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Analyst coverage and corporate tax aggressiveness☆

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ABSTRACT

We examine the impact of analyst coverage on corporate tax aggressiveness. To address endogeneity concerns, we perform a difference-in-differences analysis using a setting which causes exogenous decreases in analyst coverage. Our tests identify a negative causal effect of analyst coverage on tax aggressiveness, suggesting that higher analyst coverage constrains corporate tax aggressiveness. Further cross-sectional variation tests find that this constraining effect on tax aggressiveness is more pronounced in firms with lower investor recognition and firms with more opaque information environments. Our results are consistent with the notion that higher analyst coverage increases the visibility of aggressive tax planning behavior as well as heightens analysts' demand for more transparent information, which in turn reduces tax aggressiveness.

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1. Introduction

Despite substantial research on the determinants of tax aggressiveness over the past decade (e.g., Hanlon and Heitzman, 2010), it remains unclear whether financial analysts, as key information intermediaries in capital markets, constrain or encourage corporate tax aggressiveness.[1] Graham et al. (2014) in a recent influential survey suggests that analysts are likely to serve a *dual* role. Yet they do not examine the *overall* effect of analyst coverage on aggressive tax avoidance nor the channels through which these effects occur. Meanwhile, recent studies suggest that analysts have a significant impact on various corporate decisions (e.g., Derrien and Kecskes, 2013; He and Tian, 2013). Motivated by these two strands of literature, our study aims to examine the overall impact of analysts on corporate tax aggressive activities as well as the channels through which analysts affect such activities.

Prior literature suggests three competing views regarding the effect of analyst coverage on tax aggressiveness. We label our first view as the "investor recognition view." It focuses on the role of financial analysts in enhancing *investor recognition* for firms' stocks (e.g., Mola et al., 2013; Li and You, 2015). According to this view, higher analyst coverage increases a stock's visibility, and as such, it is also likely to increase public awareness of the underlying firm's practices such as aggressive tax strategies. Thus, to the extent that public dissemination of such activities brings about various non-tax related costs such as the loss of reputation (e.g., Hanlon and Slemrod, 2009), higher analyst coverage reduces returns to tax aggressive activities and thus dampens firms' incentives to engage in these activities.

We label our second view as the "information demand view." It posits that aggressive tax strategies not only are complex and opaque in nature (e.g., Balakrishnan et al., 2013), but also entail

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[1] Following prior literature (e.g., Frank et al., 2009), we define tax aggressiveness as the downward manipulation of taxable income through aggressive tax planning which may or may not be considered illegal. At the aggressive end of tax avoidance practices, tax aggressive activities involve significant uncertainty and risks including information risk, audit risk, and reputation risk (e.g., Hanlon and Slemrod, 2009; Kim et al., 2011; Hasan et al., 2014). Because firms engaging in tax aggressive activities tend to have lower shareholder value, focusing on tax aggressiveness allows our study to draw a relatively clean inference about the role analysts may play. We use the terms "tax aggressiveness," "aggressive tax avoidance," "tax aggressive strategies," and "tax aggressive activities" interchangeably throughout the paper.

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high uncertainty and volatility (e.g., Hanlon et al., 2014; Saavedra, 2014). This increases information asymmetry between firms and outsiders such as financial analysts over tax-related transactions, which in turn is likely to result in undervaluation of the stock (e.g., Krishnaswami and Subramaniam, 1999). To the extent that higher analyst coverage increases the likelihood that analysts as a group seek guidance from the firm's management and express concerns about the difficulty in assimilating such information, management is more likely to cater to analysts' *information demand* for predictable earnings by limiting tax aggressive activities.

We label our third view as the "market pressure view." It treats tax aggressiveness as a behavior driven by external market pressures to avoid earnings disappointments. Graham et al.'s (2014) survey shows that the majority of public firms say that increasing reported earnings is an important outcome from tax planning strategies. As prior literature also suggests, analysts put *pressure* on management to manage earnings in order to meet earnings targets (e.g., He and Tian, 2013; Irani and Oesch, 2016). To the extent that higher analyst coverage spreads bad news (e.g., earnings disappointments) more quickly and thus imposes greater pressure on management, firms with higher analyst coverage are more likely to avoid taxes aggressively. Thus, in contrast to the previous two views, this pressure view predicts a positive relationship between analyst coverage and tax aggressive activities.

Any empirical examination of the relationship between firm-level measures of analyst coverage and tax aggressiveness is complicated by endogeneity bias. To address this issue, we follow Hong and Kacperczyk (2010) and rely on brokerage house mergers which, due to laying off redundant analysts, led to an *exogenous* decrease in affected firms' analyst coverage.[2] Following prior literature (e.g., Wilson 2009; Frank et al. 2009), we adopt two measures of tax aggressiveness: the tax shelter prediction score and the discretionary permanent component of book-tax differences. We perform difference-in-differences analyses, comparing the changes in tax reporting behavior of treatment firms to those of propensity-score matched firms. Our results suggest a negative *causal* effect of analyst coverage on tax aggressiveness, which supports the predictions of the investor recognition and information demand views but does not support the market pressure view. Our results are also economically meaningful. For example, the shelter prediction scores of treatment firms are about 0.142 (approximately 9.7% of the median *Shelter*) higher in the post-merger period than in the pre-merger period, after controlling for the contemporaneous change in match firms.

We further perform a variety of tests on the cross-sectional variation in the effect of analyst coverage. If the investor recognition view holds, the constraining effect of analyst coverage should vary with the level of firm visibility. Consistent with this view, we find that the negative causal relationship between analyst coverage and tax aggressiveness is more pronounced for firms with lower visibility. As the information demand view suggests, analysts' information demand could encourage management to limit complex transactions such as tax aggressive activities. To the extent that analysts' information demand increases with corporate opacity, this view suggests that the constraining effect is likely to be more salient for opaque firms than for transparent firms. Consistent with this view, we find that the negative causal relationship between analyst coverage and tax aggressiveness is more pronounced in opaque firms.

In addition, one may argue that financial analysts play a traditional monitoring role. If higher analyst coverage constrains tax aggressiveness through the monitoring channel, the constraining effect is likely to vary with the strength of corporate governance. However, we do not find significant differences in this constraining effect between well governed and poorly governed firms. Finally, although our baseline findings do not support the pressure effect, it is still possible that the pressure effect of analyst coverage holds for a subset of firms facing excessive market pressure from analysts. We further split our sample by the level of market pressure, but our empirical evidence is not supportive of the market pressure view. In sum, our subsample test results are more consistent with investor recognition and information demand serving as plausible channels through which higher analyst coverage constrains tax aggressiveness.

Our paper makes several contributions to the prior literature. First, it contributes to the emerging literature on the effect of capital markets on corporate tax avoidance.[3] Focusing on the monitoring role of capital markets, prior literature generally investigates how capital market participants such as institutional investors affect tax avoidance (e.g., Cheng et al., 2012; Khurana and Moser 2013). Unlike these studies, we focus on financial analysts, an important intermediary in capital markets. We are the first to find evidence that higher analyst coverage constrains tax aggressive strategies. Additionally, we find that the constraining effect is achieved through two non-monitoring channels: one is the increased visibility of such activities, and the other is the heightened demand for transparent and predictable information.

Our study also contributes to the literature investigating the effects of analyst coverage on real corporate activities. Derrien and Kecskes (2013) and Chen et al. (2015) focus on the governance role of financial analysts in affecting corporate investments, while He and Tian (2013), and Irani and Oesch (2016) find that market pressure from higher analyst coverage impedes innovation and exacerbates real earnings management. Unlike these studies, we focus on the investor recognition and information demand roles of higher analyst coverage in affecting aggressive tax strategies, another important real corporate activity.

Finally, our study also adds to the literature on analyst coverage and corporate information environments. Prior studies (e.g., Roulstone, 2003; Piotroski and Roulstone, 2004; Yu, 2008; Irani and Oesch, 2013; Kelly and Ljungqvist, 2012; Mola et al., 2013) find that higher analyst coverage is associated with greater market liquidity, less accruals management, and less information asymmetry. Our findings suggest that higher analyst coverage also improves firms' information environments through a previously unexamined channel (e.g., constraining complex activities such as tax aggressive activities).

The remainder of the paper is organized as follows. Section 2 develops the hypotheses. Section 3 provides the research design and reports summary statistics. Section 4 reports the empirical results. Section 5 provides the conclusions.

2. Theory and hypothesis development

2.1. Investor recognition view

Tax aggressiveness refers to the most extreme subset of tax avoidance activities that are "pushing the envelope of tax law" (Hanlon and Heitzman, 2010; p.137). Tax aggressive activities are more likely to be scrutinized by tax authorities. When successfully challenged, firms may be subject to large penalties (Wilson, 2009). Firms engaging in tax aggressive behavior also bear potential reputational costs. In particular, as argued by Bankman (2004) and Hanlon and Slemrod (2009), if a firm is publicly revealed to be

[2] As a supplemental test, we also use Yu's (2008) instrumental variable two-stage least squares approach to address endogeneity bias and find consistent results.

[3] Recent studies (e.g., Lim, 2011; Feld et al., 2013; Lin et al., 2014) also examine the relationship between taxes and the cost of debt, capital structure, and financial leverage.

tax aggressive, it runs the risk of being labeled as a "poor corporate citizen." Consistent with this notion, Hanlon and Slemrod (2009) find that stock markets react negatively to public revelation of tax sheltering. Austin and Wilson (2013) find that firms with valuable consumer brands have higher effective tax rates (thus, less tax avoidance) than firms without valuable consumer brands. In addition, in Graham et al.'s (2014) survey, 69% of tax executives report that the potential loss of reputation is an important factor in terms of determining why they do not participate in tax planning.[4]

Prior literature suggests that financial analysts play an important role in increasing investor recognition for firms' stocks in capital markets. As Merton (1987) notes, not all investors know about all stocks; thus, stocks with higher investor recognition have higher investor demand, leading such stocks to trade at relatively high prices. Many studies support Merton's (1987) theoretical prediction. Lehavy and Sloan (2008) and Richardson et al. (2012) find that investor recognition is negatively associated with the cost of capital. Recent studies also examine financial analysts' role in increasing investor recognition for firms' stocks. For example, Mola et al. (2013) and Li and You (2015) find that financial analysts increase firm value by increasing investor recognition.

As firms' stocks are covered by more analysts and thus become more visible to the general public, these analysts are also likely to increase public awareness of the underlying firms' practices, including their tax aggressive activities. Specifically, the increased visibility is achieved through two channels. First, financial analysts would directly raise tax-related questions during the firms' conference calls as well as comment on the firms' tax behavior in their evaluations and reports. Anecdotal evidence supports this perspective. For example, in Medtronic (a S&P 500 and Fortune 500 company)'s Q4 earnings conference calls held on May 20, 2014, financial analysts raised several questions related to factors that led to a lower tax rate and whether the company planned to repatriate its outside-the-United-States cash.[5] As another example, a Bank of America equity analyst explained Tyco's tax avoidance practices as follows.

> "The subsidiaries are highly levered and incur interest expense that reduces their taxable income in countries with high income tax rates…. In effect, this structure allows the company to *shift income from high-tax countries to countries with no income taxes*." (Desai, 2005, p. 180). [emphasis added]

Second, financial analysts are also likely to provide comments on the underlying firms' aggressive tax planning activities to the press. In the US, the popular press has reported hundreds of cases of corporate tax sheltering (Hanlon and Slemrod, 2009; Wilson, 2009; Gallemore et al., 2014).[6] As the number of analysts who cover a firm's stock increases, the chance that they communicate with the press about the firms' aggressive tax strategies would also increase. Indeed, Graham et al.'s (2014) survey suggests that managers of firms with higher analyst coverage are more concerned about the adverse media attention of tax planning strategies.

In sum, to the extent that higher analyst coverage increases the visibility of aggressive tax strategies, and thus decreases returns on such activities by bringing about non-tax costs such as reputational costs, higher analyst coverage dampens firms' incentives to aggressively avoid taxes.

2.2. Information demand view

Prior literature (e.g., Kelly and Ljungqvist, 2012) generally suggests that, as the most influential information producers in capital markets, financial analysts play a crucial information intermediary role in facilitating the pricing of stocks they cover. Whether analysts can effectively fulfill this function, however, depends largely on the complexity of corporate information. Complex corporate transactions and strategies increase information asymmetry between firms and analysts (as well as other market participants), reducing the latter's abilities to assimilate information (e.g., Plumlee, 2003; Gu and Wang, 2005). This in turn causes undervaluation of the stocks by equityholders (e.g., Krishnaswami and Subramaniam, 1999).

Prior studies also suggest that, although widely regarded as sophisticated users of financial statements, analysts have limited understanding about corporate taxes. For example, Chen and Schoderbek (2000) find that analysts fail to incorporate one-time tax adjustments into their forecasts of earnings, and Plumlee (2003) finds that analysts' revisions of their forecasts of effective tax rates do not account for complex tax law changes.

Aggressive tax strategies can impair analysts' understanding of corporate tax information for two reasons. First, aggressive activities such as tax sheltering are complex in nature (Desai and Dharmapala, 2006). Such complex transactions reduce analysts' assimilation of corporate information into their forecasts. Consistent with this notion, Balakrishnan et al. (2013) find that tax aggressive firms have a higher level of information asymmetry. Second, tax aggressive activities generally entail relatively high uncertainty. Such strategies make use of the complexities and ambiguities in tax laws and are likely to be later challenged by the tax authorities (e.g., Lisowsky et al., 2013; Hanlon et al., 2014). Accordingly, tax aggressive strategies such as tax shelters tend to be unsustainable (e.g., Wilson, 2009). McGuire et al. (2013) find that firms with less sustainable tax strategies have less persistent pre-tax earnings and earnings components. Saavedra (2014) further suggests that many firms that previously avoided taxes aggressively eventually had to return part of their initial tax savings to the tax authorities, thus increasing the volatility of tax expenses and earnings in subsequent periods.

Increased analyst coverage could heighten managers' concern about how aggressive tax strategies appear. In firms with higher analyst coverage, analysts as a group are more likely to seek guidance from management about the impact of complex transactions (e.g., aggressive tax strategies) on earnings persistence in future periods. They are also more likely to complain to the management in various occasions (e.g., during conference calls) about their difficulty in assimilating complex information resulting from aggressive tax activities. Accordingly, to cater to heightened demand from analysts for more predictable earnings, management may limit aggressive tax strategies.

Both the investor recognition and information demand views suggest that higher analyst coverage constrains aggressive tax avoidance activities. Thus, we have the following hypothesis:

Hypothesis 1(a). Analyst coverage is negatively associated with aggressive tax avoidance.

[4] Gallemore et al. (2014) do not find support for reputational effects playing a significant role in lost sales, media reputation, or CEO, CFO, or auditor turnover. However, Graham et al. (2014) question the ability of the data and methodology used by Gallemore et al. (2014) to ascertain the importance of reputational impact of tax avoidance.

[5] This conference call is available at http://seekingalpha.com/article/2228993-medtronics-mdt-ceo-omar-ishrak-on-q4-2014-results-earnings-call-transcript?part=single. Similar examples on analysts' interest in corporate income tax issues can be found at many other earnings conference calls such as IBM's 2014 Q1, Duke Energy Corporation's 2013 Q4, Flowserve Corp's 2014 Q1, and Henkel's 2014 Q2 earnings conference calls.

[6] After combining the sample of tax shelters identified by prior studies (e.g., Hanlon and Slemrod, 2009; Wilson, 2009) through searching news reports, Gallemore et al. (2014) obtain a full sample of 245 tax shelter observations.

2.3. Market pressure view

The third view, called the "market pressure" view, argues that higher analyst coverage exerts greater pressure on management to inflate reported earnings. As this view suggests, managers under pressure are more likely to resort to aggressive tax strategies for the purpose of inflating earnings.

Graham et al. (2005) provide evidence that corporate executives such as CFOs treat earnings as the key metric considered by outsiders. A strand of research in the earnings management literature suggests that managers exploit discretion in tax-related accounts to manage earnings. For example, Krull (2004) suggests that, to manage earnings upward, managers increase the designation of earnings as permanently reinvested and thus defer financial statement recognition of US taxes on repatriation. Dhaliwal et al. (2004) find that managers manipulate income tax expense downward and thus increase net income in order to meet analysts' earnings expectations. In addition, other studies document that earnings are managed by using specific accounts such as the valuation allowance for deferred tax assets (Schrand and Wong, 2003) and restructuring charge reversals (Moehrle, 2002).

Recent evidence also suggests that corporate tax planning, a real economic activity that has cash flow implications, provides another important tool that facilitates upward earnings management. For example, in Graham et al.'s (2014) survey, 57% of public firms' executives indicate that increasing earnings per share is an important outcome from a tax planning strategy. In the analysis of Xerox's tax minimization practices (e.g., the transfer of intellectual property and leasing portfolios), Desai (2005) suggests that such practices are widespread among US firms and are likely intended to inflate reported earnings so as to meet earnings targets. Consistent with this notion, Robinson et al. (2010) find that evaluation of tax departments as profit centers motivates these departments to explore tax avoidance opportunities in order to manage earnings upward.

To the extent that a high level of analyst coverage helps spread bad news (e.g., missing earnings targets) more quickly,[7] managers of firms with higher analyst coverage are under greater market pressure to manage earnings upward through tax avoidance. Several empirical studies support the notion that higher analyst coverage imposes market pressure for management to manage earnings.[8] For example, He and Tian (2013) suggest that higher analyst coverage stifles innovation by exerting too much pressure on managers to meet near-term earnings targets. Irani and Oesch (2016) provide evidence that management decreases real earnings management subsequent to exogenous reductions in analyst coverage, consistent with managers using real earnings management to enhance short-term performance in response to analyst pressure. McGuire et al. (2014) suggest that capital market pressure is likely a driving force for management to employ tax shelters. Thus, if aggressive tax strategies serve as a tool for earnings management (e.g., Graham et al., 2014), firms with higher analyst coverage are more likely to be tax aggressive in order to meet analysts' earnings expectations. In sum, these arguments lead to the following hypothesis:

Hypothesis 1(b). Analyst coverage is positively associated with aggressive tax avoidance.

3. Research design, sample selection and summary statistics

3.1. Measures of tax aggressiveness

As our interest is in tax strategies that involve the most uncertainty and risk, we focus on tax aggressiveness instead of a broad range of tax avoidance. Following Frank et al. (2009), Rego and Wilson (2012), and Francis et al. (2014), we use two widely used measures to capture tax aggressiveness.

Our first measure of tax aggressiveness is the tax shelter prediction score (*Shelter*) based on Wilson (2009). Tax shelters refer to those "complex transactions used by corporations to obtain significant tax benefits probably never intended by the tax code" (Hanlon and Slemrod, 2009, p. 127).[9] Early literature generally uses one of two approaches to identify corporate use of tax shelters: confidential Internal Revenue Service tax shelter data (e.g., Lisowsky, 2010), or searches of tax court dockets and popular press articles for tax shelter litigation cases (e.g., Graham and Tucker, 2006; Hanlon and Slemrod, 2009). Empirical analyses based on these approaches, however, may be subject to endogeneity bias (Hanlon and Heitzman, 2010; Hoi et al., 2013) and restricted data availability. Wilson's (2009) empirical model overcomes these measurement issues, allowing researchers to use publicly available financial and accounting information to estimate a firm's probability of tax sheltering. Recent studies find that Wilson's (2009) shelter-based measure is associated with stock price crash risk (Kim et al., 2011), sensitivity of a manager's wealth to stock return volatility (Rego and Wilson, 2012), and irresponsible corporate social activities (Hoi et al., 2013).

Our second measure is the discretionary permanent component of book-tax differences (*DTAX*). *DTAX* is a variant of book-tax differences (i.e., the scaled total differences between financial income and taxable income). Although widely used in prior finance literature (e.g., Chen et al., 2010; Kim et al., 2011; Chyz et al., 2013), book-tax differences contain *temporary* differences (e.g., deferred tax expenses) that arise primarily from earnings management rather than tax avoidance (e.g., Phillips et al., 2003; Hanlon 2005). By comparison, aggressive tax strategies are likely to cause *permanent* differences between financial and taxable incomes (Frank et al., 2009). Frank et al. (2009) further point out that the permanent component of book-tax differences could be driven not only by tax planning activities that are subject to managerial discretion, but also by nondiscretionary factors like state income taxes that are unlikely to be related to tax planning. This calls for the removal of nondiscretionary permanent book-tax differences.

Therefore, following Frank et al. (2009), we estimate the discretionary component of permanent book-tax differences (*DTAX*) as the residual from a regression of nondiscretionary factors that are known to cause permanent differences (e.g., intangible assets, state income taxes, and tax credits) on permanent book-tax differences. Frank et al. (2009) find that *DTAX* is significantly related to actual cases of tax sheltering, suggesting that it is a valid measure of aggressive tax planning. In recent literature, *DTAX* has become increasingly popular as a proxy for tax aggressiveness (e.g., Rego and Wilson, 2012; Lisowsky et al., 2013; Hasan et al., 2014; Francis et al., 2014).

Appendix A provides detailed information about how we construct these two measures of tax aggressiveness.

[7] As Hong et al. (2000) note, high analyst coverage is particularly important in spreading bad news because managers tend to be less forthcoming about bad news.

[8] Fuller and Jensen (2010) discusses the Enron case where Enron's management engaged in a variety of practices such as aggressive revenue recognition and special purpose vehicles in order to artificially inflate reported earnings and meet analyst forecasts.

[9] Corporate tax shelter strategies include, but are not limited to, transfer pricing deals, corporate-owned life insurance deals, contingent-payment installment sales deals, contested liability acceleration strategies, lease-in-lease-out deals, cross-border dividend capture strategies, and offshore intellectual property havens deals (Graham and Tucker, 2006).

3.2. Research setting and empirical models

Any empirical analysis on the relationship between firm-level measures of analyst coverage and corporate decisions is complicated by endogeneity (e.g., Irani and Oesch, 2013). To address endogeneity concerns, we use brokerage house mergers as a natural experiment. When a stock is covered by both brokerage houses before the merger, the merged house will normally lay off one redundant analyst after the merger in order to eliminate excess research capacity and thus improve efficiency (e.g., Wu and Zang, 2009; Hong and Kacperczyk, 2010). Most coverage changes are endogenous (McNichols and O'Brien, 1997), but coverage changes caused by brokerage house mergers are not likely to be affected by covered firms' tax avoidance behavior or other characteristics. Therefore, brokerage house mergers provide a unique opportunity to isolate the effect of analyst coverage from other variables affecting a firms' tax avoidance behavior.[10]

We adopt a difference-in-differences methodology which compares the pre-post differences in the outcome variable (i.e., tax aggressiveness) between firms affected by brokerage mergers (i.e., treatment firms) to firms unaffected by such events (i.e., match firms). The model is as follows:

$$\begin{aligned}\text{Tax aggressiveness}_{it} = {} & \beta_0 + \beta_1{}^{*}\text{Treatment firm} + \beta_2{}^{*}\text{Post} \\ & + \beta_3{}^{*}\text{Treatment firm}{}^{*}\text{Post} \\ & + \sum \beta^{*}\text{Firm attributes}_{t-1} \\ & + \text{Industry effect} + \text{Year effect} + \varepsilon_t \end{aligned} \quad (1)$$

In this model, Tax aggressiveness $_{it}$ is as discussed above. The test variable of interest is the interaction term, *Treatment firm*Post*. Given that treatment firms have less analyst coverage in the post-merger periods, a positive coefficient on this interaction term indicates that reductions in analyst coverage lead to increases in corporate tax aggressiveness, which is consistent with the information demand or investor recognition view. Conversely, if we document a negative coefficient on this interaction term, the result is consistent with the market pressure view.

Following Rego (2003), Chen et al. (2010), Hope et al. (2013), and Hoi et al. (2013), we include the following firm attributes in our model. *Firm size* is the natural logarithm of firm total assets (AT)[11]; *M/B* is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ); *Leverage* is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT); *ROA* is the return on assets measured as operating income (PI – XI) scaled by lagged assets (AT); *Cash holding* is the cash ratio measured as cash and short-term investments (CHE) scaled by lagged assets (AT); *NOL* is a dummy variable coded as one if the loss carry forward (TLCF) is positive; *Change NOL* is the change in loss carry forward (TLCF) scaled by lagged assets (AT); *Equity income* is the equity income in earnings (ESUB) scaled by lagged assets (AT); *PPE* is the property, plant, and equipment (PPENT) scaled by lagged assets (AT); *Intangible assets* is intangible assets (INTAN) scaled by lagged assets (AT); *Foreign income* is foreign income (PIFO) scaled by lagged assets (AT).

3.3. Sample selection and summary statistics

To construct our list of brokerage house mergers, we first combine Hong and Kacperczyk's (2010) list of 15 brokerage house mergers with the 21 brokerage house mergers identified by Kelly and Ljungqvist (2012).[12] We exclude three mergers where Merrill Lynch was involved as the bidder broker because Merrill Lynch's analyst forecast data are dropped from the I/B/E/S database per the broker's request. Note that Kelly and Ljungqvist's list overlaps with Hong and Kacperczyk's list in four merger events during the overlapping period 2000–2005. Our final sample includes 29 unique brokerage house mergers between 1988 and 2008.

We then implement the following procedure to construct our treatment sample. We first merge the list of brokerage mergers with the I/B/E/S unadjusted detail history dataset. This allows us to identify those stocks that are covered by both the target and the bidder brokers in the one-year period prior to the merger. To the extent that merger transactions usually last several months, we follow recent studies (e.g., Derrien and Kecskes, 2013; He and Tian, 2013) and treat the six months surrounding each merger date as the "event period." As a result, the pre-merger (post-merger) one-year period is defined as the 365-day window ending three (fifteen) months before (after) each merger date.[13]

We further apply the following filters. First, following recent studies (e.g., Kelly and Ljungqvist, 2012; He and Tian, 2013; Irani and Oesch, 2013), we delete firms that are covered by both merging brokerage houses before the merger but cease to be covered by the merged entity during the year after the merger. Such coverage changes are potentially endogenous because the merged entity makes a choice to terminate the coverage in addition to laying off redundant analysts. Accordingly, we focus on coverage reductions in which one of the two analysts covering the same stock in the merged house disappears after the merger. These reductions are primarily caused by the elimination of redundant analysts and therefore are more likely to be exogenous to affected firms. Second, for firms affected by multiple events in different years, we count only the first event of each firm to avoid noise in defining the pre- and post-event periods. Third, as our purpose is to compare tax aggressiveness between pre- and post-event periods, we require that each firm has at least one observation in the pre-event period and at least one observation in the post-event period. After applying these filters, there are 1117 unique treatment firms over 1988–2008.

To implement our identification strategy, we must choose a time window before and after events. Because tax aggressiveness measures are mainly calculated from annual accounting data, and corporate tax strategies are generally long-term strategies, similar to He and Tian (2013), we choose a six-year time window (years −3 to +3). Therefore, the sample for our baseline analyses covers the period 1985–2011. We drop year zero, because year zero is the transition year and merger transactions generally span several months. We create a dummy variable, *Post,* which equals one for post-merger years and zero otherwise. The choice of a six-year window reflects a trade-off between relevance and accuracy. On the one hand, using too long a window could incorporate too much noise in the events and reduce statistical power. On the other hand, given that a time lag usually exists between the change of a firm's tax policy and its outcome, choosing too short a window

[10] In addition, as He and Tian (2013) note, an advantage of using brokerage mergers as natural experiments is that there are multiple shocks in this setting affecting different firms in different years, which facilitates the use of unaffected firms as the control group. By comparison, a common criticism of studies that examine the effect of a single shock is the failure to control for time trends in outcome variables coinciding with the shock when such a shock also affects all firms.

[11] All our results hold if we use market value to measure firm size.

[12] To ensure homogeneity of sample events, we do not include Kelly and Ljungqvist's (2012) list of stand-alone brokerage closures. Unlike Hong and Kacperczyk's list, Kelly and Ljungqvist's list does not provide the I/B/E/S' broker codes (i.e., BACODE) for brokers involved. Following Wu and Zang's (2009) methodology, we identify the appropriate BACODE for each broker by utilizing both the time-series variation in the number of analysts hired by the broker and traces of the broker's original name contained in the BAID item in I/B/E/S.

[13] In the cases where two analysts employed by the same broker cover the same stock during the same year, we retain only the analyst that issues the more recent forecast in the pre-merger period. One primary reason for a broker to have more than one analyst covering the same stock within one year is that a new analyst (i.e., the analyst who issues more recent forecasts) substitutes an old one.

could limit the ability to detect any meaningful changes in tax avoidance. Nonetheless, our results hold when we use four-year or eight-year windows.

Following recent studies (e.g., Irani and Oesch, 2013; Hasan et al., 2014), we use a propensity score matching method to identify a match firm for each treatment firm.[14] *Treatment firm* is a dummy variable that equals one if a firm is affected by the brokerage merger event and zero otherwise. We estimate a logistic regression where the dependent variable is *Treatment firm*, and the independent variables are major firm characteristics that are widely used as matching variables in the literature. Specifically, we include *Firm size, Analyst coverage, M/B, ROA, Cash holding* and *Shelter*/*DTAX* as independent variables in the logistic regression.[15] We run logistic regressions for each matching year.[16] Firms that are matched in prior years are excluded from the pool of candidate match firms. Using the predicted propensity score from this logistic regression, we then match, without replacement, each treatment firm with a match firm using the closest propensity score. To ensure that there are no significant differences between treatment firms and match firms, following Hasan et al. (2014), we use the caliper matching method in which caliper refers to the difference in the predicted probabilities between treatment and match firms. By matching within a caliper of 1%, we are able to identify 760 treatment-match pairs from this propensity matching method. Our final sample include 4355 observations when we use *Shelter* as the dependent variable and 3590 observations when we use *DTAX* as the dependent variable.

Table 1 reports summary statistics for the difference-in-differences analysis.[17] The mean value of *Shelter* is 1.658, and the mean value of *DTAX* is −0.010. We also find that the mean number of analysts is 10.48. Other sample firm-year statistics are in the range of those reported in earlier studies such as Hoi et al. (2013).

Table 2 reports correlations between the variables used in the models. We find that the two measures of tax aggressiveness are positively correlated (0.098). We also find that the correlations between analyst coverage and our two measures of tax aggressiveness are both negative. Further, we find that analyst coverage is positively correlated with firm size.

Table 1
Summary statistics.

Variables	N	Mean	S.D.	P25	P50	P75
Shelter	4355	1.658	1.572	0.866	1.458	2.209
DTAX	3590	−0.010	0.332	−0.017	0.000	0.021
Number of analysts	4355	10.481	7.440	4.500	9.083	14.833
Firm size	4355	7.425	1.588	6.376	7.432	8.409
M/B	4355	2.179	1.640	1.206	1.601	2.438
Leverage	4355	0.244	0.204	0.073	0.219	0.365
ROA	4355	0.051	0.148	0.019	0.059	0.108
Cash holding	4355	0.135	0.169	0.017	0.062	0.192
NOL	4355	0.390	0.488	0.000	0.000	1.000
Change NOL	4355	0.023	0.134	0.000	0.000	0.000
Equity income	4355	0.001	0.006	0.000	0.000	0.000
PPE	4355	0.371	0.313	0.125	0.292	0.554
Intangible assets	4355	0.140	0.226	0.005	0.033	0.189
Foreign income	4355	0.012	0.034	0.000	0.000	0.010

This table presents the firm-year level descriptive statistics for our difference-in-differences sample. Shelter is a prediction score based on Wilson's (2009) model of tax sheltering. DTAX is the discretionary permanent component of book-tax differences introduced by Frank et al. (2009). Analyst coverage is the average number of analysts from the 12 monthly earnings forecasts. Firm size is the natural logarithm of the market value of equity (PRCC_F × CSHO). M/B is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ). Leverage is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT). ROA is the return on assets measured as operating income (PI – XI) scaled by lagged assets. Cash holding is the cash ratio measured as Cash and Short-Term Investments (CHE) scaled by lagged assets (AT). NOL is a dummy variable coded as one if the loss carry forward (TLCF) is positive. Change NOL is the change in loss carry forward (TLCF) scaled by lagged assets (AT). Equity income is the equity income in earnings (ESUB) scaled by lagged assets (AT). PPE is the property, plant, and equipment (PPENT) scaled by lagged assets (AT). Intangible assets is intangible assets (INTAN) scaled by lagged assets (AT). Foreign income is foreign income (PIFO) scaled by lagged assets (AT).

4. Empirical results

4.1. Baseline analysis

A successful difference-in-differences analysis relies on the satisfaction of the key assumption behind this approach, the parallel trend assumption, which states that in the absence of an exogenous shock, the observed difference-in-differences estimator is zero (He and Tian, 2013). More specifically, this assumption requires similar trends in tax aggressiveness during the pre-shock period for both treatment and match firms. As in He and Tian (2013), we conduct two diagnostic tests to ensure that the parallel trend assumption is satisfied.

Using a graphic approach, we first demonstrate in Fig. 1 the difference in *Shelter* between the treatment and match groups over a six-year event window surrounding the brokerage merger. Panel A shows that the difference in *Shelter* between these two groups is relatively stable before the merger (from year t−3 to year t−1), suggesting that there are no pre-merger trends for *Shelter*. Likewise, we do not observe any significant pre-merger trends for *DTAX*, as shown in Panel B.

However, Fig. 1 also shows somewhat different cross-time patterns between the two measures of tax aggressiveness. Specifically, the difference between treatment and match groups is essentially flat for *DTAX* from year −3 to −1 and does not increase after year +1, but it jumps sharply between year −1 and +1. The size of this jump, which is approximately 0.05, is close to the multivariate estimate of our difference-in-differences coefficient reported in Table 4 below. By comparison, the pattern for *Shelter* is not as abrupt as for *DTAX*: the effect of brokerage house mergers is spread across several years (from year −2 to year +2) and the increase from year −1 to year +1 (0.06) accounts for approximately 40% of the overall effect (0.14, as shown in Table 4 below). The difference in patterns between *DTAX* and *Shelter* could be attributed to different aspects of tax aggressiveness that these two measures capture. For example, *Shelter* might capture longer-term tax planning strategies than *DTAX*; thereby it takes a longer period for *Shelter* to fully reflect the effect of brokerage house mergers on corporate tax aggressiveness.

As our second test of the parallel trend assumption, we compare measures of tax aggressiveness as well as major firm characteristics between the treatment and match firms in the pre-merger year t−1. The univariate comparisons in Table 3 indicate no statistically significant differences in tax aggressiveness between the treatment and match firms before the merger. Further, there are no significant differences in various firm characteristics between both groups in year t−1. In sum, these results imply that the propensity score matching process has removed the pre-merger observ-

[14] To identify match firms, Irani and Oesch (2013) adopt a propensity score matching scheme, using firm size, ROA and disclosure quality (their dependent variable) as matching variables. Other studies (e.g., Hong and Kacperczyk, 2010; Kelly and Ljungqvist, 2012) instead identify match firms by constructing benchmark portfolios based on a number of firm characteristics. When there are many firm characteristics requiring control, it is problematic to match firms directly based on firm characteristics because of the "curse of dimensionality" (Zhao, 2004). Consequently, propensity score matching has become increasingly popular in recent studies (e.g., Francis et al. 2014).

[15] Similar to Irani and Oesch (2013), we also try the match using all controls in the baseline model, and our results hold for this alternative match.

[16] Brokerage merger years include 1988, 1994, 1997, 1998, 1999, 2000, 2001, 2002, 2005, 2007 and 2008.

[17] To mitigate the influence of outliers, we winsorize all control variables at the 1% and 99% levels.

Table 2
Correlation table.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Shelter	1												
2. DTAX	0.0982	1											
	(0)												
3. Analyst coverage	−0.3474	−0.0218	1										
	(0)	(0.1536)											
4. Firm size	0.6436	0.0284	0.2533	1									
	(0)	(0.0632)	(0)										
5. M/B	−0.0043	0.0207	0.085	−0.3489	1								
	(0.7543)	(0.1758)	(0)	(0)									
6. Leverage	−0.1427	−0.0181	−0.0696	0.1193	−0.2118	1							
	(0)	(0.2358)	(0)	(0)	(0)								
7. ROA	0.4277	0.129	0.1249	0.0667	0.1865	−0.1846	1						
	(0)	(0)	(0)	(0)	(0)	(0)							
8. Cash holding	−0.1086	−0.0266	0.0055	−0.3201	0.4939	−0.3002	−0.0995	1					
	(0)	(0.0821)	(0.5705)	(0)	(0)	(0)	(0)						
9. NOL	0.0163	−0.0336	0.0013	−0.0752	0.0646	0.0235	−0.1401	0.1484	1				
	(0.2397)	(0.0281)	(0.890)	(0)	(0)	(0.0156)	(0)	(0)					
10. Change NOL	−0.0437	0.0016	−0.0453	−0.1414	0.1431	0.0133	−0.3896	0.1952	0.1969	1			
	(0.0017	(0.9168)	(0)	(0)	(0)	(0.1705)	(0)	(0)	(0)				
11. Equity income	0.088	−0.0031	−0.0057	0.0636	−0.0282	0.0138	0.1101	−0.0902	−0.0141	−0.0488	1		
	(0)	(0.8384)	(0.5577)	(0)	(0.0037)	(0.1553)	(0)	(0)	(0.1464)	(0)			
12. PPE	−0.0332	0.0184	0.1102	−0.0673	−0.0388	0.2824	0.0851	−0.2257	−0.0074	−0.0059	0.0558	1	
	(0.0167)	(0.2282)	(0)	(0)	(0.0001)	(0)	(0)	(0)	(0.4472)	(0.5458)	(0)		
13. Intangible assets	0.0278	0.0114	0.0257	−0.0274	0.0252	0.0798	−0.0138	−0.066	0.0953	0.0456	0.0005	−0.0702	1
	(0.0453)	(0.4558)	(0.0081)	(0.0047)	(0.0094)	(0)	(0.156)	(0)	(0)	(0)	(0.9584)	(0)	
14. Foreign income	0.378	0.0696	0.1486	0.0269	0.1774	−0.1172	0.2544	0.0725	0.0658	−0.0361	0.0313	−0.0236	0.0553
	(0)	(0)	(0)	(0.0057)	(0)	(0)	(0)	(0)	(0)	(0.0002)	(0.0013)	(0.0147)	(0)

This table presents the correlations among the main variables. Shelter is a prediction score based on Wilson's (2009) model of sheltering. DTAX is the discretionary permanent component of book-tax differences introduced by Frank et al. (2009). Analyst coverage is the average number of analysts from the 12 monthly earnings forecasts. Firm size is the natural logarithm of the market value of equity (PRCC_F × CSHO). M/B is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ). Leverage is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT). ROA is the return on assets measured as operating income (PI – XI) scaled by lagged assets. Cash holding is the cash ratio measured as Cash and Short-Term Investments (CHE) scaled by lagged assets (AT). NOL is a dummy variable coded as one if the loss carry forward (TLCF) is positive. Change NOL is the change in loss carry forward (TLCF) scaled by lagged assets (AT). Equity income is the equity income in earnings (ESUB) scaled by lagged assets (AT). PPE is the property, plant, and equipment (PPENT) scaled by lagged assets (AT). Intangible assets is intangible assets (INTAN) scaled by lagged assets (AT). Foreign income is foreign income (PIFO) scaled by lagged assets (AT). *P*-values are in parentheses.

Table 3
Univariate comparisons between the treatment sample and the match sample.

	Treatment firms		Match firms			
	Mean	Median	Mean	Median	Mean difference	Median difference
Shelter	1.707	1.428	1.575	1.332	0.132	0.096
DTAX	0.015	0.016	0.028	0.011	−0.013	0.005
Firm size	7.698	7.624	7.731	7.709	−0.033	−0.085
ROA	0.033	0.045	0.034	0.037	−0.001	0.008
M/B	2.021	1.513	2.031	1.458	−0.01	0.055
Leverage	0.259	0.249	0.262	0.231	−0.003	0.018
Cash holding	0.113	0.045	0.112	0.051	0.001	−0.006

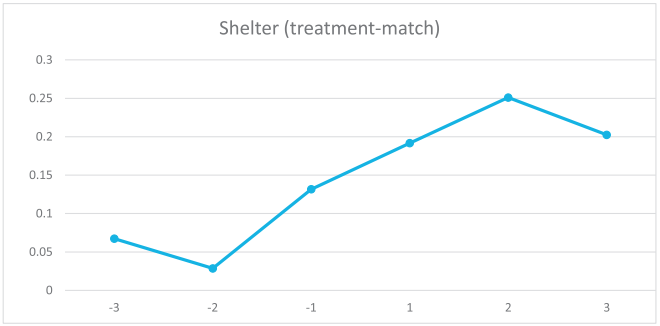
This table provides univariate comparisons of tax aggressiveness and major firm characteristics between the treatment sample and the match sample in year t-1. Shelter is a prediction score based on Wilson's (2009) model of tax sheltering. DTAX is the discretionary permanent component of book-tax differences introduced by Frank et al. (2009). Firm size is the natural logarithm of the market value of equity (PRCC_F × CSHO). ROA is the return on assets measured as operating income (PI – XI) scaled by lagged assets. M/B is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ). Leverage is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT). Cash holding is the cash ratio measured as Cash and Short-Term Investments (CHE) scaled by lagged assets (AT). T-tests are performed for mean differences between the two groups of firms, and Wilcoxon Rank-Sum tests are performed for median differences between the two groups of firms. Significance at the 10%, 5%, and 1% levels are indicated by *, **, and ***, respectively.

able differences between both groups to a large extent, and consequently enhance our confidence that the parallel trend assumption holds for our sample.

Table 4 reports the results of our baseline difference-in-differences analyses with standard errors adjusted for firm clustering. We report both six-year window (Columns 1 and 2) and four-year window results (Columns 3 and 4). In Column 1, *Shelter* is the dependent variable. We find that the coefficient on the stand-alone *Treatment firm* is insignificant, indicating that there is no difference in tax aggressiveness between the treatment and match firms in the pre-merger period. More importantly, we find that the coefficient on the interaction variable, *Treatment firm*Post*, is 0.142, significant at the 5% level.[18] Likewise, in Column 2 where *DTAX* is

[18] As Dyreng et al. (2014) note, the nature of tax avoidance activity has changed considerably over time. Many would claim that the era of off-the-shelf tax shelter products marketed in the late 1990's and early 2000's has waned. Therefore, this result should be interpreted with caution.

Panel A: Using Shelter as the proxy for tax aggressiveness



Panel B: Using DTAX as the proxy for tax aggressiveness

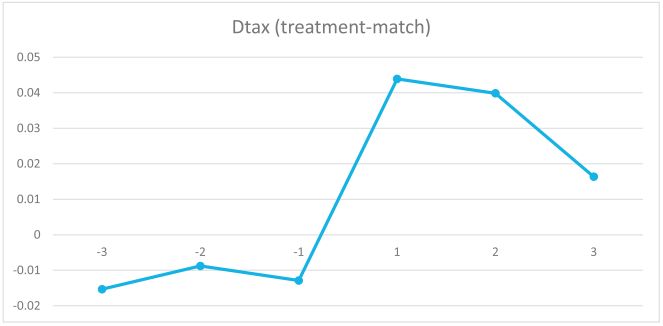


Fig. 1. Tax aggressiveness differences between treatment firms and matching firms over time, Panel A: using Shelter as the proxy for tax aggressiveness, Panel B: using DTAX as the proxy for tax aggressiveness.

the dependent variable, we find that the coefficient on the interaction variable, *Treatment firm*Post*, is 0.058, significant at the 1% level. These findings suggest that the reduction of analyst coverage causes a significant increase in corporate tax aggressiveness in the post-merger period.[19] Our results are also economically significant. For example, the post-merger increase in *Shelter* of treatment firms over a three-year window is about 0.142 (which accounts for 9.7% of the median *Shelter* (1.458) of our sample) higher than that of match firms.[20] We find similar results in columns 3 and 4 when we use [−2, 2] time window. Overall, our results suggest a negative causal effect of analyst coverage on tax aggressiveness, which is consistent with the prediction of the investor recognition and information demand views.

4.2. Exploring channels: cross-sectional analyses

In this section, we provide cross-sectional tests to identify the underlying channels through which analyst coverage constrains tax aggressiveness. Specifically, we separate our sample into two groups (e.g., high and low visibility) and rerun Model (1) over the six-year window for both subsamples. We then compare the coefficients on the interaction term (*Treatment firm*Post*) between the two subsamples and examine which channels drive our main finding.

Table 4
Difference-in-differences analysis.

	[−3, 3] window		[−2, 2] window	
	(1)	(2)	(3)	(4)
Variables	Shelter	DTAX	Shelter	DTAX
Treatment firm	−0.003	−0.023	−0.025	−0.019
	(−0.06)	(−1.47)	(−0.35)	(−1.37)
Post	0.075	−0.061***	0.059	−0.068***
	(1.32)	(−3.61)	(0.86)	(−3.11)
Treatment firm * Post	**0.142****	**0.058*****	**0.193****	**0.054****
	(2.00)	**(2.64)**	**(2.22)**	**(2.09)**
Firm size	0.117***	0.003	0.118***	−0.001
	(6.34)	(0.58)	(5.45)	(−0.16)
M/B	−0.033	−0.005	−0.032	−0.012
	(−1.20)	(−0.66)	(−1.14)	(−1.55)
Leverage	−1.915***	0.038	−1.881***	−0.042
	(−11.39)	(0.88)	(−9.95)	(−0.83)
ROA	4.542***	0.466***	4.529***	0.521***
	(7.87)	(4.17)	(7.12)	(4.03)
Cash holding	0.056	−0.004	−0.092	0.008
	(0.26)	(−0.07)	(−0.39)	(0.16)
NOL	0.153***	0.005	0.206***	0.009
	(3.23)	(0.37)	(3.63)	(0.75)
Change NOL	8.293***	0.212	8.214***	0.161
	(16.80)	(1.19)	(13.79)	(0.78)
Equity income	5.070	−2.043	5.136	−3.359***
	(1.07)	(−1.56)	(0.92)	(−2.64)
PPE	0.287*	−0.026	0.182	−0.015
	(1.80)	(−0.79)	(0.98)	(−0.42)
Intangible assets	−0.280**	0.014	−0.320**	0.047
	(−2.20)	(0.32)	(−2.21)	(1.05)
Foreign income	2.720***	0.282	2.666***	0.230
	(3.43)	(1.23)	(2.91)	(0.90)
Observations	4355	3590	3009	2491
Adjusted R-squared	0.507	0.075	0.508	0.121

The table presents difference-in-differences regression results. The treatment firms are firms that are affected by brokerage mergers. The match is based on major firm characteristics including firm size, analyst coverage, M/B, ROA, and Cash holding as well as tax aggressiveness measures (Shelter or DTAX) using one-to-one nearest neighbor propensity score match method. To ensure there are no significant differences between treatment firms and match firms, we use the caliper matching method and require a caliper of 1% during the match. Treatment firm is a dummy variable that equals one if a firm is affected by a brokerage merger event and zero otherwise. Post is a dummy variable that equals one if a year is after the merger year and zero before the merger year. Shelter is a prediction score based on Wilson's (2009) model of tax sheltering. DTAX is the discretionary permanent component of book-tax differences introduced by Frank et al. (2009). Firm size is the natural logarithm of the market value of equity (PRCC_F × CSHO). M/B is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ). Leverage is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT). ROA is the return on assets measured as operating income (PI – XI) scaled by lagged assets. Cash holding is the cash ratio measured as Cash and Short-Term Investments (CHE) scaled by lagged assets (AT). NOL is a dummy variable coded as one if the loss carry forward (TLCF) is positive. Change NOL is the change in loss carry forward (TLCF) scaled by lagged assets (AT). Equity income is the equity income in earnings (ESUB) scaled by lagged assets (AT). PPE is the property, plant, and equipment (PPENT) scaled by lagged assets (AT). Intangible assets is the intangible assets (INTAN) scaled by lagged assets (AT). Foreign income is foreign income (PIFO) scaled by lagged assets (AT). The independent variables are lagged one year relative to the dependent variables. We also control for industry and year fixed effects in all regressions. The *t*-value in the parentheses is based on heteroscedasticity robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% levels are indicated by *, **, and ***, respectively.

4.2.1. Exploring the investor recognition channel

Firms engaging in aggressive tax planning strategies could incur non-tax costs (e.g., reputation costs) if such activities are revealed to the public (e.g., Hanlon and Slemrod 2009). According to the investor recognition view, higher analyst coverage increases the visibility of tax aggressive activities to the general public, thus heightening non-tax costs of such activities to firms. This, in turn,

[19] We also compute VIFs of our model (untabulated). The mean VIF value is approximately 1.6 and the highest VIF value is 3.69. All the VIFs are lower than the commonly accepted threshold of 10 (Kutner et al., 2004). These results suggest that multicollinearity is not a serious concern in our study.

[20] The effect of analyst coverage on corporate tax aggressiveness is comparable with that of recent studies using the same setting of brokerage house mergers. For example, He and Tian (2013, p. 868), who examine the effect of analyst coverage on corporate innovation, report that "an exogenous average loss of one analyst following a firm causes it to generate 18.2% more patents over a three-year window than a similar firm without any decrease in analyst coverage." Chen, Harford, and Lin (2015, p. 390) find that "on average a one analyst drop out of 12.71 original analysts results in a one-sixth drop in the marginal value of cash holding."

Table 5
Channel test: the effect of investor recognition.

Panel A: using advertisement expenditures as the proxy for investor recognition				
Variables	(1) Without advertisement Shelter	(2) With advertisement Shelter	(3) Without advertisement DTAX	(4) With advertisement DTAX
Treatment firm	−0.156	0.051	−0.047	−0.021
	(−1.58)	(0.88)	(−1.48)	(−1.01)
Post	−0.075	−0.076	−0.118***	−0.066**
	(−0.58)	(−1.06)	(−2.81)	(−2.52)
Treatment firm * Post	**0.364**(β1)**	**0.101**(β2)**	**0.101***(β3)**	**0.030**(β4)**
	(2.80)	**(1.29)**	**(2.85)**	**(1.06)**
Chi2 (*p*-value) for test: β1 = β2 (β3 = β4)	3.08*		2.79*	
	(0.07)		(0.09)	
Controls	Yes	Yes	Yes	Yes
Observations	3082	1273	2467	1123
Adjusted R-squared	0.530	0.506	0.064	0.073
Panel B: using S&P 1500 firms as the proxy for investor recognition				
VARIABLES	(1) Non-S&P firms Shelter	(2) S&P firms Shelter	(3) Non-S&P firms DTAX	(4) S&P firms DTAX
Treatment firm	−0.076	0.128	−0.030	0.001
	(−1.24)	(1.38)	(−1.54)	(0.03)
Post	−0.062	−0.099	−0.090***	−0.085**
	(−0.79)	(−0.87)	(−3.42)	(−2.06)
Treatment firm * Post	**0.143***(β1)**	**−0.103**(β2)**	**0.084***(β3)**	**−0.045**(β4)**
	(1.76)	**(−0.76)**	**(3.08)**	**(−0.92)**
Chi2 (*P*-value) for test: β1 = β2 (β3 = β4)	2.26		4.29**	
	(0.13)		(0.04)	
Controls	Yes	Yes	Yes	Yes
Observations	1410	2950	1016	2574
Adjusted R-squared	0.539	0.514	0.030	0.118

The table explores the investor recognition effect of analyst coverage on tax aggressiveness based on the difference-in-difference [−3, 3] window models in Table 4. Shelter is a tax sheltering prediction score based on Wilson's (2009) model of tax sheltering probability. DTAX is the discretionary permanent component of book-tax differences introduced by Frank et al. (2009). Firm size is the natural logarithm of the market value of equity (PRCC_F × CSHO). M/B is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ). Leverage is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT). ROA is the return on assets measured as operating income (PI – XI) scaled by lagged assets Cash holding is the cash ratio measured as Cash and Short-Term Investments (CHE) scaled by lagged assets (AT). NOL is a dummy variable coded as one if the loss carry forward (TLCF) is positive. Change NOL is the change in loss carry forward (TLCF) scaled by lagged assets (AT). Equity income is the equity income in earnings (ESUB) scaled by lagged assets (AT). PPE is the property, plant, and equipment (PPENT) scaled by lagged assets (AT). Intangible assets is the intangible assets (INTAN) scaled by lagged assets (AT). Foreign income is foreign income (PIFO) scaled by lagged assets (AT). The independent variables are lagged one year relative to the dependent variables. We also control for industry and year fixed effects in all regressions. The *t*-value in the parentheses is based on heteroscedasticity robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% levels are indicated by *, **, and ***, respectively.

reduces these firms' incentives to aggressively avoid taxes. If this view holds, we expect the constraining effect of analyst coverage on tax aggressiveness to be more pronounced for firms with lower visibility.

To examine this conjecture, we adopt two measures of firm visibility. One is advertising expenditures (*Advertisement*). Grullon et al. (2004) find that advertising increases a firm's visibility and awareness with investors. Accordingly, we separate firms into two groups based on whether a firm has advertisement expenditures or not. The other measure of visibility is based on whether a firm is included in the Standard & Poor's (S&P) Composite 1500 Index. Recent studies suggest that S&P firms are generally larger and have higher press coverage than those outside the Index (Drake et al., 2014; Li et al., 2011). We separate firms into S&P 1500 firms and non-S&P 1500 firms. We rerun Model (1) separately for these subsamples, and report the results in Table 5.

In Panel A, we report the results for firms with and without *Advertisement*. We find that the coefficients on the variable of interest, *Treatment firm*Post*, are positive and significant for firms without *Advertisement*, while they are not significant for firms with *Advertisement*. Additionally, the coefficients are significantly different between the two subsamples regardless of which measure we use for tax aggressiveness. The results show that the reduction of analyst coverage increases tax aggressiveness only for firms with lower visibility. In Panel B of Table 5, we find similar results for non-S&P versus S&P firms. Overall, the results in Table 5 suggest that the investor recognition role of analysts is a plausible explanation for why analysts help constrain tax aggressiveness.

4.2.2. Exploring the information demand channel

As the information demand view suggests, financial analysts demand transparent, predictable information to facilitate their forecast of firms' future earnings. Accordingly, firms are likely to cater to analysts' information demand by reducing complex activities such as aggressive tax planning activities. To the extent that analysts' information demand increases with corporate opacity, the constraining effect of analyst coverage on tax aggressiveness is likely to be more salient in firms with weaker information environments.

To test this conjecture, we follow prior studies (e.g., Amihud and Mendelson, 1986; Leuz and Verrecchia, 2000; Brown and Hillegeist, 2007) and adopt two widely used measures of information environment. The first is *Spread*, which is the difference between the ask price and the bid price divided by the average of ask and bid prices. These values are calculated on a daily basis and then averaged for the one-year period. The second is *PIN*, which is the probability of informed trading computed based on Brown and Hillegeist (2007). We then create two groups of firms: firms with *High*

Table 6
Channel test: the effect of information demand.

Panel A: using bid-ask spread as the proxy for information asymmetry				
Variables	(1) Low spread Shelter	(2) High spread Shelter	(3) Low spread DTAX	(4) High spread DTAX
Treatment firm	−0.162	−0.243	−0.024	−0.100
	(−1.37)	(−1.54)	(−1.35)	(−1.51)
Post	−0.108	−0.163	−0.029	−0.439***
	(−0.72)	(−0.76)	(−1.35)	(−4.43)
Treatment firm*Post	**0.243 (β1)**	**0.601*** (β2)**	**0.003(β3)**	**0.181**(β4)**
	(1.39)	**(3.55)**	**(0.11)**	**(2.40)**
Chi2 (*P*-value) for test: $\beta1=\beta2$ ($\beta3=\beta4$)	2.83* (0.09)		5.52** (0.01)	
Controls	Yes	Yes	Yes	Yes
Observations	904	932	787	846
Adjusted R-squared	0.489	0.604	0.265	0.160
Panel A: using PIN as the proxy for information asymmetry				
Variables	(1) Low PIN Shelter	(2) High PIN Shelter	(3) Low PIN DTAX	(4) High PIN DTAX
Treatment firm	0.020	−0.059	−0.008	−0.007
	(0.22)	(−0.48)	(−0.26)	(−0.15)
Post	−0.044	−0.139	−0.069**	−0.113**
	(−0.41)	(−0.96)	(−2.00)	(−2.13)
Treatment firm*Post	**−0.006(β1)**	**0.313**(β2)**	**−0.036(β3)**	**0.087*(β4)**
	(−0.054)	**(2.18)**	**(−0.84)**	**(1.84)**
Chi2 (*P*-value) for test: $\beta1=\beta2$ ($\beta3=\beta4$)	2.81* (0.09)		2.80* (0.09)	
Controls	Yes	Yes	Yes	Yes
Observations	1195	1382	908	1178
Adjusted R-squared	0.541	0.560	0.002	0.085

The table explores the information demand effect of analyst coverage on tax aggressiveness based on the difference-in-difference [−3, 3] window models in Table 4. Spread is the difference between the ask price and the bid price divided by the average of the ask and bid prices. These values are calculated on a daily basis and then averaged for the one-year period. PIN is probability of informed trading computed based on Brown and Hillegeist (2007). High spread (High PIN) refers to firms whose spread (PIN) are in the top quartile of the sample, and Low spread (PIN) refers to firms whose spread (PIN) are in the bottom quartile of the sample. Shelter is a prediction score based on Wilson's (2009) model of tax sheltering. DTAX is the discretionary permanent component of book-tax differences introduced by Frank et al. (2009). Firm size is the natural logarithm of the market value of equity (PRCC_F × CSHO). M/B is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ). Leverage is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT). ROA is the return on assets measured as operating income (PI – XI) scaled by lagged assets Cash holding is the cash ratio measured as Cash and Short-Term Investments (CHE) scaled by lagged assets (AT). NOL is a dummy variable coded as one if the loss carry forward (TLCF) is positive. Change NOL is the change in loss carry forward (TLCF) scaled by lagged assets (AT). Equity income is the equity income in earnings (ESUB) scaled by lagged assets (AT). PPE is the property, plant, and equipment (PPENT) scaled by lagged assets (AT). Intangible assets is the intangible assets (INTAN) scaled by lagged assets (AT). Foreign income is foreign income (PIFO) scaled by lagged assets (AT). The independent variables are lagged one year relative to the dependent variables. We also control for industry and year fixed effects in all regressions. The t- value in the parentheses is based on heteroscedasticity robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% levels are indicated by *, **, and ***, respectively.

Spread (*High PIN*) if their *Spread* (*PIN*) is in the top quartile of the sample, and firms with *Low Spread* (*Low PIN*) if their *Spread* (*PIN*) is in the bottom quartile of the sample. We rerun Model 1 for these two subsamples separately. The results are reported in Table 6.

In Panel A, we report the results for *High* and *Low Spread* subsamples. We find that the coefficients on variable of interest, *Treatment firm*Post*, are positive and significant for the *High Spread* subsample, while they are not significant for the *Low Spread* subsample. Additionally, we provide tests on the coefficient differences and find that they are significantly different between the two subsamples regardless of which measure we use for tax aggressiveness. In Panel B of Table 6, we use *PIN* as the proxy for information asymmetry and find similar results. The effect of analyst coverage on tax aggressiveness is concentrated in firms with high information asymmetry, and the effect is significantly different between the two subsamples. Overall, the results in Table 6 suggest that analysts' information demand is another channel through which analyst coverage helps constrain tax aggressiveness.

4.2.3. Exploring the monitoring channel

Analysts are also likely to play a governance role in curbing managerial agency problems (e.g., Jensen and Meckling, 1976; Irani and Oesch, 2013). On the one hand, prior studies (e.g., Desai, 2005; Desai and Dharmapala, 2006) suggest that managers may make use of complex transactions such as tax aggressive activities to cover up their expropriation of shareholder wealth. Thus, if analysts constrain corporate tax aggressiveness through their monitoring role in reducing managerial expropriation, we expect the constraining effect of analyst coverage to vary with the strength of traditional governance mechanisms.[21]

[21] To the extent monitoring by analysts and traditional governance mechanisms perform similar functions and thus serve as substitutes, the constraining effect of analyst coverage is likely to be more salient in firms with weaker governance. Yet, if analysts facilitate the monitoring function of other governance mechanisms through producing and disseminating value-relevant information, the constraining effect of analyst coverage is likely to be more pronounced in firms with stronger governance.

On the other hand, self-interested management tend to enjoy the quiet life and shirk their responsibility to engage in costly, but value-enhancing, activities (Bertrand and Mullainathan, 2003). Strong governance mechanisms align managers' interests with those of shareholders, thus reducing this shirking-related agency problem. Prior studies also suggest that tax avoidance in general and tax aggressiveness in particular are risky and resource-intensive corporate activities (e.g., Christensen et al., 2015). Accordingly, unless disciplined by strong governance, managers tend to select a lower level of tax avoidance than shareholders prefer, because such activities are generally complex and require substantial managerial effort (e.g., coordination of business units across the firm). Consistent with this notion, Cheng et al. (2012) and McGuire et al. (2014) suggest that stronger governance mechanisms increase corporate tax efficiency. Therefore, if analyst monitoring encourages management to engage more in tax aggressiveness, we also expect the effect of analyst coverage on tax aggressiveness to vary with the strength of governance.

We use two proxies of governance to test this channel. Khurana and Moser (2013) find that firms with higher levels of long-term institutional ownership have lower levels of tax avoidance, suggesting that institutional investors monitor management and thus constrain expropriation-related tax avoidance. By obtaining institutional ownership (13f) data from Thomson Reuters Ownership Database, we construct our first measure of corporate governance, *Institutional ownership*, which is the fraction of a firm's outstanding shares owned by institutional investors. Our second measure of governance quality is Gompers et al.'s (2003) *G-index*. A higher *G-index* indicates that management is more entrenched and insulated from takeover markets, which implies higher agency risk. Then we create two subsamples based on whether a firm's *Institutional ownership* (*G-index)* is in the top or bottom quartile of *Institutional ownership* (*G-index)*. We rerun Model 1 separately for these subsamples, and report the results in Table 7.

Panel A and Panel B report the results when *Institutional ownership* and *G-index* are used as proxies for governance quality, respectively. We find that regardless of which measure we use for tax aggressiveness, we do not find any statistically significant difference between good governance firms and bad governance firms in terms of the effect of analyst reduction on tax aggressiveness. In addition, the subsample results do not indicate that higher analyst coverage encourages more tax aggressiveness. Overall, the results in Table 7 suggest that the monitoring role of analysts is not a plausible explanation for why analysts affect tax aggressiveness.

4.2.4. Exploring the market pressure channel

The results in Section 4.1 suggest that the information and investor recognition effects of analysts dominate the pressure effect in the full sample. Yet the pressure effect may still be at play in certain firms, for example, those under the most extreme pressure imposed by analysts. If so, we should observe a significantly negative sign of the interaction term, *Treatment firm*Post*, in these firms. Next, we adopt two approaches to examine whether the pressure effect prevails in the highest-pressure subsamples.

Our first approach is to focus on firm-years that just meet the consensus analyst forecast, a widely studied earnings benchmark. Brown and Caylor (2005) find that the stock market tends to react negatively when management fails to meet the performance target. This creates pressure for management to avoid earnings disappointments. In addition to manipulation of accruals and real activities (e.g., Burgstahler and Dichev, 1997; Roychowdhury, 2006), another way management can inflate reported earnings is through tax avoidance activities (Desai, 2005; Desai and Dharmapala, 2006, 2009). Specifically, we follow prior studies (e.g., Cheng and Warfield, 2005; Roychowdhury, 2006) and identify a subsample of firms that are more likely to have managed earnings upward (i.e., *Suspect firms*): firms with final consensus forecast errors before earnings announcements falling between zero and one cent for at least one year during the pre-merger window, where forecast error is defined as actual earnings per share (EPS) minus the consensus forecast of EPS.[22] Firms with no consensus forecast errors falling within the range during the whole time window are classified as *Non-Suspect firms*. We then rerun Model 1 for these two subsamples and report the results in Panel A of Table 8.

Contrary to our expectation, we do not find any negative signs on the interaction terms in Panel A. Specifically, when we use *Shelter* as the proxy for tax aggressiveness, we find that the interaction term, *Treatment firm*Post*, is positive and insignificant for both *Suspect firms* and *Non-Suspect firms*. When we use *DTAX* as the proxy for tax aggressiveness, we find that the interaction term, *Treatment firm*Post*, is positive and significant for *Suspect firms* but not for *Non-Suspect firms*. More importantly, we do not observe any coefficient differences between these two subsamples.

We further use the existence of analyst cash forecast as a proxy for the market pressure from analysts. Ayers et al. (2013) find that firms with analyst cash flow forecasts have higher levels of tax avoidance compared to firms without such forecasts, suggesting that analysts' cash flow forecasts impose additional pressure on managers to engage in tax avoidance activities. We construct a dummy variable, *Cash forecast firms,* which equals one if a firm has analysts' cash flow forecasts for at least one year during the pre-merger window. Firms with no cash flow forecasts during the entire window are classified as *Non-Cash forecast firms*. We separate our sample into two subsamples based on this dummy variable. We rerun Model 1 for the two subsamples and report the results in Panel B of Table 8.

Similar to the results in Panel A, we do not find any negative signs on the interaction terms in Panel B. Specifically, when we use *Shelter* as the proxy for tax aggressiveness, we find that the interaction term, *Treatment firm*Post*, is insignificant for both subsamples. When we use *DTAX* as the proxy for tax aggressiveness, we find that the interaction term, *Treatment firm*Post*, is positive and significant for the subsample with *Cash forecast firm* equal to 1, but not significant for the other subsample. Overall, our results in Table 8 do not lend support to the market pressure effect of analyst coverage.[23]

4.3. Instrumental variable approach to address endogeneity bias

In this section, we provide the second identification strategy to correct for potential bias due to the endogeneity of analyst coverage. Following Yu (2008) and He and Tian (2013), we use expected coverage as a plausible instrument for analyst coverage. Expected coverage is calculated based on the change in brokerage house size. Yu (2008) argues that a change in a brokerage house's size is driven primarily by the change of the broker's own revenue or profit, and thus is unlikely to be driven by the behaviors of firms covered by the broker. Accordingly, the change of coverage driven by the change of brokerage house size is a plausibly exogenous variation that helps us to address the endogeneity of analyst coverage.

Following Yu (2008) and He and Tian (2013), we use the models below to calculate expected coverage:

$$ExpCoverage_{i,t,j} = (Brokersize_{t,j}/Brokersize_{0,j}) \times Coverage_{i,0,j} \quad (2)$$

[22] As Roychowdhury (2006) suggests, the final consensus can be thought of as an *ex post* proxy for what managers expect the final consensus to be during the year.

[23] Given the fact that analysts are more likely to focus on GAAP effective tax rates (GAAP ETRs) when projecting future earnings, GAAP ETR might also be an appropriate measure to capture pressure-driven tax avoidance in the test of the market pressure hypothesis. In untabulated tests with GAAP ETR as the dependent variable, we do not find evidence supporting the market pressure effect of analyst coverage.

Table 7
Channel test: the effect of monitoring.

Panel A: using institutional ownership as the proxy for corporate governance				
Variables	(1) High IO Shelter	(2) Low IO Shelter	(3) High IO DTAX	(4) Low IO DTAX
Treatment firm	−0.011	0.128	−0.068	−0.010
	(−0.10)	(1.18)	(−1.63)	(−0.27)
Post	0.150	−0.212	−0.141***	−0.013
	(1.13)	(−1.64)	(−2.77)	(−0.26)
Treatment firm*Post	**0.082(β1)**	**0.059(β2)**	**0.122**(β3)**	**0.099*(β4)**
	(0.60)	**(0.36)**	**(2.35)**	**(1.75)**
Chi2 (*P*-value) for test: $\beta1=\beta2$ ($\beta3=\beta4$)	0.01		0.12	
	(0.90)		(0.72)	
Controls	Yes	Yes	Yes	Yes
Observations	1168	934	738	624
Adjusted R-squared	0.478	0.653	0.050	0.129
Panel B: using G-index as the proxy for corporate governance				
Variables	(1) High G-index Shelter	(2) Low G-index Shelter	(3) High G-index DTAX	(4) Low G-index DTAX
Treatment firm	0.145	0.026	0.018	0.033
	(0.90)	(0.14)	(0.26)	(0.42)
Post	0.284	0.232	−0.029	−0.049
	(1.42)	(1.09)	(−0.38)	(−0.53)
Treatment firm*Post	**−0.224(β1)**	**−0.098(β2)**	**0.012(β3)**	**−0.015(β4)**
	(−1.14)	**(−0.46)**	**(0.15)**	**(−0.16)**
Chi2 (*P*-value) for test: $\beta1=\beta2$ ($\beta3=\beta4$)	0.61		0.06	
	(0.43)		(0.80)	
Controls	Yes	Yes	Yes	Yes
Observations	459	510	418	440
Adjusted R-squared	0.466	0.605	0.029	0.133

The table explores the monitoring effect of analyst coverage on tax aggressiveness based on the difference-in-difference [−3, 3] window models in Table 4. Institutional ownership (IO) is the fraction of a firm's outstanding shares owned by institutional investors. G-index is the Gompers et al.'s (2003) management entrenchment index. High IO (High G-index) refers to firms whose IO (G-index) are in the top quartile of the sample, and Low IO (G-index) refers to firms whose IO (G-index) are in the bottom quartile of the sample. Shelter is a prediction score based on Wilson's (2009) model of tax sheltering. DTAX is the discretionary permanent component of book-tax differences introduced by Frank et al. (2009). Firm size is the natural logarithm of the market value of equity (PRCC_F × CSHO). M/B is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ). Leverage is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT). ROA is the return on assets measured as operating income (PI – XI) scaled by lagged assets Cash holding is the cash ratio measured as Cash and Short-Term Investments (CHE) scaled by lagged assets (AT). NOL is a dummy variable coded as one if the loss carry forward (TLCF) is positive. Change NOL is the change in loss carry forward (TLCF) scaled by lagged assets (AT). Equity income is the equity income in earnings (ESUB) scaled by lagged assets (AT). PPE is the property, plant, and equipment (PPENT) scaled by lagged assets (AT). Intangible assets is the intangible assets (INTAN) scaled by lagged assets (AT). Foreign income is foreign income (PIFO) scaled by lagged assets (AT). The independent variables are lagged one year relative to the dependent variables. We also control for industry and year fixed effects in all regressions. The *t*-value in the parentheses is based on heteroscedasticity robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% levels are indicated by *, **, and ***, respectively.

and

$$ExpCoverage_{i,t} = \sum_{j=1}^{n} ExpCoverage_{i,t,j} \quad (3)$$

where $ExpCoverage_{i,t,j}$ is the expected coverage of firm i from broker j in year t. $Brokersize_{0,j}$ and $Brokersize_{t,j}$ are the number of analysts employed by broker j in the benchmark year 0 and year t, respectively. $Coverage_{i,0,j}$ is the size of the coverage for firm i from broker j in the benchmark year 0. $ExpCoverage_{i,t}$ is the expected coverage of firm i from all brokers in year t.[24]

Following Yu (2008) and He and Tian (2013), we use the first year of our sample, 1985, as the benchmark year.[25] To construct a meaningful measure of expected coverage, we require a firm to be covered by at least one analyst in the benchmark year. In our 2SLS analysis, following He and Tian (2013), we drop all observations in the benchmark year because the expected coverage for that year is automatically set to one by this design.

In the first-stage regression, we use *Analyst coverage* as the dependent variable to check the relevance of the instrumental variable. The main variable of interest is the instrument, *ExpCoverage*. The other control variables are the same firm attributes as those in the Model (1). Firm and year fixed effects are also included. The results are in Column 1 of Table 9. The coefficient on *ExpCoverage* is positive and significant at the 1% level. The *t*-statistics of *ExpCoverage* is 88.37, indicating a high correlation between *Analyst coverage* and *ExpCoverage*. Thus, as in Yu (2008) and He and Tian (2013), *ExpCoverage* is a plausible instrument for *Analyst coverage*, which enhances the reliability of inferences in the second-stage regressions.

Columns 2 and 3 of Table 9 report the results from the second-stage regressions where the fitted value of *Analyst coverage* from

[24] Following Yu (2008), we constrain to one the maximum number of analysts that a broker sends to cover a firm.

[25] We try to use some other years with more observations, and our results hold with alternative benchmark years.

Table 8
Channel test: the effect of market pressure.

Panel A: using suspect firm as the proxy for market pressure

Variables	(1) Suspect firm Shelter	(2) Non suspect firm Shelter	(3) Suspect firm DTAX	(4) Non suspect firm DTAX
Treatment firm	−0.012	0.178	−0.033	−0.011
	(−0.20)	(1.52)	(−1.50)	(−0.34)
Post	0.045	−0.065	−0.089***	−0.084**
	(0.57)	(−0.52)	(−3.18)	(−2.20)
Treatment firm*Post	**0.093 (β1)**	**0.090(β2)**	**0.082***(β3)**	**0.028(β4)**
	(1.12)	**(0.66)**	**(2.79)**	**(0.70)**
Chi2 (P-value) for test: $\beta1 = \beta2$ ($\beta3 = \beta4$)	0.02		1.46	
	(0.91)		(0.23)	
Controls	Yes	Yes	Yes	Yes
Observations	2371	1202	1966	951
Adjusted R-squared	0.472	0.546	0.105	0.075

Panel B: using cash forecast as the proxy for market pressure

Variables	(1) Cash forecast firm Shelter	(2) Non cash forecast firm Shelter	(3) Cash forecast firm DTAX	(4) Non cash forecast firm DTAX
Treatment firm	0.044	0.074	−0.026	−0.012
	(0.64)	(1.01)	(−0.89)	(−0.57)
Post	−0.033	−0.090	−0.134***	−0.041*
	(−0.36)	(−1.04)	(−3.40)	(−1.73)
Treatment firm ∗ Post	**0.128(β1)**	**0.053(β2)**	**0.102***(β3)**	**0.016(β4)**
	(1.39)	**(0.55)**	**(2.73)**	**(0.59)**
Chi2 (P-value) for test: $\beta1 = \beta2$ ($\beta3 = \beta4$)	0.31		5.29**	
	(0.58)		(0.01)	
Controls	Yes	Yes	Yes	Yes
Observations	2462	1893	1979	1611
Adjusted R-squared	0.493	0.571	0.104	0.081

The table explores the market pressure effect of analyst coverage on tax aggressiveness based on the difference-in-difference [−3, 3] window models in Table 4. Suspect firms are those firms whose final consensus forecast errors before earnings announcements fall between zero and one cent for at least one year during the pre-merger window, where forecast error is defined as actual earnings per share (EPS) minus the consensus forecast of EPS. Non-Suspect firms refer to those firms with no consensus forecast errors falling within the range during the whole time window. Cash forecast firms are those firms which have analysts' cash flow forecasts for at least one year during the pre-merger window. Non-Cash forecast firms are those with no cash flow forecasts during the whole time window. Shelter is a prediction score based on Wilson's (2009) model of tax sheltering. DTAX is the discretionary permanent component of book-tax differences introduced by Frank et al. (2009). Firm size is the natural logarithm of the market value of equity (PRCC_F × CSHO). M/B is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ). Leverage is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT). ROA is the return on assets measured as operating income (PI – XI) scaled by lagged assets Cash holding is the cash ratio measured as Cash and Short-Term Investments (CHE) scaled by lagged assets (AT). NOL is a dummy variable coded as one if the loss carry forward (TLCF) is positive. Change NOL is the change in loss carry forward (TLCF) scaled by lagged assets (AT). Equity income is the equity income in earnings (ESUB) scaled by lagged assets (AT). PPE is the property, plant, and equipment (PPENT) scaled by lagged assets (AT). Intangible assets is the intangible assets (INTAN) scaled by lagged assets (AT). Foreign income is foreign income (PIFO) scaled by lagged assets (AT). The independent variables are lagged one year relative to the dependent variables. We also control for industry and year fixed effects in all regressions. The t-value in the parentheses is based on heteroscedasticity robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% levels are indicated by *, **, and ***, respectively.

the first-stage regression substitutes for *Analyst coverage* in Eq. (1). Consistent with the findings from the baseline regressions, the coefficients on the fitted value of *Analyst coverage* are negative and significant in both columns, reinforcing our findings in the difference-in-difference analysis.

5. Conclusion

The steady increase in firms' aggressive use of tax planning strategies in recent years has triggered an expanding literature on the determinants of this corporate behavior. We contribute to this literature by examining the causal effect of financial analysts, a key information intermediary, on corporate tax aggressiveness. Prior literature suggests three views regarding the role of financial analysts. According to the investor recognition, higher analyst coverage increases the visibility of the stocks they follow and thus the visibility of the underlying firms' business practices such as tax aggressive activities. To the extent that public dissemination of such activities brings about non-tax costs, firms with higher analyst coverage are more likely to limit tax aggressiveness. Another view, the information demand view, posit that tax aggressive activities entail high uncertainty and risk, thereby impeding analysts' ability to assimilate information and make accurate forecasts. To the extent that analysts' demand for transparent and predictable earnings increases with the number of analysts following the firm, management would likely cater to the heightened information demand by suppressing the firm's tax aggressiveness. Both views predict a negative association between analyst coverage and tax aggressiveness. On the other hand, pressure from analysts would likely exacerbate earnings management. To the extent that aggressive tax planning strategies are convenient tools for earnings management, greater analyst coverage could result in managers using more aggressive tax planning strategies. Therefore, this view predicts a positive association between analyst coverage and tax aggressiveness.

To address endogeneity concerns, we perform a difference-in-differences analysis using a setting with exogenous decreases in analyst coverage. Our tests identify a negative causal effect of analyst coverage on tax aggressiveness, suggesting that financial analysts constrain corporate tax aggressiveness. We also find that this

Table 9
Two-stage least squares regression results.

Variables	(1) First stage Analyst coverage	(2) Second stage Shelter	(3) DTAX
ExpCoverage	0.888***		
	(88.37)		
Fitted analyst coverage		**−0.116****	**−0.038****
		(−2.49)	**(−2.48)**
Firm size	0.244***	0.769***	−0.012**
	(39.03)	(41.86)	(−2.56)
M/B	0.026***	−0.063***	−0.013***
	(6.71)	(−5.98)	(−5.51)
Leverage	−0.206***	−1.437***	0.067***
	(−8.04)	(−24.90)	(4.73)
ROA	0.015	5.827***	0.427***
	(0.38)	(56.69)	(18.16)
Cash holding	0.045	−0.257***	−0.028**
	(1.24)	(−4.11)	(−1.96)
NOL	−0.044***	0.362***	0.015***
	(−5.55)	(19.57)	(3.48)
Change NOL	0.002	3.997***	0.373***
	(0.04)	(30.52)	(12.43)
Equity income	−1.650***	−1.273	−0.023
	(−2.83)	(−0.88)	(−0.07)
PPE	0.044*	−0.208***	−0.017**
	(1.95)	(−5.82)	(−2.01)
Intangible assets	−0.065**	0.077	−0.020*
	(−2.57)	(1.37)	(−1.69)
Foreign income	0.439***	11.943***	−0.108*
	(3.87)	(48.42)	(−1.91)
Observations	14,045	13,748	11,390
(Adjusted) R-squared	0.925	0.836	0.070

The table presents the 2SLS regression results. The dependent variables in the second-stage are Shelter and DTAX. Shelter is a prediction scored based on Wilson's (2009) model of tax sheltering. DTAX is the discretionary permanent component of book-tax differences introduced by Frank et al. (2009). Number of analysts is the average of the 12 monthly numbers of earnings forecasts. The instrumental variable for Analyst coverage is ExpCoverage as described in Section 4.3. Firm size is the natural logarithm of the market value of equity (PRCC_F × CSHO). M/B is the market-to-book ratio measured as market value of equity (PRCC_F × CSHO) scaled by book value of equity (CEQ). Leverage is leverage measured as long-term debt (DLTT) scaled by lagged assets (AT). ROA is the return on assets measured as operating income (PI – XI) scaled by lagged assets Cash holding is the cash ratio measured as Cash and Short-Term Investments (CHE) scaled by lagged assets (AT). NOL is a dummy variable coded as one if the loss carry forward (TLCF) is positive. Change NOL is the change in loss carry forward (TLCF) scaled by lagged assets (AT). Equity income is the equity income in earnings (ESUB) scaled by lagged assets (AT). PPE is the property, plant, and equipment (PPENT) scaled by lagged assets (AT). Intangible assets is the intangible assets (INTAN) scaled by lagged assets (AT). Foreign income is foreign income (PIFO) scaled by lagged assets (AT). The independent variables are lagged one year relative to the dependent variables. We also control for industry and year fixed effects in all regressions. The *t*-value in the parentheses is based on heteroscedasticity robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% levels are indicated by *, **, and ***, respectively.

effect is achieved through the investor recognition channel and the information demand channel. Our results do not support the notion that analysts' monitoring function contributes to less tax aggressiveness. Finally, our subsample tests are not supportive of the view that pressure from analysts' expectations exacerbates tax aggressiveness.

In sum, the findings improve our understanding of the role of financial analysts, and more broadly, capital market scrutiny, in affecting corporate tax avoidance. Our study contributes to prior literature on the determinants of tax avoidance and furthers the understanding of the "under-sheltering puzzle." Our study also contributes to prior literature on the effects of analyst coverage on various corporate behaviors by suggesting that analysts' role in enhancing investor recognition and information demand constrains corporate tax aggressiveness.

Appendix A: Measures of tax aggressiveness

DTAX	DTAX is equal to firm i's residual from the following regression estimated by two-digit SIC code and fiscal year: $PERMDIFF_{i,t} = \beta 0 + \beta 1\ INTANG_{i,t} + \beta 2\ UNCON_{i,t} + \beta 3\ MI_{i,t} + \beta 4\ CSTE_{i,t} + \beta 5\ \Delta NOL_{i,t} + \beta 6\ LAGPERM_{i,t} + \varepsilon_{i,t}$; Where: $PERMDIFF_{i,t} = BI_{i,t} - [(CFTE_{i,t} + CFOR_{i,t})/STR_{i,t}] - (DTE_{i,t}/STR_{i,t})$, $BI_{i,t}$ = pre-tax book income (PI) for firm i in year t; $CFTE_{i,t}$ = current federal tax expense (TXFED) for firm i in year t; $CFOR_{i,t}$ = current foreign tax expense (TXFO) for firm i in year t; $DTE_{i,t}$ = deferred tax expense (TXDI) for firm i in year t; $STR_{i,t}$ = statutory tax rate in year t; $INTANG_{i,t}$ = goodwill and other intangibles (INTAN) for firm i in year t; $UNCON_{i,t}$ = income (loss) reported under the equity method (ESUB) for firm i in year t; $MI_{i,t}$ = income (loss) attributable to minority interest (MII) for firm i in year t; $CSTE_{i,t}$ = current state income tax expense (TXS) for firm i in year t; $\Delta NOL_{i,t}$ = change in net operating loss carryforwards (TLCF) for firm i in year t; $LAGPERM_{i,t}$ = one-year lagged PERMDIFF for firm i in year t; and $\varepsilon_{i,t}$ = discretionary permanent difference (DTAXi, t) for firm i in year t. We follow the method in Frank, Lynch, and Rego (2009) to handle the missing value problems in estimating DTAX. If minority interest (MII), current foreign tax expense (TXFO), income from unconsolidated entities (ESUB), or current state tax expense (TXS) is missing on Compustat, then we set MI, CFOR, UNCON, or CSTE, respectively, to zero. If current federal tax expense (TXFED) is missing on Compustat, then we set the value of CFTE to: total tax expense (TXT) less current foreign tax expense (TXFO) less current state tax expense (TXS) less deferred tax expense (TXDI). If goodwill and other intangibles (INTAN) is missing on Compustat, then we set the value for INTANG to 0. If INTAN = C, then we set the value of INTANG to that for goodwill (GDWL). The variables in this regression model are deflated by total assets (AT) and are winsorized at 1% and 99% level to mitigate the impact of extreme observations and possible data errors.
BT	$BT_{i,t}$ is Manzon and Plesko (2002) book-tax difference (BT) for firm *i* in year *t*. BT is defined as (US domestic financial income – US domestic taxable income – Income taxes (State) – Income taxes (Other) – Equity in Earnings)/lagged assets = (PIDOM – TXFED/Statutory tax rate – TXS – TXO – ESUB)/AT_{t-1}. Firms with zero or negative taxable income are assumed to have attenuated incentives, at the margin, to engage in tax sheltering activity. We follow the prior literature, e.g., Desai and Dharmapala (2006), and include only firm-years with positive TXFED.
Shelter	Tax shelter prediction score, where the tax sheltering model is based on Wilson's (2009): Sheltering = −4.86 + 5.20 × BT + 4.08 × |DAP| − 1.41 × LEV + 0.76 × SIZE + 3.51 × ROE + 1.72 × Foreign Income + 2.43 × R&D, where BT is defined as above; |DAP| is the absolute value of discretionary accruals from the performance-adjusted modified cross-sectional Jones (1991) model; LEV is long-term debt divided by beginning of year total assets; SIZE is the log of total assets; ROE is pre-tax return on equity; Foreign Income is an indicator variable set equal to 1 for firm observations reporting foreign income, and zero otherwise; R&D is R&D expense divided by lagged total assets.

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