test the effect of XBRL adoption on corporate tax accruals. Tax accrual quality represents variation in the degree to which income tax accruals match with subsequent cash flows from corporate income tax. Lower variation denotes higher quality of tax

[18] However, Hanlon and Heitzman (2010) suggest that caution should be exercised when using this measure, because it could be driven by both tax and financial reporting incentives. Although higher UTB may indicate more uncertainty in a firm's tax position, and thus reflect its level of tax avoidance, UTB is also constructed based on an accounting accrual, which is subject to managerial discretion.

[19] Because our control sample does not feature the data necessary to calculate these alternative measures of tax avoidance, we are not able to assess the robustness of the DiD results to these measures.

accruals (Choudhary et al., 2016). The quality of the income tax accruals is particularly relevant to examining the effect of XBRL on reducing information processing costs. The complexity of tax accruals highlights that information processing costs could be non-trivial to the IRS. This characteristic of tax accruals is evidenced by a recent increase in income tax-related financial reporting issues; for example, tax-related issues have now become one of the top-ten most recurrent restatement issues (Usvyatsky and Whalen, 2014). Moreover, the estimation procedure for tax accruals involves managerial judgment with respect to whether, where, and when transactions are taxable, because corporate managers have some discretion in applying tax regulations to the measurement of taxes with respect to individual items and events (SFAS 109; FASB, 1992). Accordingly, regulators are more focused on financial reporting of income taxes (Ernst and Young, 2014; Usvyatsky and Whalen, 2014). Taken all together, the above discussion emphasizes the relevance of examining the effect of XBRL adoption on the quality of tax accruals that are complex in nature.

In this analysis, we re-estimate our baseline regression for Eq. (1) using tax accrual quality as the dependent variable. Following Choudhary et al. (2016), we measure *TAXAQ* as the negative standard deviation of the residuals from firm-specific estimates of total tax accruals on income taxes paid, change in the long-term portion of the deferred tax asset, and change in the long-term portion of the deferred tax liability. To ensure that our *TAXAQ* measure is clean, we calculate it for the pre-XBRL adoption period using data from 2006 to 2010 and for the post-XBRL adoption period using data from 2011 to 2015. The sample for this test contains 2,938 observations. Control variables in the *TAXAQ* model are the same as those used in Choudhary et al. (2016). We report the analysis of *TAXAQ* in Table 9, and we find that the coefficient on *XBRL_Adoption* is positive and statistically significant. This result is consistent with the notion that mandatory XBRL

adoption reduces costs and risks associated with processing complex tax-related information reflected in tax accrual quality.

5.5. Extending the sample period to 2018

In our main tests, the sample period is from 2009 to 2013. We focus on a relatively short time window around 2011 in order to pinpoint the effect of adoption of XBRL. However, an interesting question is whether the XBRL effect on tax avoidance behavior can persist for a longer period. To examine this question, we extend our sample period to 2018 and rerun Eq. (1). We continue to find that the coefficient on *XBRL_Adoption* is negative and statistically significant (untabulated, available on request). More importantly, we find that the magnitude of the coefficient on *XBRL_Adoption* does not significantly differ from that in our short window test reported in Table 3. Thus, this finding suggests that the effect of XBRL adoption on corporate tax avoidance does not dissipate quickly over time.

6. Conclusion

In 2009, the SEC mandated that all registrants file their financial statements using XBRL over a three-year phase-in implementation period. This new search-facilitating technology is adopted to assist external users of financial statements in accessing, extracting, comparing, and screening financial information in a more accurate, timelier, and more efficient manner. It is reasonable to believe that the use of XBRL for financial reporting lowers both the costs of acquiring, processing, integrating, and analyzing financial statements, and information processing costs to outside information users, despite the fact that it does not change the content of the information reported in the financial statements.

We examine whether the XBRL-induced reduction in information processing costs to the IRS mitigates corporate tax avoidance. The reduction in information processing costs should

facilitate IRS monitoring. With XBRL reporting, it is less costly for tax examiners to process tax-related information reported in the financial statements and scrutinize excessive tax avoidance, which in turn deters such behaviors. We show that the extent of corporate tax avoidance decreases significantly after the adoption of XBRL for financial reporting. We also find that this pattern is less pronounced for firms that were subject to more intense IRS monitoring before the XBRL mandate.

Although a large body of research has examined the capital market consequences of XBRL reporting, researchers have paid little attention to the implications for managerial (real) actions such as tax avoidance. Our study attempts to fill this gap in the research. Furthermore, it remains highly controversial, from a policy perspective, whether small firms should be exempt from XBRL reporting. Although we do not intend to resolve this policy debate by directly testing the cost-benefit trade-off associated with XBRL reporting, our results suggest that another benefit from XBRL reporting is to facilitate IRS monitoring of corporate tax avoidance.

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Appendix A: Variable definitions

BTD	=	Total book-tax differences, equal to pre-tax income (*pi*) less estimated taxable income scaled by lagged total assets (*at*). Taxable income is the sum of the current federal tax expense (*txfed*) and current foreign tax expense (*txfo*) divided by the statutory tax rate less the change in net operating loss carryforward (*tlcf*). If the current federal tax expense is not reported, the total current tax expense is calculated as total income taxes (*txt*) less deferred taxes (*txdi*), state income taxes (*txs*), and other income taxes (*txo*) (Kim et al., 2011; McGuire et al., 2012). We remove observations with total assets of less than $1 million and observations with negative taxable income (*txfed*<0).
DD_BTD	=	The Desai–Dharmapala (2006) residual book-tax differences. Calculated as the residual estimated from the following firm fixed effects regression: $BTD_{i,t} = \beta_1 TACC_{i,t} + \mu_i + \varepsilon_{i,t}$, where *BTD* is total book-tax differences and *TACC* is total accruals derived from the statement of cash flows and scaled by lagged total assets.
ETR_Differential	=	The effective tax rate (ETR) differential based on Frank et al. (2009) and Kim et al. (2011). It is calculated as (PI - ((TXFED + TXFO)/STR)) - (TXDI/STR), scaled by lagged assets (*at*). PI is pre-tax book income (*pi*); TXFED is the current federal tax expense (*txfed*); TXFO is the current foreign tax expense (*txfo*); TXDI is the deferred tax expense (*txdi*); STR is the statutory tax rate.
BTD_Factor	=	A common factor extracted from three different book-tax difference measures: *BTD*, *DD_BTD*, and *ETR_Differential*.
XBRL_Adoption	=	An indicator variable that equals one for firm-years in the post-XBRL-adoption period, and zero otherwise.
SIZE	=	The natural logarithm of total assets (*at*) at the beginning of year *t*.
RDEXP	=	R&D expense divided by lagged total assets.
LEV	=	Total long-term debt divided by lagged total assets.
BTM	=	The natural logarithm of the book value of common equity (*ceq*) divided by the market value of common equity (*csho* × *prcc_f*).
CASHSIZE	=	Cash and short-term investments (*che*) divided by lagged total assets.
NOL	=	An indicator variable that equals one if the firm reports a tax-loss carryforward, and zero otherwise.
ΔNOL	=	The change in tax-loss carryforwards from year *t-1* to year *t* scaled by lagged total assets.
ROA	=	Income before extraordinary items (*pi* - *xi*) divided by the average total assets.
PPE	=	Property, plant, and equipment (*ppegt*) divided by lagged total assets.
IRSAUDITPROB	=	The number of face-to-face corporate audits completed in IRS fiscal year t in asset class a, divided by total number of 1120s filed in calendar year t-1 in asset class a.
PRE_IRSAUDIT	=	*IRSAUDITPROB* in the pre-XBRL-adoption period, multiplied by minus one.
Phase3	=	An indicator variable that equals one for small-cap firms with a public float less than $700 million that are required to adopt XBRL for financial reporting on or after June 15, 2011, and zero otherwise.
MNE		An indicator variable that equals one for multinational firms (i.e., firms that report any foreign pre-tax income (*PIFO*)), and zero otherwise.
SALESGROWTH		The difference between current-year sales (*SALE*) and prior-year sales, divided by prior-year sales.

INTANGINT		Intangible assets (*INTAN*) divided by lagged total assets; missing values set to equal zero.
TAXAQ	=	Standard deviation of the residuals from firm-specific estimates of ($TaxACC_{jt} = b_0 + b_1CTP_{jt-1} + b_2CTP_{jt} + b_3CTP_{jt+1} + b_4DDTL\_LT_{jt} + b_5DDTA\_LT_{jt} + e_{jt}$), multiplied by -1. TaxACC is the total tax accrual. CTP is cash taxes paid for income taxes, scaled by total assets. DDTA_LT is the change in the long-term portion of the deferred tax asset scaled by total assets. DDTL_LT is the change in the long-term portion of the deferred tax liability scaled by total assets.
UTB_EST	=	Predicted value of unrecognized tax benefits, estimated from Equation 1 in Rego and Wilson (2012).
ESO_INDUSTRY	=	Indicator variable equal to one if a firm operates in an industry with potentially large tax deductions from the exercise of options (defined as industry SIC codes 30-39 and 70-89), and zero otherwise.
DISC_EXTRA	=	Indicator variable equal to one when a firm reports a large discretionary/extraordinary item (defined as discontinued and extraordinary items from the Statement of Cash Flows ($XIDOC_{jt}$) > one percent of revenue (REVTjt)), and zero otherwise.
PTBI_VOL	=	Standard deviation of pre-tax income ($PTBI_{jt}$) scaled by total assets (AT_{jt}), measured from years t-7 through t.
TAX_LOSS	=	Indicator variable equal to one when the current tax expense ($UTXFED_{jt}$) is less than zero, and zero otherwise.
FOREIGN	=	Indicator variable equal to one when a firm reports a non-zero foreign tax expense ($TXFO_{jt}$), and zero otherwise.
LNAT	=	The natural logarithm of total assets (AT_{jt}).
AQ	=	Standard deviation of the residuals from firm-specific estimates of $\Delta WC_{jt} = \alpha + \beta 1CFO_{jt-1} + \beta 2CFO_{jt} + \beta 3CFO_{jt+1} + \beta 4\Delta REV_{jt} + \beta 5PPE_{jt} + \varepsilon_{jt}$, multiplied by -1 so larger values indicate better working capital accruals quality.

Appendix B: Control sample for the difference-in-differences test

Company Name	Country	Company Name	Country
ACIES CORP	USA	INVICTUS FINANCIAL INC	CAN
ACQUITY GROUP LTD -ADR	HKG	IVANHOE ENERGY INC	CAN
ADC TELECOMMUNICATIONS INC	USA	JACLYN INC	USA
ADECOAGRO SA	LUX	KINROSS GOLD CORP	CAN
AETERNA ZENTARIS INC	USA	KONINKLIJKE PHILIPS NV	NLD
AFRICA OIL CORP	CAN	LADISH CO INC	USA
ALDILA INC	USA	LE GAGA HOLDINGS LTD -ADR	HKG
ALLIANCE PHARMACEUTICAL	USA	LUXFER HOLDINGS PLC	GBR
ALLIANCE SEMICONDUCTOR CORP	USA	MACKAY LIFE SCIENCES INC	USA
ALPHATRADE.COM	CAN	MAG SILVER CORP	CAN
ALPINE GROUP INC	USA	MARINE HARVEST ASA	NOR
AMBASSADORS INTERNATIONL INC	USA	MATRIXX INITIATIVES INC	USA
AMERICAN COMMUNITY DEV INC	USA	MED BIOGENE INC	CAN
AMERICAN SECURITY RES CORP	USA	MEDLINK INTERNATIONAL INC	USA
AMERICAN WENSHEN STEEL GROUP	USA	MEGOLA INC	CAN
AVINCI MEDIA CORP	USA	METAL STORM LTD	AUS
BALLARD POWER SYSTEMS INC	CAN	MICROMEM TECHNOLOGIES INC	CAN
BANRO CORP	CAN	MIDDLEBROOK PHARMACEUTICALS	USA
BIOLINE RX LTD	ISR	NATURAL RESOURCES USA CORP	USA
BITAUTO HOLDINGS LTD -ADR	CHN	NGAS RESOURCES INC	USA
BORDERS GROUP INC	USA	NIVS INTELLIMEDIA TECHNOLOGY	CHN
BRITISH AMER TOBACCO PLC	GBR	NMT MEDICAL INC	USA
BRONCO DRILLING CO	USA	NOBEL LEARNING CMNTYS INC	USA
CALIFORNIA PIZZA KITCHEN INC	USA	NOVADAQ TECHNOLOGIES INC	CAN
CANARC RESOURCE CORP	CAN	NOVAMED INC	USA
CARDIMA INC	USA	NU HORIZONS ELECTRONICS CORP	USA
CARGO CONNECTION LOGISTICS	USA	NYMOX PHARMACEUTICAL CORP	BHS
CAVICO CORP	USA	OCCAM NETWORKS INC	USA
CELLU TISSUE HOLDINGS INC	USA	OCEANFREIGHT INC	GRC
CHINA ENTERPRISES LTD	HKG	OCTUS INC	USA
CHINA MEDIAEXPRESS HLDGS INC	HKG	ODYSSEY HEALTHCARE INC	USA
CHINA REAL ESTATE INFO -ADR	CHN	OMEGA NAVIGATION ENT INC	GRC
CHINA RITAR POWER CORP	CHN	ORSUS XELENT TECHNOLOGIES	CHN
CHINA SHUANGJI CEMENT LTD	CHN	PACIFIC RIM MINING CORP	CAN
CHINA WIND ENERGY INC	CHN	PC GROUP INC	USA
CHINA ZENIX AUTO INTL -ADR	CHN	PETAQUILLA MINERALS LTD	CAN
CHINAWE.COM INC	HKG	PHOSPHATE HOLDINGS INC	USA
COMMERCE GROUP CORP	USA	PINAFORE HOLDINGS BV	USA
CRH PLC	IRL	PLAYBOY ENTERPRISES -CL B	USA
CRUDE CARRIERS CORP	GRC	POLYMET MINING CORP	CAN
CYPRESS BIOSCIENCE INC	USA	PRANA BIOTECHNOLOGY LTD	AUS
DATASCENSION INC	USA	PRIME STAR GROUP INC	USA
DHT HOLDINGS INC	BMU	PROGEN PHARMACEUTICALS LTD	AUS
DIALYSIS CORP OF AMERICA	USA	QEP CO INC	USA
DIGERATI TECHNOLOGIES INC	USA	QUARTZ MOUNTAIN RESOURCES	CAN
DOVER SADDLERY INC	USA	REDHILL BIOPHARMA LTD	ISR
DRUGSTORE.COM INC	USA	REVO BIOLOGICS INC -REDH	USA
DYADIC INTERNATIONAL INC	USA	RIVAL TECHNOLOGIES INC	USA
ELLOMAY CAPITAL LTD	ISR	ROCK OF AGES CORP -CL A	USA
ENCORIUM GROUP INC	USA	ROYAL STANDARD MINERALS INC	CAN
ENDWAVE CORP	USA	RUSORO MINING LTD	CAN
ENERGY FUELS INC	USA	SAND TECHNOLOGY INC -CL A	CAN

ENI SPA	ITA	SANDSTORM GOLD LTD	CAN
EVERGREEN SOLAR INC	USA	SCORPIO TANKERS INC	MCO
EVOTEC AG	DEU	SEAHAWK DRILLING INC	USA
EXCEED CO LTD	HKG	SENSIVIDA MEDICAL TECH INC	USA
FIRE RIVER GOLD CORP	USA	SINO SHIPPING HOLDINGS INC	CHN
GALLERY OF HISTORY INC	USA	SKY-MOBI LTD -ADR	CHN
GASLOG LTD	MCO	SPECTRUM CONTROL INC	USA
GDT TEK INC	USA	SPIRENT COMMUNICATIONS	GBR
GENETIC TECHNOLOGIES LTD	AUS	TAG OIL LTD	CAN
GEOS COMMUNICATIONS INC	USA	TBC GLOBAL NEWS NETWORK-OLD	USA
GERBER SCIENTIFIC INC	USA	TIGRENT INC	USA
GLAXOSMITHKLINE PLC	GBR	TITAN TECHNOLOGIES INC	USA
GLOBAL SOURCES LTD	BMU	TOLLGRADE COMMUNICATIONS INC	USA
GLOBUS MARITIME LTD	GRC	TRANSGLOBE ENERGY CORP	CAN
GOLDEN ELEPHANT GLASS TECH	CHN	TRANSNET CORP	USA
GRUMA SAB DE CV	MEX	TRINITY BIOTECH PLC	IRL
HEARUSA INC	USA	URIGEN PHARMACEUTICALS -REDH	USA
HENRY BROS ELECTRONICS INC	USA	VITAL IMAGES INC	USA
HUGHES COMMUNICATIONS INC	USA	VOLCOM INC	USA
HYDROGENICS CORP	CAN	WIPRO LTD	IND
HYDRON TECHNOLOGIES INC	USA	WIRELESS XCESSORIES GRP INC	USA
HYPERCOM CORP	USA	WOLSELEY PLC	CHE
IMPERIAL TOBACCO GROUP PLC	GBR	XETA TECHNOLOGIES INC	USA
INCA DESIGNS INC	USA	XTL BIOPHARMACEUTICALS	ISR
INFOSMART GROUP INC	USA	ZUOAN FASHION LTD -ADR	CHN
INTEGRAL SYSTEMS INC	USA		

Table 1: Sample distribution

Panel A: Sample distribution by industry

Fama-French industry classification (industry number)	Frequency	Percent
Agriculture (1)	27	0.42
Aircraft (24)	32	0.50
Alcoholic Beverages (4)	10	0.16
Apparel (10)	54	0.84
Automobiles and Trucks (23)	147	2.29
Business Services (34)	952	14.80
Business Supplies (38)	54	0.84
Beverage (3)	11	0.17
Chemicals (14)	125	1.94
Coal (29)	13	0.20
Computers (35)	188	2.92
Construction Materials (17)	184	2.86
Construction (18)	71	1.10
Consumer Goods (9)	90	1.40
Defense (26)	17	0.26
Electrical Equipment (22)	160	2.49
Electronic Equipment (36)	445	6.92
Entertainment (7)	110	1.71
Fabricated Products (20)	16	0.25
Food Products (2)	123	1.91
Healthcare (11)	170	2.64
Machinery (21)	193	3.00
Measuring and Control Equipment (37)	160	2.49
Medical Equipment (12)	350	5.44
Miscellaneous (48)	113	1.76
Non-metallic Mining (28)	86	1.34
Personal Services (33)	81	1.26
Petroleum and Natural Gas (30)	301	4.68
Pharmaceutical Products (13)	745	11.58
Precious Metals (27)	75	1.17
Publishing (8)	36	0.56
Recreational Products (6)	52	0.81
Restaurants and Hotels (43)	100	1.55
Retail (42)	285	4.43
Rubber and Plastic Products (15)	44	0.68
Ship Building, Railroad Equipment (25)	18	0.28
Shipping Containers (39)	5	0.08
Steel Works, Etc. (19)	57	0.89
Telecommunications (32)	208	3.23
Textiles (16)	21	0.33
Transportation (40)	216	3.36
Utilities (31)	39	0.61
Wholesale (41)	248	3.85
Total	6,432	100.00

Panel B: Sample distribution by year

Fiscal Year	Frequency	Percent
2009	1,210	18.81
2010	1,312	20.40
2011	1,386	21.55
2012	1,307	20.32
2013	1,217	18.92
Total	6,432	100.00

Table 2: Descriptive statistics

Variables	Pre-XBRL-adoption subsample (n = 2,692)			Post-XBRL-adoption subsample (n = 3,740)			Difference in means
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	
XBRL_Adoption	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	
BTD	-0.3064	0.0060	1.4340	-0.3310	0.0060	1.5012	-0.0246
DD_BTD	0.1453	0.0017	2.0594	0.1239	0.0027	2.0540	-0.0214
ETR_Differential	-0.5589	-0.0093	1.7145	-0.6282	-0.0122	1.8558	-0.0693*
BTD_Factor	0.4677	0.3398	2.2989	0.4419	0.3400	2.3457	-0.0258
SIZE	4.2809	4.6311	1.7973	4.3835	4.6743	1.9966	0.1026**
RDEXP	0.1081	0.0007	0.2364	0.1039	0.0019	0.2221	-0.0042
LEV	0.1667	0.0102	0.3202	0.1849	0.0195	0.3339	0.0181**
BTM	0.3690	0.4710	1.6604	0.2901	0.4405	1.8288	-0.0789*
CASHSIZE	0.3672	0.1690	0.6336	0.3127	0.1550	0.5207	-0.0545***
NOL	0.7805	1.0000	0.4140	0.8406	1.0000	0.3661	0.0602***
ΔNOL	0.3604	0.0000	1.8208	0.4410	0.0046	1.9577	0.0806*
ROA	-0.6482	-0.0180	2.2977	-0.8053	-0.0080	2.6217	-0.1571**
PPE	0.2566	0.1406	0.3114	0.2467	0.1295	0.3046	-0.0098
IRS_AUDITPROB	0.1449	0.1327	0.0770	0.1838	0.2038	0.0917	0.0389***
DIST_IRS	-0.0024	-0.0894	0.9929	0.0017	-0.0749	1.0051	0.0041

Table 2 reports descriptive statistics for the pre-XBRL-adoption and post-XBRL-adoption subsamples. The pre-XBRL-adoption period is from 2009 to 2010. The post-XBRL-adoption period is from 2011 to 2013. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. See Appendix A for variable definitions.

Table 3: The relationship between XBRL adoption and corporate tax avoidance

Variables	(1) *BTD*	(2) *DD_BTD*	(3) *ETR_Differential*	(4) *BTD_Factor*
XBRL_Adoption	-0.0522	-0.0302	-0.0996	-0.0370
	(-1.99)**	(-3.36)***	(-4.65)***	(-2.37)**
SIZE	0.0639	-0.0208	0.0506	-0.0152
	(6.86)***	(-3.27)***	(6.81)***	(-3.80)***
RDEXP	-0.4109	-0.1532	-0.5618	-0.4004
	(-2.42)**	(-6.01)***	(-4.06)***	(-3.34)***
LEV	-0.1511	0.0573	-0.1864	0.0522
	(-1.84)*	(1.29)	(-2.03)**	(0.81)
BTM	0.0284	-0.0278	0.0325	-0.0168
	(2.02)**	(-5.79)***	(2.54)**	(-3.29)***
CASHSIZE	-0.7933	-0.6433	-0.7886	-0.6468
	(-11.87)***	(-30.59)***	(-11.59)***	(-10.50)***
NOL	0.0348	-0.0989	0.0507	-0.0422
	(1.02)	(-2.36)**	(1.37)	(-1.47)
ΔNOL	0.3620	0.5046	-0.2093	0.5740
	(15.61)***	(57.68)***	(-9.32)***	(40.34)***
ROA	0.4155	0.0960	0.4627	0.1103
	(25.76)***	(23.12)***	(26.47)***	(26.24)***
PPE	-0.7413	-0.7522	-0.6688	-0.6853
	(-6.74)***	(-19.74)***	(-6.14)***	(-4.08)***
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Number of obs.	6,432	6,432	6,432	6,432
Adj. R-Square	0.547	0.188	0.769	0.187

Table 3 presents the OLS regression results for the relationship between XBRL adoption and corporate tax avoidance. We report *t*-statistics in parentheses with standard errors clustered by firm and year. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. See Appendix A for variable definitions.

Table 4: The relationship between XBRL reporting and corporate tax avoidance, conditional on IRS monitoring before the XBRL adoption

Variables	(1) *BTD*	(2) *DD_BTD*	(3) *ETR_Differential*	(4) *BTD_Factor*
XBRL_Adoption (α_1)	-0.2691	-0.3396	-0.1022	-0.3249
	(-0.14)	(-1.17)	(-0.89)	(-1.36)
PRE_IRSAUDIT (α_2)	-0.634	-2.2319	-1.9024	-2.5032
	(0.75)	(-4.34)***	(-4.16)***	(-3.19)***
XBRL_Adoption	1.3375	1.4123	0.2084	1.8591
×*PRE_IRSAUDIT* (α_3)	(2.43)**	(3.10)***	(0.45)	(3.35)***
SIZE	0.0362	0.0438	-0.0040	0.0210
	(0.99)	(0.87)	(-0.48)	(1.13)
RDEXP	-0.0413	-1.3182	-0.5231	-0.3854
	(-0.13)	(-1.62)	(-3.03)***	(-0.75)
LEV	-0.2357	0.3108	-0.2674	0.0707
	(-1.38)	(0.60)	(-2.65)***	(0.40)
BTM	0.0772	-0.0647	0.0312	-0.0168
	(2.63)***	(-1.35)	(1.97)**	(-1.07)
CASHSIZE	-1.8127	-1.3997	-0.7179	-0.6483
	(-13.89)***	(-5.94)***	(-9.47)***	(-6.29)***
NOL	0.0937	-0.4662	0.0705	-0.1350
	(1.68)*	(-0.98)	(1.77)*	(-0.74)
ΔNOL	0.8394	1.1480	-0.1927	0.5915
	(19.11)***	(10.10)***	(-8.33)***	(12.07)***
ROA	0.9582	0.1255	0.4596	0.1141
	(20.17)***	(1.09)	(25.78)***	(3.76)***
PPE	-1.4772	-1.4371	-0.4697	-0.6548
	(-11.66)***	(-2.48)**	(-4.66)***	(-4.80)***
Test of *average* marginal effect of XBRL adoption on tax avoidance (H_0: $\alpha_1 + \alpha_3 \times$ mean value of *PRE_IRSAUDIT* = 0)				
Value	-0.0753	-0.1350	-0.0720	-0.0555
F stat.	(3.04)**	(11.36)***	(0.59)	(10.84)***
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Number of obs.	5,713	5,713	5,713	5,713
Adj. R-Square	0.530	0.187	0.767	0.203

Table 4 reports the OLS regression results of estimating the relationship between XBRL adoption and corporate tax avoidance, conditional on IRS monitoring intensity (i.e., tax audit risk) before the XBRL mandate. We report *t*-statistics in parentheses with standard errors clustered by firm and year. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. See Appendix A for variable definitions.

Table 5: Difference-in-differences regression analyses of the relationship between XBRL adoption and corporate tax avoidance

Variables	(1) *BTD*	(2) *DD_BTD*	(3) *ETR_Differential*	(4) *BTD_Factor*
XBRL_Adoption	0.4468	0.2142	0.2620	0.1320
	(1.82)*	(1.13)	(1.31)	(1.80)*
Phase3	0.3255	0.1940	-0.1992	0.1471
	(1.37)	(1.03)	(-1.60)	(1.77)*
XBRL_Adoption	-0.6012	-0.4065	-0.4552	-0.2158
× *Phase3*	(-2.36)**	(-2.10)**	(-2.29)**	(-2.35)**
SIZE	0.1429	0.0431	0.1134	0.0296
	(5.08)***	(1.65)*	(3.33)***	(2.87)***
RDEXP	0.2449	0.6343	2.4794	-0.0041
	(0.37)	(0.69)	(3.56)***	(-0.01)
LEV	-0.9297	-0.4976	0.0425	-0.3475
	(-3.00)***	(-0.72)	(0.15)	(-1.26)
BTM	0.0640	-0.0164	0.0530	-0.0013
	(1.22)	(-0.32)	(1.76)*	(-0.06)
CASHSIZE	-2.1065	-1.8448	-3.2534	-0.6984
	(-2.47)**	(-2.97)***	(-1.77)*	(-2.64)***
NOL	0.0426	0.0010	-0.1045	0.0203
	(0.59)	(0.01)	(-0.60)	(0.34)
ΔNOL	0.2918	0.3239	-0.3264	0.2010
	(5.69)***	(2.78)***	(-4.57)**	(3.66)***
ROA	0.0469	0.0071	0.0553	0.0080
	(4.94)***	(1.06)	(3.14)***	(2.67)***
PPE	-1.6338	-1.7883	-3.6255	-0.4979
	(-1.59)	(-1.80)*	(-1.45)	(-1.16)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Number of obs.	6,776	6,776	6,776	6,776
Adj. R-Square	0.541	0.717	0.760	0.599

Table 5 reports difference-in-differences regression results of estimating the relationship between XBRL adoption and tax avoidance. For the control sample, we manually identify and extract 155 firms from the SEC's EDGAR website that did not adopt XBRL prior to 2014. We report *t*-statistics in parentheses with standard errors clustered by firm and year. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. See Appendix A for variable definitions.

Table 6: The relationship between XBRL adoption and corporate tax avoidance – dynamic analysis

Variables	(1) *BTD*	(2) *DD_BTD*	(3) *ETR_Differential*	(4) *BTD_Factor*
One_Year_Before	0.0034	0.0335	0.0377	0.0764
	(0.50)	(3.28)***	(8.02)***	(6.29)***
Adoption_Year	-0.0354	-0.0922	0.0102	-0.0806
	(-2.51)***	(-3.43)***	(0.96)	(-2.94)***
One_Year_After	-0.1208	-0.1908	-0.0710	-0.1211
	(-6.55)***	(-5.94)***	(-4.95)***	(-3.86)***
SIZE	0.0622	-0.0222	0.0490	-0.0148
	(10.05)***	(-1.39)	(5.89)***	(-0.96)
RDEXP	-0.4283	-0.1653	-0.5743	-0.4073
	(-3.46)***	(-0.41)	(-4.85)***	(-1.36)
LEV	-0.0181	0.1682	-0.0955	0.1819
	(-0.24)	(1.37)	(-0.81)	(1.18)
BTM	0.0324	-0.0250	0.0355	-0.0152
	(2.56)**	(-0.61)	(2.61)***	(-0.26)
CASHSIZE	-0.7882	-0.6316	-0.7879	-0.6320
	(-13.49)***	(-6.23)***	(-12.38)***	(-7.81)***
NOL	0.0253	-0.1051	0.0428	-0.0453
	(1.17)	(-1.79)	(1.53)	(-0.74)
ΔNOL	0.3616	0.5052	-0.2101	0.5771
	(17.69)***	(14.63)***	(-9.01)***	(18.55)***
ROA	0.4167	0.0970	0.4635	0.1145
	(25.88)***	(2.10)**	(4.53)***	(2.94)***
PPE	-0.7915	-0.7640	-0.7172	-0.7141
	(-6.70)***	(-5.02)***	(-6.91)***	(-3.82)***
YEAR_C	0.0206	0.0287	0.0181	0.0172
	(4.12)***	(4.22)***	(4.88)***	(1.84)*
Industry dummies	Yes	Yes	Yes	Yes
Number of obs.	6,432	6,432	6,432	6,432
Adj. R-Square	0.546	0.188	0.768	0.188

Table 6 reports the results of estimating dynamic effects of XBRL adoption on corporate tax avoidance. In Eq. (1), we replace the *XBRL_Adoption* variable with three indicator variables: *One_Year_Before*, *Adoption_Year*, and *One_Year_After*, to denote the relative years around initial XBRL adoption. *One_Year_Before* is a dummy variable that equals one for observations in the one-year period prior to the initial adoption year, and zero otherwise; *Adoption_Year* is a dummy variable that equals one for observations in the year XBRL is first adopted, and zero otherwise; *One_Year_After* is a dummy variable that equals one for observations one year after the initial adoption year, and zero otherwise. We report *t*-statistics in parentheses with standard errors clustered by firm and year. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. See Appendix A for other variable definitions.

Table 7: Increase in the IRS's use of financial statements subsequent to the adoption of XBRL reporting

Variables	(1) *IRS 10-K DOWNLOADS*	(2) *IRS 10-K DOWNLOADS*
XBRL_Adoption	0.0443	-0.5477
	(3.21)***	(-2.87)***
Phase3		-0.0403
		(-0.44)
XBRL_Adoption × *Phase3*		0.5861
		(3.16)***
SIZE	0.0987	0.0935
	(7.41)***	(13.89)***
RDEXP	-0.1830	-0.1696
	(-2.34)**	(-3.59)***
LEV	0.0469	0.0237
	(1.31)	(0.70)
BTM	-0.0052	-0.0044
	(-0.90)	(-0.76)
CASHSIZE	-0.0877	-0.0794
	(-3.10)***	(-5.13)***
NOL	-0.0464	-0.0195
	(-3.15)	(-0.61)
ΔNOL	0.0024	0.0017
	(0.66)	(0.37)
ROA	0.0070	0.0075
	(2.59)***	(1.92)*
PPE	-0.0610	-0.0472
	(-2.64)***	(-1.07)
MNE	0.0967	0.1007
	(4.20)***	(3.43)***
SALESGROWTH	-0.0235	-0.0267
	(-1.57)	(-3.08)***
INTANGINT	-0.0503	-0.0735
	(-0.63)	(-1.30)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
Num. of obs.	6,029	6,175
Adj. R-Square	0.108	0.165

Table 7 reports the results of estimating the effect of XBRL adoption on the IRS's use of financial statement information. *IRS 10-K DOWNLOADS* is the number of times during year t that a computer with an IRS IP address downloaded a 10-K from EDGAR for a given firm. We report *t*-statistics in parentheses with standard errors clustered by firm and year. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. See Appendix A for other variable definitions.

Table 8: The relationship between XBRL adoption and corporate tax avoidance – alternative tax avoidance measures

Variables	(1) *ETR_Avg*	(2) *TAETR*	(3) *UTB_ETR*	(4) *UTB_Total*
XBRL_Adoption	0.0166	0.0135	-0.0019	-0.0036
	(1.70)*	(2.89)***	(-4.25)***	(-2.77)***
SIZE	0.0228	0.0012	0.0009	0.0005
	(6.79)***	(0.56)	(3.30)***	(1.05)
RDEXP	-0.0996	-0.0418	0.0027	0.0378
	(-2.51)**	(-1.18)	(2.19)**	(4.21)***
LEV	-0.0963	-0.1035	-0.0020	0.0006
	(-2.98)***	(-3.78)***	(-1.91)*	(0.23)
BTM	0.0079	-0.0078	0.0000	-0.0016
	(1.10)	(-1.93)*	(0.29)	(-3.00)***
CASHSIZE	-0.0453	-0.0334	0.0009	0.0006
	(-3.04)***	(-2.26)**	(1.22)	(0.21)
NOL	-0.1560	-0.1501	0.0021	0.0053
	(-12.54)***	(-18.32)***	(12.48)***	(7.95)***
ΔNOL	0.0034	0.0033	-0.0004	0.0001
	(0.55)	(0.62)	(-1.43)	(0.05)
ROA	0.0352	0.0281	0.0002	0.0012
	(2.89)***	(3.48)***	(1.46)	(1.54)
PPE	-0.0258	-0.0263	-0.0025	-0.0091
	(-1.12)	(-0.88)	(-5.23)***	(-5.39)***
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Num. of obs.	3,139	3,139	3,139	3,139
Adj. R-Square	0.1068	0.0598	0.0680	0.0981

Table 8 reports the results of estimating the relationship between XBRL adoption and corporate tax avoidance using four alternative measures: *ETR_Avg* is the average three-year GAAP effective tax rate; *TAETR* is computed as *ETR_Avg* adjusted by the mean three-year GAAP ETR of the firm's size and industry peers; *UTB_ETR* is the amount of total unrecognized tax benefits at the end of year that will impact the effective tax rate, scaled by lagged total assets; *UTB_Total* is total unrecognized tax benefits at the end of year scaled by lagged total assets. We report *t*-statistics in parentheses with standard errors clustered by firm and year. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. See Appendix A for other variable definitions.

Table 9: Regression analyses of XBRL adoption and Tax Accrual Quality

Variables	*TAXAQ*
XBRL_Adoption	0.0015
	(2.02)**
UTB_EST	0.0008
	(1.04)
ESO_INDUSTRY	0.0018
	(0.53)
DISC_EXTRA	-0.0054
	(-2.40)**
PTBI_VOL	-0.0080
	(-1.91)*
TAX_LOSS	-0.0032
	(-4.01)***
FOREIGN	0.0008
	(0.87)
LNAT	0.0005
	(1.48)
AQ	0.0173
	(1.06)
Year dummies	Yes
Industry dummies	Yes
Number of obs.	2,938
Adj. R-Square	0.137

Table 9 presents the OLS regression results of estimating the relationship between XBRL adoption and tax accrual quality (*TAXAQ*). *TAXAQ* is the standard deviation of the residuals from firm-specific estimates of the following model: $TAXACC_{jt} = b_0 + b_1CTP_{jt-1} + b_2CTP_{jt} + b_3CTP_{jt+1} + b_4DDTL\_LT_{jt} + b_5DDTA\_LT_{jt} + e_{jt}$. We multiply *TAXAQ* by -1, so larger values indicate better tax accrual quality. This regression model is fitted in pre- and post-XBRL periods, separately, to compute *TAXAQ*. *CTP* is cash taxes paid scaled by total assets. *TAXACC* is the total tax accrual, calculated as the total tax expense scaled by total assets less cash taxes paid scaled by total assets. *DDTL_LT* is change in the long-term portion of the deferred tax liability scaled by total assets. *DDTA_LT* is change in the long-term portion of the deferred tax asset scaled by total assets. We report *t*-statistics in parentheses with standard errors clustered by firm and year. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. See Appendix A for variable definitions.