Does Information Asymmetry Affect Corporate Tax Aggressiveness?

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Abstract:

The paper investigates the effect of information asymmetry on corporate tax avoidance. Our baseline results indicate that analyst coverage reduces tax avoidance. Using a Difference-in-Differences approach based on two sources of exogenous changes in information asymmetry caused by broker closures and mergers, we find that firms engage in more tax avoidance activities after an exogenous drop in the number of analysts following the firm, compared to similar firms that do not experience such an exogenous drop in analyst coverage. The evidence therefore suggests a strong negative *causal* effect of analyst coverage on tax avoidance. We further find that the effect is mainly driven by the firms with smaller initial analyst coverage and more financial constraints. Moreover, the effect is more pronounced in the subset of firms with more information asymmetry and poorer corporate governance. We further discuss potential channels through which analysts affect tax avoidance: with less competition due to exogenous broker exits, the remaining analysts are producing less informative reports and issuing more biased forecasts. Overall, our paper offers novel evidence that information asymmetry plays an important role in corporate tax avoidance decisions, and with increased information asymmetry induced by exogenous drops in analyst coverage, firms are likely to avoid taxes more aggressively.

JEL classification: D82; G24; G32; G34; H26; M40

Keywords: Information asymmetry; Analyst coverage; Corporate tax avoidance; Natural experiment; Broker closures and mergers

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1. Introduction

What affects corporate tax avoidance? This question is of particular importance given world-wide renewed attention to corporate tax avoidance from both academics and policy makers. 30.5% of large US firms reported zero tax liability from 1998 to 2005 (US General Accounting Office, 2008),[1] and the US Internal Revenue Service estimated that the tax compliance rate is officially estimated at only 83.1 (IRS, 2012). The estimate of money stashed away using tax havens might go above $20 trillion, as indicated by a recent special report in 2013 in the *Economist*.[2] Although it is obviously of significant value to both academics and policy makers for identifying which factors have first-order effects in driving or reducing corporate tax avoidance,[3] it has received limited attention from both finance and accounting research until recently. Hanlon and Heitzman (2010) provide a very recent survey of the existing literature and conclude that "the field cannot explain the variation in tax avoidance very well" and call for more research.

Recently public media and lawmakers have called for greater transparency from companies in fighting against tax avoidance.[4] Although studies in the last few years have linked tax avoidance to various factors,[5] surprisingly little work has been done on the effects of information asymmetry. Lying at the heart of modern corporate finance (e.g., Stiglitz and Weiss, 1981; Myers and Majluf, 1984), information asymmetry matters for tax

[1] Large firms are those with assets of at least $250 million dollars or gross receipts of at least $50 million dollars.

[2] See "Tax havens: The missing $20 trillion", The Economist, February 16, 2013.

[3] We follow Hanlon and Heitzman (2010) and define tax avoidance broadly as the reduction of explicit cash taxes, which includes all transactions from investing in a municipal bond to engaging in tax shelters.

[4] See "U.K. has Unwinnable Battle on Tax Avoidance, Panel Says", Bloomberg, April 26, 2013.

[5] These factors include firm characteristics (e.g., Gupta and Newberry, 1997; Rego, 2003; Wilson, 2009; Lisowsky et al., 2013), corporate governance (e.g., Desai and Dharmapala, 2006), ownership structure (e.g., Chen et al., 2010; Cheng et al., 2012; Badertscher et al., 2013; McGuire et al., 2014), cultural norms (DeBacker et al., 2012), labor unions (Chyz et al., 2013) and executives (e.g., Dereng et al., 2010).

avoidance for the following intuitive reasons. First, firms with less information asymmetry could find it much more difficult to hide revenues and earnings through complicated financial structure or tax sheltering, i.e., they have higher transaction cost for tax avoidance. Second, decreased information asymmetry raises the direct cost of tax avoidance – an increase in the likelihood of being detected by tax authorities and investors, which in turn increases managers' reputational cost and career concerns.[6] In addition, the increased likelihood of being detected increases firm's concerns about the potential increase in financing cost.[7] Consequently, decreasing firms' information asymmetry could deter the ex ante incentives of firm managers in tax avoidance.

The paucity of the research might be partially driven by the potential endogeneity concerns. Most existing studies measure information asymmetry by using firm characteristics such as firm size, firm age, credit ratings, accounting accruals, as well as analyst following. However, these factors are inevitably correlated with unobservable firm heterogeneity such as investment opportunities, agency costs and unobserved quality, which makes it difficult to establish causality from information asymmetry to corporate policies (Tang, 2009). Also, there is a possibility that the corporate outcomes (e.g., tax avoidance) might affect the proxy variables directly (e.g., accruals), which raises the concern of reverse causality. Using analyst coverage as an illustration, literature has suggested that analysts tend to cover firms with higher quality and less information asymmetry (e.g., Chung and Jo, 1996; Bushman., 2005). Therefore, a negative link between analyst coverage and corporate tax avoidance might be caused by the fact that firms with less tax avoidance attract more analysts to cover. Moreover, the regression estimates might

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[6] Hanlon and Slemrod (2009) find that a company's stock price declines when there is news about its involvement in tax shelters. Kim et al. (2012) argue that tax avoidance increase concerns for shareholders as it provides management the tools, mask and justifications for managerial rent-diverting and other self-dealing activities. Graham et al. (2014) find that reputational concerns affect the degree to which managers engage in tax avoidance using survey responses from nearly 600 corporate executives.

[7] For instance, Shevlin et al. (2013) find that tax avoidance increases cost of public debt.

get biased because the unobservable firm heterogeneity might be correlated with both analyst coverage and tax avoidance.

Nevertheless, the most recent research has started to look at the relation between information asymmetry and tax avoidance. Using cross-country data, Kerr (2012) finds that information asymmetry leads to tax avoidance, as asymmetry allows managers a greater ability to obfuscate tax avoidance. By contrast, Balakrishnan et al. (2012) find that tax planning raises information asymmetry. Therefore, the idea that the information environment affects, or is affected by tax avoidance, is under debate, and the direction of the causality between these two constructs is unclear.

To overcome the endogeneity problem and identify the link between information asymmetry and tax avoidance, we rely on two natural experiments, brokerage closures and brokerage mergers, which generate exogenous variations in analyst coverage, to examine the causal impact of information asymmetry on tax avoidance. These two experiments directly affect firms' analyst coverage, but are exogenous to individual firms' corporate decisions and policies.[8] News of brokerage closures and mergers can easily reach firms and investors through press releases and media outlets. A key advantage of this identification approach is that it not only resolves endogeneity concerns, but also alleviates the omitted variable problem by allowing multiple shocks to affect different firms at different times. Therefore our paper is the first one, to our knowledge, to examine how information asymmetry *causally* affects corporate tax avoidance.

The information environment change caused by exogenous loss in analyst coverage matters for corporate tax avoidance through at least the following ways. Firstly, evidence from the field indicates that reputation concern and risk of adverse media attention are the

[8] These setting have been used in recent literature, such as Kelly and Ljungqvist (2012), and Derrien and Kecskes (2013).

two major factors that corporate executives rate as important or very important factors in decisions to not engage in aggressive tax planning, and these two factors are more important for firms with more analyst following (Graham et al., 2014). This happens because higher analyst coverage firms are under more scrutiny as analysts are distributing both public and private information to institutional investors and millions of individual investors through research reports and media outlets such as newspapers and TV programs (Miller, 2006).

In fact, anecdotal evidence suggests that analysts indeed pay attention to tax avoidance behaviors of the firms. For example, stock analysts "estimate the tax benefit to G.E. to be hundreds of millions of dollars a year".[9] In an article in 2012 in the Daily Telegraph, Bruce Packard, an analyst at Seymour Pierce, said "Barclays risks 'a fierce customer backlash' if it does not reduce its exposure to offshore tax havens or limit legitimate tax avoidance". [10] And he added that "…we are rather skeptical of companies that operate in offshore tax havens, believing companies generate shareholder returns by performing services or making products their customers value, rather than through complicated financial structures". Another analyst said "…issues like this – which smack of possible willful tax avoidance – are enough to generate the ire of investors, as they may indicate a lack of transparency, questionable governance and a real impact to the firm's bottom line". [11]

Secondly, the recent literature in tax avoidance suggests an agency perspective of avoidance, in the sense that complexity and obfuscation nature of tax avoidance can mask and facilitate managerial opportunism behaviors and other resource diversion activities

[9] See "G.E.'s Strategies Let It Avoid Taxes Altogether", The New York Times, March 24, 2011.

[10] See "Barclays 'Risks Backlash' Unless Its Tax Affairs Are Simplified", The Daily Telegraph, January 4, 2012.

[11] See "DJ Market Talk: NEC Down 3.1% after Reports of Unreported Income", Dow Jones Institutional News, June 25, 2012.

(e.g., Desai and Dharmapala, 2006, 2009; Chen et al., 2010; Hanlon and Heitzman, 2010; Kim et al., 2011). In particular, Desai and Dharmapala (2006) argue that the decisions for tax avoidance and rent diversion are simultaneously made by managers, and Desai and Dharmapala (2009) point out that there are positive feedback effects or complementarities between managerial diversion and tax avoidance[12]. Therefore, stronger corporate governance reduces managerial rent diversion incentives and as a consequence, also reduces the tax avoidance activities (Desai and Dharmapala, 2006)[13]. In line with this view, firms with better external monitoring from the analysts have less information asymmetry and lower rent diversion and self-dealing incentives, and thereby engage less in tax avoidance.

Taken together, analyst coverage increases the information dissemination, amplifies the reputation concern and risk of adverse media attention of corporate tax avoidance and thus reduces the tax avoidance incentives. The field evidence from the practical world provides direct support for this argument. It is therefore expected that firms with an exogenous drop in analyst coverage might avoid tax more aggressively.

Thirdly, as an active information intermediary in the financial market, analysts help reduce information asymmetry between firms and investors. Financial analysts are well trained in finance and accounting with substantial background knowledge in the industry. Also they track firms on a regular basis so that they can figure out potential irregularities in tax spending on a timely basis. Therefore, an exogenous loss in analyst coverage

[12] Desai and Dharmapala (2006) and Desai, Dyck and Zingales (2007) provide a more general theoretical framework and real examples (e.g. Dynegy, Sibneft) about how tax shelter may provide diversionary opportunities through obfuscation that is easily rationalized as tax avoidance.

[13] In line with this argument, Desai and Dharmapala (2006) find that firms with better aligned incentives (high-powered incentives) engage in less tax avoidance activities. Desai, Dyck and Zingales (2007) find that increase in corporate tax rates only increases revenues in countries with stronger corporate governance institutions as the insiders of firms in countries with weaker governance find it easier to divert rents and so have greater incentives to keep the tax avoidance activities.

significantly increases information asymmetry (e.g., Kelly and Ljungqvist, 2012; Derrien and Kecskes, 2013), which reduces the likelihood of being detected about the tax avoidance activities. More importantly, as pointed out by Hong and Kacperczyk (2010), a drop in analyst coverage results in less competition among analysts, which might further reduces the information production incentives of the remaining analysts. Later on in our analysis in Section 7.1, we indeed find that the exogenous loss in analyst coverage reduces the information content and increases the forecast bias in the forecast reports provided by the remaining analysts. Taken together, it suggests that the increased information asymmetry caused by exogenous drops in analyst coverage would increase the likelihood of managerial rent diversion and self-dealing activities, and thereby increase the incentives to avoid tax more aggressively.

To sum, financial analysts have the ability and incentives to produce and distribute information for the firms they cover and hence reduce the information asymmetry between firms and investors. And anecdotal evidence indicates that they do pay attention to corporate tax avoidance issues. As a consequence, more financial analysts could deter corporate tax avoidance.

In order to directly test this hypothesis, we use a mostly comprehensive set of nine measures of tax avoidance used in the literature (e.g., Hanlon and Heitzman, 2010), including five measures of book-tax difference, one measure of tax sheltering, and three measures of effective tax rates.[14] As both Phillips, Pincus, and Rego (2003) and Hanlon (2005) document that some of the tax avoidance measures might partially capture earnings management activities, our strategy is to employ two measures that are intended to address such a concern. Firstly, for book-tax difference measures, we follow Desai and Dharmapala (2006) and adjust for earnings management with an accruals proxy to

[14] Out of these nine measures, we use five in the main test, and use the other four for robustness checks.

separate out the component of earnings management. Secondly, for effective tax rate measures, we develop a new measure by only using cash flow statements, which are less subject to earnings accruals. By doing so, we believe that we are really looking into the effect of information asymmetry on tax avoidance.

We start with our baseline empirical tests by running fixed effects regressions of our measures of tax avoidance on the number of analysts following the firm and a battery of control variables. The baseline results suggest a negative correlation between analyst coverage and tax avoidance. Quantitatively, for example, a one standard deviation increase in analyst coverage increases a firm's cash effective tax ratio (CETR) by about 1.4%.

We then strive to establish the causal effect of information asymmetry on tax avoidance by using our two natural experiments. We successfully identify 47 brokerage closures and mergers between 2000 and 2010, associated with 1,415 firm-year observations that experience exogenous analyst coverage decreases. We compare the tax avoidance outcomes of the firms from one year prior to the brokerage disappearance (*t-1*) to one year after the brokerage disappearance (*t+1*) relative to a matched control sample to ensure that we are capturing only the effect due to the exogenous shocks to analyst coverage.

Relying on both Abadie and Imbens (2006) matching and propensity score matching strategies, our Difference-in-Differences (DID) estimation results indicate that our measures of tax avoidance significantly increase after the firm loses an analyst, compared to similar firms that do not experience an exogenous drop in analyst coverage. The results are robust to alternative matching criteria. Looking at the economic magnitude, treated firms' CETR drops by at least 0.9% relative to the control firms that do not experience an exogenous drop in analyst coverage. The evidence therefore suggests a strong negative causal effect of analyst coverage on tax avoidance. In further tests, we find that the significant increase in tax avoidance only exists in the subsample of firms with low initial analyst coverage, where one loss out of five analysts obviously matters more for the firm compared to one loss out of 15 analysts, consistent with Hong and Kacperczk (2010).

We further examine the factors that influence the link between analyst coverage and corporate tax avoidance to explore the channels through which the associated tax avoidance incentives induced by the exogenous drop in analyst coverage can be exacerbated or mitigated. As pointed out by Rajan and Zingales (1998), "the 'smoking gun' in the debate about causality" is to focus on the details of theoretical mechanisms and document their working. We first focus on firms' financial constraints. Intuitively, firms with financial constraints might find it more appealing to engage in tax avoidance activities more aggressively to boost earnings, and save more cash internally to release their financial constraints, when facing increased information asymmetry. Moreover, firms with more financial constraints are subject to more information asymmetry risks because financially constrained firms are less likely to obtain external financing, thus risk losing growth opportunities from positive NPV projects due to more underinvestment problems. Therefore, financially constrained firms are more likely to preserve funds through tax avoidance to maintain their competitiveness and alleviate the underinvestment problem. In other words, if the exogenous loss in analyst coverage induces more tax avoidance, the effect should be more profound for firms with more financial constraints. Using four different measures of financial constraints (i.e., Hadlock and Pierce financial constraint index (HP index), Whited and Wu financial constraint index (WW index), whether the firm receives an investment grade or not, and whether the firm pays out dividend), we find consistent evidence that the effect is indeed more pronounced in firms that are more financially constrained prior to broker terminations.

We then look at firms' initial level of information asymmetry. An intuitive prediction is that the exogenous drop in analyst coverage matters more for firms with higher levels of initial information asymmetry prior to broker terminations. Using a comprehensive list of five different measures of information asymmetry (namely firm size, firm age, whether or not included in S&P 500 index, whether or not receiving S&P rating, and discretionary accruals), we consistently find the effects of analyst coverage on tax avoidance are more pronounced in the subset of firms with more information asymmetry prior to the exogenous loss in analyst coverage. This finding further strengthens our main hypothesis that information asymmetry materially affects corporate tax avoidance activities.

We then turn to the corporate governance mechanisms and examine how these mechanisms could affect the link between financial analysts and tax avoidance. Tax avoidance might be partially driven by agency problems because the complex tax structures caused by tax avoidance transactions can help management to mask and justify managerial opportunism behaviors and other self-dealing activities. Strong corporate governance and monitoring mechanisms reduce rent extraction and self-dealing incentives and protect the shareholders against expropriation by corporate insiders and as a consequence, limit tax avoidance activities. In line with this argument, Desai and Dharmapala (2006) show that strengthened managerial incentives reduce corporate tax avoidance for firms with weak corporate governance arrangement. In our setting, we expect that the firms with strong governance respond less to exogenous decreases in analyst coverage by increasing their tax avoidance, compared to the firm with weak governance mechanisms. In other words, firms with strong governance and monitoring mechanisms are more reluctant to use tax avoidance to boost earnings because they care more about the potential agency costs of tax avoidance activities. Using various governance measures (i.e., institutional holdings, product market completion, and CEO equity portfolio incentives), we find strong and consistent evidence that the effect of analyst coverage on tax avoidance is more profound for firms with weaker governance and monitoring mechanisms.

We further discuss potential channels through which analysts affect tax avoidance: the information content of analyst reports and analyst forecast accuracy. We find that with less competition due to exogenous broker exits, the remaining analysts are producing less informative reports and issuing more biased forecasts. Taken together, we show that analyst coverage causally reduces corporate tax avoidance, and the link between these two further depends on financial constraints, information asymmetry, and agency costs associated with tax avoidance activities.

By doing so, our paper contributes to several strands of the literature. Primarily, our paper adds to the tax avoidance literature (e.g., Johnson et al., 1997; 1998; Desai and Dharmapala, 2006, 2009; Crocker and Slemrod, 2005; Hanlon and Slemrod, 2009; Hanlon and Heitzman, 2010; Kim et al., 2011; Beck et al., 2013) by investigating new potential mitigating factors of firms' tax avoidance activities. While there are renewed both intellectual and policy interests on tax avoidance from governments, media and academics, little has been done to identify the fundamental factors in influencing tax avoidance. In fact, Hanlon and Heitzman (2010) argue that the existing identified factors are not clear and call for more research. Our paper is among the first to document that information asymmetry causally affects firms' incentive to engage in tax avoidance activates. In a recent paper, Hanlon et al. (2014) find that country-level information-sharing agreements with tax havens decrease individual investor-level tax avoidance from tax havens. Our paper finds that firm-level information asymmetry increases corporate tax avoidance. In this regard, our paper also contributes to the broader literature of tax avoidance.

Our paper also adds to the literature that explores the role played by financial analysts on corporate policies and outcomes (e.g., Derrien and Kecskes, 2013; Chen et al., 2014). Financial analysts track financial statements regularly, distribute public and private information to investors, and interact directly with managers during earnings release conference calls. Jensen and Meckling (1976) argue that security analysts are socially productive. Chung and Jo (1996) find a positive correlation between analyst coverage and Tobin's Q. Kelly and Ljungqvist (2012) document negative abnormal event returns from an exogenous reduction in analyst coverage. Derrien and Kecskes (2013) conclude that the exogenous decrease in analyst coverage results in changes in corporate investment, financing and payout policies. In this paper we document that analyst coverage causally reduces tax avoidance.

The remainder of the paper is organized as follows. Section 2 describes related literature and hypothesis development. Section 3 presents the construction of our sample and summary statistics. Section 4 shows our baseline regression results. Section 5 describes our identification strategy and the two natural experiments we use, and presents Difference-in-Differences results. Section 6 conducts further explorations of tax avoidance by conducting subsample analysis according to initial analyst coverage, financial constraints, information asymmetry and corporate governance. Section 7 provides additional robustness tests including evaluating potential channels, the persistence of the effects, and the effect of tax planning capacity. Section 8 concludes.

2. Related Literature and Hypothesis Development

Firstly, Graham et al. (2014) analyze survey responses from about 600 corporate tax executives to study firms' incentives for tax planning and yield insightful observations from the field. One observation is that they find that reputational concerns are important, and 69.5% of executives rate reputation as important or very important and the factor ranks the second among all disincentive factors for tax planning. Another is that the factor of "risk of adverse media attention" receives high rating as well with 57.6% of firms responding that this factor is important or very important. More importantly perhaps, they find that reputation and adverse media attention are significantly more important in firms with higher analyst coverage. This is because firms with more analysts following are likely under more scrutiny as a larger number of analysts are disseminating information to both institutional and individual investors. Therefore, when there is an exogenous drop in analyst coverage, we expect firms to avoid tax more aggressively. This provides direct evidence from the field that analysts do matter for corporate tax aggressiveness, as analysts are distributing both public and private information to investors through reports and mass media, and the information dissemination is more efficient for firms with higher analyst coverage.

Second, in theory, recently researchers have promoted a corporate governance view of tax avoidance, in the sense that tax avoidance can mask and facilitate managerial opportunism behaviors and other resource diversion activities. In particular, Desai and Dharmapala (2006) argue that decisions about tax avoidance and rent diversion are made simultaneously by managers and are potentially interdependent. More formally, the technologies of tax avoidance and rent diversion can be thought to be complementary (Desai and Dharmapala, 2008). As discussed in the literature (e.g., Scholes, Wolfson, Erickson, Maydew, and Shevlin, 2005; Kim et al., 2011), the complexity and obfuscation caused by tax avoidance transactions can provide management with the tools to mask and justify managerial opportunism behaviors and other rent extraction activities (e.g., earning manipulations, perks consumption, related party transactions, etc.). In other words, the obscurity created by tax avoidance activities might facilitate managers to extract rents and divert resources for private benefit. This agency cost of tax avoidance can be as high as to offset or even dominate its tax benefits, as shown by Desai et al. (2007) and Desai and Dharmapala (2008).[15] In line with this argument, Desai and Dharmapala (2006) find that firms with better aligned interests between shareholders and mangers engage in less tax

[15] Traditional theories view that tax avoidance is determined by tax rates, the probability of detection and potential penalties, risk aversion levels, and intrinsic motivations such as civil duty (Hanlon and Heitzman, 2010). Therefore, firms are expected to maximize shareholders' value by reducing tax liabilities as long as the incremental benefit exceeds the incremental cost as it reduces tax burdens and minimize cash outflows. According to the agency view of tax avoidance, however, the cost will eventually outweigh the benefit of tax avoidance.

avoidance activities. Kim et al., (2011) find that firms with higher degree of tax aggressiveness are subject to more stock crash risks. Desai and Dharmapala (2009) find that the relation between tax avoidance and firm value is a function of corporate governance, and suggest that tax avoidance is value-destroying for firms with weak governance. Taken together, firms with lower analyst coverage are less transparent and more importantly, managers in such firms have stronger incentives in rent diversion and hence have stronger incentive in tax avoidance activities.[16]

Moreover, analysts indeed pay attention to tax avoidance issues. In Section 1, we cite quotes from financial analysts in the press, which directly shows that analysts are concerned with firms' tax avoidance activities. We further try to verify analysts' interest in firms' tax avoidance activities by running content analysis for 6,010,450 analyst reports downloaded from Investext database. These constitute all reports in the database for all the firms from 2007 to 2013. We implement keyword searching related to tax planning. We firstly search for all the tax related keywords (tax*), and we find that on average 56.19% of the reports are related, which ranges from 45.94% in 2007 to 70.80% in 2013. This suggests that more than half of the analysts write about firm's tax planning policy in their reports. We further narrow down, and find that on average 12.46% of all the universal analyst reports are concerned with firms' tax avoidance activities (tax* avoid*, avoid* tax*, tax* avoidance, evad*, evas*, tax*, tax* shelter*, effective tax rate, and tax* aggress*), indicating that analysts pay substantial amount of attention to tax aggressiveness of the firms they cover. We also read through some of the reports and confirm that analysts are indeed expressing concerns on tax avoidance. For example, in a forecast report on Affordable Residential Communities Inc (ARC) issued by Wachovia Securities on March 7, 2006, Stephen Swett analyzed and concluded that "ARC was giving up its REIT status to escape from tax penalties". In a report on Northrop Grumman (NOC) issued by Joseph F.

[16] There is also an alternative view that casts doubt on the association between corporate governance and tax avoidance (e.g., Minnick and Noga, 2010; Rego and Wilson, 2012). Therefore, whether analyst coverage matters for tax avoidance again seems to be an empirical question that we investigate in this paper. Our findings that firms avoid more tax after exogenous drops in analyst coverage and that the effects can be mitigated by strong corporate governance mechanisms provide support for the agency theory of tax avoidance.

Campbell, Harry Breach and Carter Copeland from Barclays Capital on August 20, 2009, they pointed out that the main choice for the divestiture of The Analytical Science Corporation (TASC) is whether to sell and pay taxes, or spin and avoid taxes by using a reverse Morris trust.

Third, financial analysts help significantly decrease firms' information asymmetry. With higher disclosure quality, managers may find it more difficult and riskier to avoid tax due to greater transaction cost and larger likelihood of detection by IRS. When firms experience an exogenous drop in analyst coverage, not only the information asymmetry increases, but also the information content produced by the remaining analysts might decrease as well due to less competition and consequently less information producing incentives among the analysts. In our analysis in Section 7.1, this is confirmed by our findings that the exogenous loss in analyst coverage reduces the information content and increases forecast error in the forecast reports provided by the remaining analysts. This further reduces the detection likelihood of managerial rent seeking activities and consequently increases managers' incentives for aggressive tax planning.[17] Therefore, as our main hypothesis, a larger number of analysts covering the firm could deter managers' incentive to avoid tax aggressively.

Furthermore, as information asymmetry increases cost of capital (e.g., Easley and O'Hara, 2004; Armstrong et al., 2011), it becomes more difficult for the firms to access external financing after experiencing exogenous drops in the number of analysts following the firm. Edwards et al. (2013) find that firms avoid more tax when firms have higher degree of macro-level financial constraints (i.e., GDP growth, bank lending and IPO). The intuition is that tax avoidance is more appealing in such a situation as it could become the marginal source of financing to preserve more liquidity to avoid underinvestment problems. Therefore, we expect the firms with exogenous increase in information

[17] Also, there is a view that analysts do not really understand complicated tax issues (e.g., Plumlee, 2003; Hoopes, 2014). If analysts indeed fail to clearly understand tax issues, there is a possibility that analyst coverage will have little effect on corporate tax avoidance. Following this logic, whether analyst coverage matters or not for firms' incentive to engage in tax avoidance and avoidance activities is an empirical question that we will explore in this paper.

asymmetry to avoid tax more aggressively, and the effect should be stronger in firms with more financial constraints.

3. Sample Construction and Summary Statistics

This section describes the construction of our sample and presents summary statistics for the major variables used in the paper.

3.1. Sample Selection

To construct our sample, we firstly extract financial and accounting data from Compustat's North America Fundamentals Annual database for the period from 1999 to 2011. We choose listed U.S. firms that are not financials or utilities, and that have CRSP data. We eliminate firm-year observations for which information on total assets is not available, and we also exclude observations with negative cash holdings, sales and total assets. Analyst coverage data are obtained from the Institutional Brokers' Estimate System (I/B/E/S) database. Information about institutional ownership comes from CDA/Spectrum Institutional 13(f) filings. We also use ExecuComp database for the information about CEO. For the natural experiments, we extract information from I/B/E/S, Factiva, and Kelly and Ljungqvist (2012) for broker closures, and information from SDC M&A database for broker mergers.

3.2. Measuring Tax Avoidance

Following the literature (e.g., Hanlon and Heitzman, 2010), we adopt five main measures of tax avoidance: total book-tax difference (BTD), Desai and Dharmapala (2006) residual book-tax difference (DDBTD), SHELTER, DTAX, and Cash effective tax rate (CETR). The total book-tax difference is the most commonly used measure of book-tax difference, calculated by book income less taxable income standardized by lagged assets (*at*). Book income is pre-tax income (*pi*) in year *t*. Taxable income is calculated by summing the current federal tax expense (*txfed*) and current foreign tax expense (*txfo*) and dividing by the statutory tax rate (STR) and then subtracting the change in net operating loss (NOL) carryforwards (*tlcf*) in year *t*. If the current federal tax expense is missing, the total current tax expense equals the total income taxes (*txt*) less deferred taxes (*txdi*), state income taxes (*txs*), and other income taxes (*txo*).

As argued by the literature, total book-tax gap does not necessarily reflect tax avoidance, and might partially capture earnings management activities (e.g., Phillips et al., 2003; Hanlon, 2005). We follow Desai and Dharmapala (2006) and adjust book-tax difference for earnings management with an accruals proxy to isolate the component of the gap that is due to earnings management. Specifically, the residual book-tax difference (DDBTD) equals the residual from the following fixed effects regression:

$$BTD_{i,t} = \beta_1 TACC_{i,t} + \mu_i + \varepsilon_{i,t}, \quad (1)$$

where BTD is the total book-tax difference and TACC is the total accruals. Both variables are scaled by lagged total assets. As for BTD and DDBTD, we remove observations with total assets less than \$1 million and observations with negative taxable income (*txfed*<0).

SHELTER is to measure an extreme form of tax avoidance, which is tax sheltering. It is the estimated probability that a firm engages in a tax shelter based on Wilson's (2009) tax sheltering model:

$$SHELTER = 4.86 + 5.20\times BTD + 4.08\times Discretionary\ Accruals - 1.41\times Leverage + 0.76\times AT + 3.51\times ROA + 1.72\times Foreign\ Income + 2.42\times R\&D, \quad (2)$$

where BTD is the total book-tax difference; Discretionary accruals is the absolute value of discretionary accruals from the modified cross-sectional Jones model; Leverage is the long-term leverage, defined as long-term debt (*dltt*) divided by total assets (*at*); AT is the log of total assets (*at*); ROA is the return on assets, measured as operating income (*pi* - *xi*) divided by lagged assets; Foreign income is an indicator variable set equal to one for firm observations reporting foreign income (*pifo*), and zero otherwise; and R&D is R&D expense (*xrd*) divided by lagged total assets.

DTAX is based on Frank, Lynch, and Rego (2009), which attempts to measure the discretionary portion of tax avoidance, which removes underlying determinants of tax avoidance that are not driven by intentional tax avoidance while leaving the intentional portion in the residual. Specifically, it is measured by a firm's residual from the following regression, estimated by industry and year:

$$ETRDIFF_{it}= \beta_0+\beta_1\ INTANG_{it} + \beta_2\ EQIN_{it} + \beta_3\ MI_{it} + \beta_4\ TXS_{it} + \beta_5\ \Delta NOL_{it} + \beta_6\ LAGETRDIFF_{it} + \varepsilon_i, \quad (3)$$

Where ETRDIFF is calculated as (PI - ((TXFED + TXFO)/STR)) - (TXDI/STR), scaled by lagged assets (*at*); PI is pre-tax book income (*pi*); TXFED is the current federal tax expense (*txfed*); TXFO is the current foreign tax expense (*txfo*); TXDI is the deferred tax expense (*txdi*). INTANG is goodwill and other intangible assets(*intan*), scaled by lagged assets(*at*); EQIN is income (loss) reported under the equity method (*esub*), scaled by lagged assets (*at*); MI is income (loss) attributable to minority interest (*mii*), scaled by lagged assets(*at*); TXS is current state tax expense(*txs*), scaled by lagged assets; ΔNOL is change in net operating loss carry forwards (*tlcf*), scaled by lagged assets (*at*); LAGETRDIFF is ETRDIFF in the previous fiscal year.

CETR is cash effective tax rate based on Chen et al. (2010), calculated as cash taxes paid (*txpd*) divided by pre-tax income (*pi*). We use CETR as our main measure of effective tax rate as it is not affected by changes in the tax accounting accruals. CETR is set to missing when the denominator is zero or negative. We winsorize both CETR to the range [0, 1]. Note that we cannot use the long-run measure of tax effective rates (Dyreng et al., 2008) as we find that our exogenous events are temporary shocks to the firms and the effects disappear after three years, which is consistent with Derrien and Kecskes (2013).[18]

In the robustness tests, we use four additional measures of tax avoidance: Manzon and Plesko (2002) book-tax difference (MPBTD), ETR Differential (ETRDIFF), Effective tax rate (ETR), and Cash flow effective tax rate (CFETR). MPBTD is Manzon and Plesko (2002) book-tax difference, which is calculated by US domestic book income less US domestic taxable income less state tax income (*txs*) less other tax income (*txo*) less equity in earnings (*esub*) scaled by lagged assets (*at*). We use this measure to check whether firms are also affected by information asymmetry in reporting domestic taxable earnings. US domestic book income is domestic pre-tax income (*pidom*) in year *t*. US domestic taxable income is calculated by the current federal tax expense (*txfed*) divided by the statutory tax rate (STR). ETRDIFF is based on Frank, Lynch, and Rego (2009) and Kim et al. (2011), which is calculated as (PI - ((TXFED + TXFO)/STR)) - (TXDI/STR), scaled by lagged assets (*at*). PI is pre-tax book income (*pi*); TXFED is the current federal tax expense (*txfed*); TXFO is the current foreign tax expense (*txfo*); TXDI is the deferred tax expense (*txdi*). ETR is effective tax rate based on Zimmerman (1983), calculated as total tax expense (*txt*) less change in deferred tax (*txdi*), divided by operating cash flows (*oancf*). ETR is set to missing when the denominator is zero or negative.

Our final measure is CFETR, which is cash flow effective tax rate, calculated as cash taxes paid (*txpd*) divided by operating cash flows (*oancf*). This measure only uses information from the cash flow statements, which can further separate out the earnings management effect. We winsorize both ETR and CFETR to the range [0, 1].

3.3. Measuring Analyst Coverage and Other Control Variables

Analyst information is obtained from I/B/E/S, and our major variable is the log of the total number of stock analysts following the firm during the year. Following the tax avoidance literature (e.g., Chen et al., 2010), we include a vector of firm characteristics that

[18] We further discuss this in details in the persistent test in Section 7.2.

could affect corporate tax avoidance. These control variables include firm size (SIZE), Tobin's Q (Q), tangibility (PPE), foreign income (FI), leverage (LEV), ROA, NOL, ΔNOL, intangibility, and EQINC. SIZE is the log of the market value of equity (*csho × prcc_f*), Q is calculated as the market value of assets over book value of assets: (*at − ceq + csho × prcc_f*)/*at*, and PPE is defined as property, plant, and equipment (*ppegt*) divided by total assets (*at*). FI is calculated as foreign income (*pifo*) divided by total assets (*at*). LEV is the long-term leverage, measured as long-term debt (*dltt*) scaled by total assets, and ROA is return on assets. NOL is a dummy variable coded as one if loss carryforward (*tlcf*) is positive, and zero otherwise. ΔNOL is the change in loss carryforward, and EQINC is the equity income in earnings (*esub*) divided by lagged assets. Detailed information about variable definitions is provided in Appendix A.

3.4. Summary Statistics

After merging the tax avoidance data with analyst coverage, our final sample consists of 23,475 firm-year observations from 5,401 publicly traded U.S. firms covering the period 1999-2011. We winsorize all the parameters excluding dummy variables at the 1^{st} and 99^{th} percentiles to minimize the effect of outliers. Table 1 reports descriptive statistics on our measures of tax avoidance, analyst coverage, and other control variables. For example, from Table 1 we find that out of our sample, the mean (median) value of book-tax difference is -0.062 (0.008), mean (median) value of Desai and Dharmapala (2006) residual book-tax difference is 0.023 (0.004), and mean (median) value of cash effective tax rate is 0.270 (0.256). All of the measures have significant variations as shown by large standard deviations: 0.421, 0.293, and 0.211 respectively.

[Table 1 about here]

4. Baseline Regression Results

We begin our analysis of the effect of analyst coverage on corporate tax by running fixed effects regressions of our main measures of tax avoidance on the number of analysts following the firm and other firm-level control variables.

4.1. Estimation Model and Variables

Specifically, e build the following fixed effects regression model:

$$Tax\ Avoidance_{i,t} = \alpha_0 + \beta_1 \times LnCoverage_{i,t} + \delta' X + \gamma_i + \mu_t + \varepsilon_{i,t}\,, \qquad (4)$$

where the dependent variable is our measures of tax avoidance. We make use of five measures of tax avoidance, including three measures of book-tax avoidance (BTD, DDBTD, and DTAX), one measure of tax sheltering (SHELTER), and one measure of effective tax rate (CETR). Detailed definitions and descriptions of the variables are available in Section 3.2 and Appendix A.

The vector X includes a set of firm-specific control variables, as specified in Section 3.3. Our primary focus is β_1, the coefficient estimate of LnCoverage. A negative (positive) and statistically significant β_1 for BTD, DDBTD, DTAX and SHELTER (CETR) in regression (4) would be evidence for a negative correlation between analyst coverage and tax avoidance.

4.2. Regression Results

Table 2 shows the regression results. All regressions control for year and firm fixed effects, whose coefficient estimates are suppressed. Heteroskedasticity-consistent standard errors clustered at the firm level are reported. Across all the five measures of tax avoidance, we find that LnCoverage has a statistically significant coefficient (β_1) with expected sign for all the models, which is consistent with our hypothesis that firms with a larger number of analysts following avoid less taxes. Using the estimates in column (1) as an example, BTD decreases by 0.013 (=0.943*0.014) for one standard deviation increase in LnCoverage, holding other factors constant. Similarly, a one standard deviation increase in LnCoverage increases a firm's cash effective tax ratio (CETR) by about 1.4%.

[Table 2 about here]

5. Identification and Natural Experiments

In this section, we address the potential endogeneity concern to further establish the causality from analyst coverage to tax avoidance.

Specifically, we adopt a Difference-in-Differences (DID) approach built on two natural experiments, namely broker mergers and broker closures that generate exogenous variations in analyst coverage and that are at the same time orthogonal to corporate tax avoidance.

5.1. Natural Experiments

We have obtained encouraging baseline results in Section 4. A potential concern is that analyst coverage is likely to be endogenous. A large volume of literature has shown that analysts tend to cover higher quality firms (Chung and Jo, 1996) and firms with less information asymmetry (e.g., Lang and Lundholm, 1996; Bhushan, 1989; Bushman et al., 2005). Firms with less tax avoidance and less information asymmetry may attract more analyst coverage. In addition, unobservable firm heterogeneity correlated with both analyst coverage and corporate decisions and policies could also bias the estimation results.

To cope with the potential endogeneity concern, our identification strategy is to use two natural experiments that create exogenous variations in analyst coverage. The first one is brokerage closures. As argued by Kelly and Ljungqvist (2012),[19] broker closure provides an ideal source of exogenous shocks to analyst coverage as it is not correlated with firm-specific characteristics, since they are mostly driven by business strategy considerations of the brokers themselves. It should only affect a firm's tax avoidance through its effect on the number of analysts covering the firm. The second natural experiment is broker mergers, firstly adopted by Hong and Kacperczyk (2010), who study how competition affects earnings forecast bias. As documented by Wu and Zang (2009), when two brokerage firms merge, they typically fire analysts due to redundancy or culture-clash. Consequently, broker mergers also provide exogenous variations in analyst coverage.

To identify broker closures, we use the I/B/E/S database to find a list of brokers who disappear from the database between 2000 and 2010, and then search Factiva to confirm the exit is due to closure. We also complement our sample with a list of brokerage closures provided by Kelly and Ljungqvist (2012), and we have a list of 30 broker closures. The construction of broker merger sample follows Hong and Kacperczk (2010). We firstly collect broker merger events using Thomson's SDC M&A database, by restricting both the acquirer and target primary SIC codes to 6211 (investment banks and brokerage firms) or 6282 (independent research firms). We only consider completed deals and deals in which 100% of the target is acquired. Then we manually match all the acquirers and targets with the names of broker houses in the I/B/E/S database. Our procedure produces 24 merger events.[20] Put together with the broker closure sample, our list of 54 broker terminations is

[19] Using closures as exogenous shocks to the supply of information, Kelly and Ljungqvist (2012) document the importance of information asymmetry in asset pricing.

[20] We select only those mergers where both merging houses analyze at least two of the same firms (Hong and Kacperczk, 2010). Note that Lehman is not in our sample, as it is not a suitable shock for identification purposes as also pointed out by Kelly and Ljungqvist (2012), because Barclays, which had no U.S. equities business of its own, took over Lehman's entire U.S. research department. The data for Merrill Lynch and Bank of America are retrieved using data downloaded in the earlier date, as their observations are dropped by I/B/E/S in the current database.

similar to those of Kelly and Ljungqvist (2012) and Hong and Kacperczyk (2010) combined.[21]

To obtain a sample of affected firms, we merge our final sample of broker exits with the I/B/E/S unadjusted historical detail dataset. For broker closures, we need the covered firms to stay in the I/B/E/S sample in year *t+1*. For broker mergers, we restrict the firms to be covered by both acquiring and target houses before the merger and continue to be followed by the remaining broker after the merger. In addition, we choose listed U.S. firms that are not financials or utilities, and that have CRSP and Compustat data in years *t-1* and *t+1*. Following the recent literature (e.g., Derrien and Kecskes, 2013), we keep the firm-year observations of only *t-1* and *t+1* to ensure that we capture only the direct effects of the exogenous drop in analyst coverage. It is possible that the entry of other brokers will make up for the diminished research or the terminated analyst could find a job in other brokerage houses in the long term. Therefore, this setting enables us to make good use of the short-term deviation from the equilibrium and analyze how analyst coverage affects tax avoidance.

5.2. Variable Description and Estimation Methodology

We match our sample of affected firms due to exogenous broker closures and mergers with our measures of tax avoidance. The final sample consists of 1,415 firm-years for 1,031 unique firms (associated with 47 broker terminations) from 1999 to 2011. Appendix B shows the number of broker terminations and the corresponding number of affected firms each year from 2000 to 2010 in our sample, and we find that there is no obvious evidence of clustering in time and the terminations are spread out fairly equally over time. On

[21] We examine whether our main results are driven by broker mergers or broker closures, and we find no qualitative difference between the two groups.

average, treated firms experience an exogenous drop in the number of analysts by 0.96. And firms in the top quartile, median, and the bottom quartile all have precisely one analyst missing.

To investigate the effects of exogenous shocks to analyst coverage on corporate tax avoidance, we use a Difference-in-Differences approach to minimize the concern that the variation in analyst coverage and in tax avoidance are caused by any unobservable cross-sectional or time-series factors that affect both analyst coverage and avoidance. We use two matching strategies: Abadie and Imbens (2006) matching and propensity score matching.

Abadie and Imbens (2006) matching estimator simultaneously minimizes the Mahalanobis distance between a vector of observed matching covariates across treated and non-treated firms.[22] The primary matching variables include firm size (SIZE), Tobin's Q (Q), tangibility (PPE), foreign income (FI), and analyst coverage (COV) prior to broker terminations. We also make sure that both of the treatment firm and the control firm are in the same Fama-French 48 industry and fiscal year.

Alternatively, we adopt a nearest-neighbor logit propensity score matching strategy, developed by Rosenbaum and Rubin (1983). The control pool is the remainder of the Compustat universe with analyst coverage and valid matching variables. We construct a control sample of firms that are matched to the treated firms along a set of relevant firm characteristics measured in the year prior to broker terminations. First, we estimate a logit regression where the dependent variable equals one if a particular firm-year is classified as treated and zero otherwise, and our matching variables are the independent variables. We use a panel of 1,415 treatment firm-years and the remainder of the Compustat universe pre-merger firm-years with analyst coverage and valid matching variables. Second, the

[22] The Abadie and Imbens (2006) matching estimator approach has been used by, among others, Campello et al. (2010).

estimated coefficients are used to predict propensity scores of treatment, which are then used to perform a nearest-neighbor match.

In order to measure the effect of the exogenous decrease in analyst coverage on tax avoidance, for each matching approach, we compare the differences in tax avoidance ($\Delta Tax\ Avoidance_i^{Treated}$) between one year after the broker termination and one year prior to the termination, to that of its matched control firm ($\Delta Tax\ Avoidance_i^{Control}$) for a treated firm *i*. We then take the mean of the difference-in-differences across all the firms in our sample. To be more specific, the average treatment effect of the treatment group (DID) is calculated as:

$$DID(Tax\ Avoidance) = \frac{1}{N}\sum_{i=1}^{N} \Delta Tax\ Avoidance_i^{Treated} - \frac{1}{N}\sum_{i=1}^{N} \Delta Tax\ Avoidance_i^{Control}, \quad (5)$$

where *N* refers to the number of treatment and control firms.

5.3. Estimation Results

Table 3 presents the DID estimation results. Panel A reports the summary statistics for matched samples prior to broker terminations. The balance test shows that the treatment firms and the control firms are similar across all of the matching variables in the pre-event year, ensuring that the change in tax avoidance is caused only by the exogenous drop in analyst coverage. For example, the treated sample has a mean of 11.701 in the number of analysts covering the firm prior to broker terminations while the control sample has a mean of 11.556. Moreover, the difference is not statistically significant. In Panel B, we present the DID results using Abadie and Imbens (2006) matching. The dependent variable is our main measures of tax avoidance. Higher value of the first four measures (BTD, DDBTD, SHELTER, and DTAX) indicates more tax avoidance, while lower value of the last measure (CETR) suggests more tax avoidance. Through all the five measures of tax avoidance, we find that four are consistent with the fact that tax avoidance increases significantly after the firm exogenously loses an analyst relative to matched control firms. The result is not only statistically but also economically significant. Specifically, after the broker closure or merger, BTD increases by 0.023 (or 0.052, using alternative matching strategy) compared to control firms (significant at 5% level), holding everything else constant, which is 5.5% (or 12.4%) of one standard deviation of BTD prior to broker termination.[23] DDBTD experiences an increase of 0.031 (or 0.041, using alternative matching strategy) compared to control sample after an exogenous loss in analyst coverage (significant at 1% level). Treated firms' CETR drops by at least 0.9% (or 2.5%, using alternative matching strategy) relative to the control firms that do not experience an exogenous drop in analyst coverage, statistically significant at 10% (or 5%) level, which is 3.3% of the sample mean of CETR prior to broker exits. The direction of the DID estimate of SHELTER is correct, but it is insignificant at conventional significance levels. This is not surprising, as it aims to measure an extreme form of tax avoidance (e.g., Hanlon and and Heitzman, 2010; Kim et al., 2011). Note that the DID estimate of SHELTER becomes significant at 10% level when using propensity score matching as shown in Panel C of Table 3. Also in Section 6.2, we find that SHELTER becomes positive and statistically significant for firms with financial constraints, indicating that financially constrained firms are more likely to engage in tax sheltering following exogenous increase in information asymmetry.

[Table 3 about here]

[23] Shevlin (2002) argues that one must be cautious when drawing inferences about the levels and trends in tax avoidance based on book-tax differences. The consistent results using alternative measures relax such a concern.

The significant effect of analyst coverage due to brokerage exit is consistent with the literature using the same natural experiments of broker mergers and closures (e.g., Kelly and Ljungqvist, 2012; Balakrishnan et al., 2014; Fong et al., 2014). Specifically, Kelly and Ljungqvist (2012) find that the cumulative abnormal returns average is -112 basis points on the day of an exogenous exit. Balakrishnan et al. (2014) find that the liquidity drops by 20%. Fong et al. (2014) find that a drop in one analyst coverage increases the subsequent credit ratings of a firm by around a half-rating notch. Moreover, as we discuss below, in Section 6.1 we reestimate our results by partitioning the whole sample into subsamples of low or high analyst coverage before brokerage exit, and find that the increase in tax avoidance is largely driven by the subsample of firms with initial low analyst coverage, where the effect of an individual analyst is larger (firms lose 20% of their analysts on average). In addition, in Section 7.1 we further look at the channels of the large effect of analyst coverage, and we find that the broker exits largely affect the information production incentives of the remaining analysts due to less competition, as shown by the less information content of the reports and more biased forecast estimates issued by the remaining analysts. The combined effects further amplify the effects of the exogenous drop in analyst coverage.

Panel C applies a nearest-neighbor logit propensity score matching estimator. We find that all of the main mean Difference-in-Differences are highly significant. The results are consistent with our hypothesis that firms avoid more taxes after an increase in information asymmetry.

5.4. *Robustness Test: Alternative Measures of Tax Avoidance*

We conduct a battery of robustness tests for the DID analysis. We firstly use four alternative measures of tax avoidance to check whether our results are robust. MPBTD is to measure domestic tax aggressiveness, through which we can check whether information asymmetry affects firms' incentive to avoid tax domestically. ETRDIFF measures the permanent portion of tax avoidance (Frank et al., 2009), ETR is the rate that affects accounting earnings, and CFETR further removes the effect of earnings accruals. We redo the Difference-in-Differences analysis using these measures, and Table 4 reports the results.

[Table 4 about here]

In Table 4, Panel A shows the results using Abadie and Imbens (2006) matching while Panel B reports the results using propensity score matching. We find that across all of our additional measures of tax aggressiveness, all of the DID estimates are statistically significant except ETR with propensity score matching.

5.5. Robustness Test: Alternative Matching Methods

We then check the robustness of our results by using alternative combinations of matching variables. The results are presented in Table 5. We now concentrate on four major measures of tax avoidance (BTD, DDBTD, DTAX, and CETR), and the results on other measures are qualitatively similar. We begin with a simple matching by merely requiring both treated and control firms to have valid information in regard to measures of tax avoidance and analyst coverage. DID estimates of BTD, DDBTD, and DTAX are all significant and positive, while CETR is negative and statistically significant, indicating treated firms are more involved in tax avoidance activities compared to control firms after broker terminations. We then match by pre-event BTD and analyst coverage. Firms with aggressive tax planning might differ with other firms in the dimensions that could not be fully captured by our matching variables, and that's why we include pre-event BTD level to fulfill such a purpose. We find that the results presented in the second row are similar to what we discover previously. We further add matching criteria step by step until we include all the control variables in our fixed effects regression model (1). We find that our results are strongly robust to those combinations of matching variables. Indeed, out of 28 models in Table 5, we only have one DID estimate (DTAX) statistically insignificant at conventional levels.

[Table 5 about here]

6. Further Explorations of Corporate Tax Avoidance

In Section 5, we have found an economically significant effect of the exogenous decrease in analyst coverage on corporate tax avoidance. In this section, we start to study the factors that affect the relationship between analyst coverage and tax avoidance, and how the effects on avoidance can be mitigated or exacerbated. As pointed out by Rajan and Zingales (1998), focusing on the details of theoretical mechanisms and documenting their working is "the 'smoking gun' in the debate about causality". We concentrate on initial analyst coverage, firms' financial constraints, information asymmetry, and corporate governance in this section.

6.1. Firms with Low Analyst Coverage before Broker Terminations

We first divide the whole sample into low and high initial analyst coverage subsamples, and expect that the effects are more pronounced in the initial low analyst coverage subset of firms as one loss out of five analysts should matter more than one loss out of 15 analysts (Hong and Kacperczyk, 2010). The initial analyst coverage subsample results are reported in Table 6.

[Table 6 about here]

We present results using all of our five main measures of tax avoidance. In columns (1) and (2), we partition the sample using arbitrary numbers of analysts following the firm before broker terminations: five and 15, and Column (1) consists of 870 firm-year observations while Column (2) consists of 646 firm-year observations. Columns (3) and (4) divide the sample according to the terciles sorted on initial analyst coverage, where the firms defined as with high initial analyst coverage are those in the top tercile of the sample, and firms defined as with low initial analyst coverage are in the bottom tercile of the sample. Column (3) consists of 932 firm-year observations while Column (4) consists of 948 firm-year observations. We find that our DID estimate is only statistically significant in the low analyst coverage subsample at conventional significance levels for four out of five measures of tax avoidance, for both sample division criteria. The estimates are larger in magnitude than those in the whole sample regressions. The results so far confirm our hypothesis that the large effect of an exogenous loss in analyst coverage is mainly driven by the low initial analyst coverage firms. We further have a look at the summary statistics of these firms with low initial analyst coverage. One possible concern is that if the firms are loss-making ones, we would expect to learn little from these firms. We find that the mean ROA of this subset of firms reaches 5.94%, indicating that those firms are actually generating positive earnings, alleviating our concern that those firms avoid tax because of poorer financial position rather than higher degree of information asymmetry as we document.

6.2. Firms with Higher Levels of Financial Constraints

As discussed above, the effect of exogenous decrease in analyst coverage should be more pronounced for financially constrained firms, since in their case, firms are more motivated to evade tax to preserve investment funding as they are more likely to suffer from underinvestment problems.

To test this hypothesis, we divide the sample into low and high financial constraint subsamples. We totally exploit four different measures of financial constraints: the Hadlock and Pierce (2010) financial constraint index (HP index), the Whited and Wu (2006) financial constraint index (WW index), whether the firm has an investment grade, and whether the firm pays out dividends.[24] HP index is measured as follows:

$$HP_{i.t} = -0.737 \times Size_{i,t} + 0.043 \times Size_{i,t}^{2} - 0.040 \times Age_{i,t} \qquad (6)$$

where Size is the log of book assets, and Age is defined as the number of years the firm is listed. In calculating this index, Size is capped at (the log of) $4.5 billion and Age is capped at 37 years.

WW index is calculated as follows:

$$WW_{i.t} = -0.091 \times \frac{CF_{i.t}}{AT_{i,t-1}} - 0.062 \times Dividend\ Dummy_{i,t} + 0.021 \times Leverage_{i,t} - 0.044 \times Log(AT_{i,t}) + 0.102 \times Industry\ Sales\ Growth_{i,t} - 0.035 \times Sales\ Growth_{i,t}, \qquad (7)$$

where CF is operating cash flow and AT is book assets. Dividend Dummy is the indicator for dividend payment, which takes the value of one if the firm pays cash dividends in the year and zero otherwise. Leverage is calculated as total debt scaled by total assets. Industry Sales Growth is the average sales growth of all firms in the firm's three-digit SIC industry. Investment grade is a dummy variable that equals one if the S&P rating is BBB or higher and zero otherwise.

[24] We also experiment with a new Kaplan and Zingales (1997) measure as described in Hadlock and Pierce (2010), but we find the correlation of this measure with others are very low.

Financially more constrained firms have higher HP index, higher WW index, non-investment grade, or do not pay out dividends. For continuous measures, we place a firm in the more financially constrained subsample if the corresponding financial constraint measure is in the top tercile of the sample, and in the less financially constrained subsample if it is in the bottom tercile of the sample. We repeat the DID analysis and the results are presented in Table 7.

[Table 7 about here]

Throughout all of our measures of financial constraint and measures of tax avoidance, we find that the DID estimates are statistically significant with right directions only in the subsamples with more financial constraints. For example, in terms of HP index, the Difference-in-Differences estimate is 0.123 in high HP index subsample for BTD, significant at 1%, while the DID estimate is -0.002 in the low HP index subsample, statistically indifferent from zero. For DDBTD, the DID estimate is 0.114 in the high HP index firms, significant at 1% level, while the DID estimate is -0.007 in the low HP index firms, statistically insignificant at 10% level. Interestingly, we find that SHELTER now becomes positive and statistically significant for firms with financial constraints, indicating that financially constrained firms are more likely to engage in tax sheltering following exogenous increase in information asymmetry.

6.3. Firms with Higher Levels of Information Asymmetry

As discussed previously, an intuitive prediction is that the exogenous drop in analyst coverage makes a greater deal for firms with higher levels of initial information asymmetry prior to broker terminations, and therefore we expect the effects of exogenous decrease in analyst coverage to be more pronounced for firms with high levels of information asymmetry.

To test the effects of initial level of information asymmetry on the relationship between analyst coverage and tax avoidance, we use five different measures of information asymmetry: firm size, firm age, whether or not included in S&P 500 index, whether or not receiving S&P rating, and discretionary accruals. Discretionary accruals is the absolute value of discretionary accruals from the modified cross-sectional Jones model. Small (young) is a dummy variable with one indicating the firm's size (age) is in the bottom tercile of the sample, and zero indicating the firm's size (age) is in the top tercile of the sample. Small, young, non-S&P 500, non-S&P rating firms, or firms with higher discretionary accruals are generally regarded as more opaque firms.

We divide the sample into subsamples with low or high levels of information asymmetry prior to broker terminations, and repeat the DID estimations. Table 8 presents the results. As expected, we find that the Difference-in-Differences estimates are only significant in the subsample with high information asymmetry for 23 out of 25 pairs of subsamples. The evidence thus lends further support to our hypothesis that information asymmetry materially affects firms' tax avoidance incentives.

[Table 8 about here]

6.4. Firms with Poor Corporate Governance

In this section, we test the potential mechanisms that can reduce the impact of increased information asymmetry induced by exogenous decrease in analyst coverage on tax avoidance activities. Specifically, we look at measures of corporate governance.

Recent research in an agency theory perspective, argues that tax avoidance activities can facilitate managerial opportunism, such as earnings manipulation and outright resource diversion, as tax avoidance can help to mask such managerial misbehaviors with the increased complexity and information opaqueness (Desai and Dharmapala, 2006, 2009; Kim et al., 2011). In particular, Desai and Dharmapala (2009) show that the relation between tax avoidance and firm value is a function of corporate governance. Moreover, Desai and Dharmapala (2006) show that increases in incentive compensation reduce the level of tax avoidance in firms with poor governance. Therefore, we expect that measures of governance could mitigate the effects of analyst coverage on tax avoidance, as strong corporate governance helps reduce rent extraction and earnings manipulation incentives, and limit firm's tax avoidance activities.

In testing the role of corporate governance, we use institutional holdings to proxy corporate governance following Desai and Dharmapala (2009), and we further rely on a measure in capturing the effects of incentive compensation: CEO equity portfolio incentives. CEO equity portfolio incentives measures the percentage change in the equity portfolio value held by the CEO of the firm for a 1% increase in stock price, which is calculated as the sum of all shares (restricted and unrestricted) and delta-weighted options (exercisable and unexercisable) held by the CEO divided by the total number of shares outstanding multiplied by 100, for a given fiscal year. The calculation of the delta-weighted options uses the detailed information on current and previous option grants to calculate the options' delta and multiplies the number of options held in each series by its delta. Merging with the information of incentive compensation calculated using ExecuComp database leaves us with 725 firms affected by broker terminations from 1999 to 2011, since such information is only available for S&P 1500 firms. We further divide the samples by product market competition. Theory predicts that product market competition reduces managerial slack (for example, Jensen and Meckling, 1976; Hart, 1983; Holmström, 1982; Schmidt, 1997). Market competition is measured by HHI, which is calculated as the sum of squared market shares of all Compustat firms in each Fama-French 48 industry, and higher values indicate greater concentration and lower product market competitiveness.

We partition the sample into subsamples with low or high institutional holdings, less or more product market competition, and low or high CEO equity portfolio incentives prior to broker closures or broker mergers. High institutional holding indicates that the firm's institutional holding is in the top tercile of the sample, and low institutional holding means that the firm's institutional holding is in the bottom tercile of the sample. Firms are placed in less product market competition subsample when their HHIs are in the top tercile of the sample, while firms placed in more market competition subsample when their HHIs are in the bottom tercile of the sample. Firms with high CEO equity portfolio incentives are defined as firms with the value of CEO equity portfolio incentives higher than the median of the sample, and low CEO equity portfolio firms are those with the value lower than the median of the sample.[25] We repeat the DID estimations, and the results are shown in Table 9.

[Table 9 about here]

Not surprisingly, the results in Table 9 show that the Difference-in-Differences estimates are only significant in the subsample with low institutional holdings (except one measure: ETR). The DID estimates are not statistically different from zero for the well-governed firms as indicated by high institutional holdings. For instance, in terms of total book-tax difference, the Difference-in-Differences estimate is 0.140 in the low institutional holdings subsample, significant at 1% level, while it is -0.002 in the firms with high institutional holdings (not statistically different from zero). For product market competition, DID estimates of three out of five measures of tax avoidance are only significant in less market competition subsamples, and the estimates of the other two

[25] The information is only available to ExecuComp (typically S&P 1500) firms. We will result in a small number of observations if we still divide the sample according to terciles.

measures are slightly more pronounced in the less market competition subsamples. For CEO equity portfolio incentives, DID estimates of three measures of tax avoidance are only significant in the low equity portfolio incentives subset of firms.[26] This is consistent with Desai and Dharmapala's (2006) findings that increases in incentive compensation tend to reduce the level of tax avoidance. To sum, the results are coherent with our expectation that good corporate governance can mitigate the firms' incentive to engage in tax avoidance activities following an exogenous increase in information asymmetry.

7. Additional Robustness Checks

Overall, the results confirm our hypothesis that analyst coverage deters corporate tax avoidance, strongly supported by baseline regressions and DID analysis using our natural experiments. In this section, we provide additional robustness checks, including evaluating potential channels through which analysts affect tax avoidance, the persistence of the effects, and the effects of tax planning capacity.

7.1. Channels

We have found strong evidence that firms avoid tax more aggressively after experiencing an exogenous drop in analysts following the firm due to increased information asymmetry. Some might wonder whether it is the number of analysts or the content of analysts report affect the information asymmetry of a particular firm. It is plausible that with less competition among analysts (Hong and Kacperczyk, 2010), the

[26] For another measure, DTAX, the estimate in the low equity portfolio incentive subsample is more significant, and it almost doubles the estimate in the high equity portfolio incentive subsample in magnitude.

information content of the reports by the remaining analysts decreases after the drop in the number of analysts following the firm. We directly test this by performing a Difference-in-Differences test of the information content of analyst research, by comparing the measure of information content of analyst reports from one year prior to the brokerage exit *(t-1)* to one year after the brokerage exit *(t+1)*.

Treated firms are matched using nearest-neighbor logit propensity score matching. The matching variables include Size (SIZE), Tobin's Q (Q), Leverage (LEV), Cash (CASH) and Coverage (COV). The main variable of interest is the information content of analyst research. The construction of information content measuring the average informativeness of analyst reports, follows Frankel, Kothari, and Weber (2006), which is defined as the percentage of a firm's stock return related to analyst forecast revisions to the total stock returns during the fiscal year (the time period between 10-K filing and the subsequent fiscal year-end). Specifically, we first sum the absolute size-adjusted returns on all the forecast revision dates for a firm in a given fiscal year. Then it is divided by the sum of the one-day, absolute size-adjusted returns for all the trading dates during the fiscal year. Finally, we divide this ratio by the number of analyst forecast revisions in a given fiscal year. Multiple reports issued in the same day are treated as a single report. We exclude analyst report dates that coincide with earnings announcement following Lehavy, Li, and Merkley (2011). The sample consists of 1,714 firm-years for the treatment sample and a same number of firm-years for the control sample. Table 10 reports the results.

[Table 10 about here]

The summary statistics are presented in Panel A of Table 10. We find that the mean value of our measure is 0.58%, indicating that on average analysts produce information for the investors as it is larger than 0.4% (1/250 in a given year with 250 trading days), consistent with Frankel, Kothari, and Weber (2006). The measure is of large variation as indicated by a standard deviation of 0.21%. Panel B provides DID estimation results. We find that after the exogenous drop in analyst coverage induced by broker exits, the average information content of analyst reports is reduced by 0.04%, statistically significant at 1% level. The effect is also economically significant as a drop of one analyst decreases the information content by 6.90% (0.04%/0.58%) of the mean value of the sample. We further divide the sample into subsamples according to initial analyst coverage, and the results are shown in Panel C. specifically, we divide the sample according to the terciles sorted on initial analyst coverage, where the firms defined as with high initial analyst coverage are those in the top tercile of the sample, and firms defined as with low initial analyst coverage are in the bottom tercile of the sample. From Panel C, we find that the effect on information content is mainly driven by the low initial analyst coverage subsample. The finding confirms our hypothesis that the exogenous broker exists reduce the competition among the analysts following a particular firm and consequently analysts produce less informative research, resulting in an increase in information asymmetry and an increase in tax avoidance.

Moreover, we check the change in analyst forecast bias using our Difference-in-Differences approach. Similar to Hong and Kacperczyk (2010), we find that the mean (median) optimistic bias significantly increases after the exogenous drop in analyst coverage, implying that the remaining analysts make worse earnings forecast after exogenous shocks to analyst coverage.[27]

Taken together, the drop of one analyst due to broker merger or broker closure is not only a matter of this particular analyst, but also affects the behavior of the remaining analysts following the same firm. The remaining analysts are producing less informative reports and making more optimistically biased earnings forecast due to less competition.

[27] The results are not tabulated here but are available upon request.

These combined and amplified effects translate into less transparent information environment, and managers avoid tax more aggressively.

7.2. Persistence Test

In the preceding analysis, we directly test the effects of the exogenous decrease in analyst coverage by comparing our measures of tax avoidance from one year prior to the brokerage exit *(t-1)* to one year after the brokerage exit *(t+1).* One might be concerned whether the increase in information asymmetry is permanent or not. However, even if the exogenous change in information environment is not permanent, managers might still want to take advantage of this short-window opportunity of increased information asymmetry and relaxed external monitoring. This short-term opportunistic behavior is supported by the existent literature using the same natural experiments of broker exits. For example, Derrien and Kecskes (2013) find that firms change investment, financing and payout decisions. Even creditors pay attention to such an exogenous change in information environment, as Fong et al. (2014) find that a drop in one analyst coverage increases the subsequent credit ratings of a firm by around a half-rating notch.

We directly test this hypothesis in our data. We find that most of our treatment firms regain their analyst coverage after three years. This is consistent with Derrien and Kecskes (2013) that the shocks to analyst coverage due to broker exits are one-time temporary decreases. We compare our tax avoidance variables between three years (*t+3* vs. *t-1*) or five years (*t+5* vs. *t-1*) after and one year prior to the shock in our tests, and find no significant results, implying that the significant changes in tax avoidance due to exogenous reductions in analyst coverage mainly occur between *t-1* and *t+1*. These evidences provide further support that, for managers observing the exogenous drop in analyst coverage and knowing that the deceases are only temporary, they are more likely to take more aggressive tax planning strategies immediately, in order to take full advantage of this short-window opportunity.

7.3. Tax Planning Capacity

As we find in Section 7.2, managers are more likely to immediately take short-term opportunistic actions to exploit the opportunity of exogenous increase in information asymmetry. One concern is that this might be based on the assumption that mangers have the ability to change tax planning quickly. As suggested by the literature (e.g., Desai and Dharmapala, 2006; Chen et al., 2010; Hanlon and Heitzman, 2010), the techniques for tax avoidance could include all transactions from investing in a municipal bond, transfer pricing, to engaging in tax shelters. It is possible that many firms have tax planning capacity in the first place, in terms of for example, being familiar with transfer pricing practices, having complicated financial structure, owning entities in tax havens and etc. Because of the stringent external monitoring and less information asymmetry, the firms do not engage in much aggressive tax planning due to reputational concern, adverse media attention concern, or the concern of higher cost of financing. The exogenous increase in information asymmetry due to drops in analyst coverage provides a good opportunity for managers to fully utilize firms' tax planning capacity. We directly test this hypothesis, by dividing the sample into subsamples with high and low tax planning capacity prior to the broker exit events.

Specifically, the sample is partitioned into subsamples according to the number of segments or whether the firm is a multinational corporation or not. Intuitively, firms with a greater number of business segments could have more complicated financial structure to easily engage in more aggressive tax planning activities (e.g., Desai and Dharmapala, 2006;

Hanlon and Heitzman, 2010). We also look at whether the firm is multinational or not, as multinational firms might have more mechanisms to avoid taxes through shifting profits into low-tax foreign subsidiaries, shifting debt to high-tax jurisdictions, seeking offshore tax havens, and related party transactions with foreign subsidiaries (e.g., Chen et al., 2010; Gravelle, 2010). A high number of segments indicates that the firm's number of segments is in the top tercile of the sample, and low number of segments implies that the firm's number of segments is in the bottom tercile of the sample. The data for the number of segments come from Compustat's Business Segment files. A firm is defined as multinational if it realizes a positive foreign income. Table 11 presents the results.

[Table 11 about here]

From Table 11, we find that for both of the two measures of tax planning capacity, the effect of exogenous drop in analyst coverage is more pronounced in the subset of firms with higher tax planning capacity prior to the broker merger or closure events. This result provides strong support to our hypothesis that managers would take advantage of the short-term increase in information asymmetry immediately by fully utilizing their firms' tax planning capacity.

8. Concluding Remarks

In this paper, we examine the role of information asymmetry proxied by analyst coverage in corporate tax avoidance. Specifically, we test whether analyst coverage reduces or encourages tax avoidance activities. Our baseline results indicate a negative association between analyst coverage and tax avoidance. To further establish the causality, we rely on two sources of exogenous shocks to analyst coverage – broker closures and mergers to explore the causal effect of analyst coverage. We find that when a firm experiences an exogenous decrease in analyst coverage, it engages in more tax avoidance activities, compared to a similar firm that does not experience an exogenous drop in analyst coverage.

The evidence therefore suggests a strong negative *causal* effect of analyst coverage on tax avoidance. We further find that the effects are mainly driven by the firms with smaller initial analyst coverage and more financial constraint. Moreover, the effects are more pronounced in the subset of firms with more information asymmetry and poorer corporate governance.

Overall, our findings suggest that financial analysts help reduce corporate tax avoidance. By doing so, we provide novel evidence that information asymmetry plays an important role in firms' tax avoidance decisions, and firms avoid taxes more aggressively after experiencing increases in information asymmetry induced by exogenous drops in analyst coverage. Consequently, our paper lends academic support to the recent view from both public media and policy makers who call for greater transparency from companies to fight against tax avoidance.

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Table 1
Summary Statistics

This table presents descriptive statistics on measures of tax avoidance, analyst coverage, and firms' characteristics for the sample in regression analysis. Our sample consists of 23,475 firm-years from 5,401 publicly traded U.S. firms covering the period 1999-2011. The BTD is the total book-tax difference, is calculated by book income less taxable income scaled by lagged assets (*at*). Book income is pre-tax income (*pi*) in year *t*. Taxable income is calculated by summing the current federal tax expense (*txfed*) and current foreign tax expense (*txfo*) and dividing by the statutory tax rate (STR) and then subtracting the change in net operating loss (NOL) carryforwards (*tlcf*) in year t. If the current federal tax expense is missing, the total current tax expense equals the total income taxes (*txt*) less deferred taxes (*txdi*), state income taxes (*txs*), and other income taxes (*txo*). We remove observations with total assets less than $1 million and observations with negative taxable income (*txfed*<0). DDBTD is Desai and Dharmapala (2006) residual book-tax difference, which is equal to the residual from the following fixed effects regression:

$BTD_{i,t}=\beta_1 TACC_{i.t} + \mu_i + \varepsilon_{i,t},$

where BTD is the total book-tax difference and TACC is the total accruals measured using the cash flow method per Hribar and Collins (2002). Both variables are scaled by lagged total assets. We remove observations with total assets less than $1 million and observations with negative taxable income (*txfed*<0). SHELTER is the estimated probability that a firm engages in a tax shelter based on Wilson's (2009) tax sheltering model:

$SHELTER= 4.86 + 5.20\times BTD + 4.08\times Discretionary\ Accruals - 1.41\times Leverage + 0.76\times AT + 3.51\times ROA + 1.72\times Foreign\ Income + 2.42\times R\&D,$

where BTD is the total book-tax difference; Discretionary accruals is the absolute value of discretionary accruals from the modified cross-sectional Jones model; Leverage is the long-term leverage, defined as long-term debt (*dltt*) divided by total assets (*at*); AT is the total assets (*at*); ROA is the return on assets, measured as operating income (*pi - xi*) divided by lagged assets; Foreign income is an indicator variable set equal to one for firm observations reporting foreign income (*pifo*), and zero otherwise; and R&D is R&D expense (*xrd*) divided by lagged total assets. DTAX is based on Frank, Lynch, and Rego (2009), which is measured by a firm's residual from the following regression, estimated by industry and year:

$ETRDIFF_{it}= \beta_0+\beta_1\ INTANG_{it} + \beta_2\ EQIN_{it} + \beta_3\ MI_{it} + \beta_4\ TXS_{it} + \beta_5\ \Delta NOL_{it} + \beta_6\ LAGETRDIFF_{it} + \varepsilon_i,$

where ETRDIFF is based on Frank, Lynch, and Rego (2009) and Kim et al. (2011), which is calculated as (PI - ((TXFED + TXFO)/STR)) - (TXDI/STR), scaled by lagged assets (*at*); PI is pre-tax book income (*pi*); TXFED is the current federal tax expense (*txfed*); TXFO is the current foreign tax expense (*txfo*); TXDI is the deferred tax expense (*txdi*). INTANG is goodwill and other intangible assets(*intan*), scaled by lagged assets(*at*); EQIN is income (loss) reported under the equity method (*esub*), scaled by lagged assets (*at*); MI is income (loss) attributable to minority interest (*mii*), scaled by lagged assets(*at*); TXS is current state tax expense(*txs*), scaled by lagged assets; ΔNOL is change in net operating loss carry forwards (*tlcf*), scaled by lagged assets (*at*); LAGETRDIFF is ETRDIFF in the previous fiscal year. CETR is cash effective tax rate based on Chen et al. (2010), calculated as cash taxes paid (*txpd*) divided by pre-tax income (*pi*). CETR is set to missing when the denominator is zero or negative. We winsorize CETR to the range [0, 1]. MPBTD is Manzon and Plesko (2002) book-tax difference, which is calculated by US domestic book income less US domestic taxable income less state tax income (*txs*) less other tax income (*txo*) less equity in earnings (*esub*) scaled by lagged assets (*at*). US domestic book income is domestic pre-tax income (*pidom*) in year t. US domestic taxable income is calculated by the current federal tax expense (*txfed*) divided by the statutory tax rate (STR). We remove observations with total assets less than $1 million and observations with negative taxable income (*txfed*<0). ETR is effective tax rate based on Zimmerman (1983), calculated as total tax expense (*txt*) less change in deferred tax (*txdi*), divided by operating cash flows (*oancf*). ETR is set to missing when the denominator is zero or negative. We winsorize ETR to the range [0, 1]. CFETR is cash flow effective tax rate, calculated as cash taxes paid (*txpd*) divided by operating cash flows (*oancf*). We winsorize CFETR to the range of [0, 1]. LnCoverage is the log of the total number of stock analysts following the firm during the year. SIZE is the log of the market value of equity (*csho × prcc_f*), Q is calculated as the market value of assets over book value of assets: (*at – ceq + csho × prcc_f*)/*at*, and PPE is defined as property, plant, and equipment (*ppegt*) divided by total assets. FI is calculated as foreign income (*pifo*) divided by total assets (*at*). Other variable definitions are given in Appendix A.

	Mean	Std.	Q1	Median	Q3	N
Measures of tax avoidance						
BTD	-0.062	0.421	-0.053	0.008	0.046	23,475
DDBTD	0.023	0.294	-0.036	0.004	0.061	20,421
SHELTER	0.152	3.846	-0.934	0.739	2.346	18,572
DTAX	0.031	0.441	-0.019	0.025	0.111	18,853
CETR	0.270	0.211	0.116	0.256	0.361	14,836
MPBTD	-0.128	0.433	-0.095	-0.004	0.028	23,404
ETRDIFF	-0.123	0.435	-0.076	0.002	0.020	23,343
ETR	0.267	0.255	0.045	0.227	0.388	16,395
CFETR	0.211	0.244	0.009	0.137	0.317	19,161
Analyst coverage						
LnCoverage (LNCOV)	1.421	0.943	0.693	1.447	2.150	23,475
Firm characteristics						
Firm size (SIZE)	6.121	1.907	4.868	6.089	7.303	23,475
Tobin's Q (Q)	2.438	2.307	1.223	1.729	2.734	23,475
Tangibility (PPE)	0.443	0.369	0.156	0.333	0.641	23,475
Foreign income (FI)	0.008	0.030	0	0	0.005	23,475
ROA	0.025	0.321	0.016	0.114	0.175	23,475
Leverage (LEV)	0.166	0.216	0	0.085	0.265	23,475
NOL	0.662	0.473	0	1	1	23,475
ΔNOL	8.746	47.195	0	0	0.058	23,475
EQINC	3.216E-04	0.005	0	0	0	23,475
Intangibility (INTAN)	0.209	0.284	0.006	0.099	0.306	23,475

Table 2
Baseline Regressions

This table presents results of fixed effects regressions examining the effect of analyst coverage on corporate tax avoidance. Our sample consists of 23,475 firm-years from 5,401 publicly traded U.S. firms covering the period 1999-2011. The dependent variables are Book-tax difference (BTD), Desai and Dharmapala (2006) residual book-tax difference (DDBTD), SHELTER, DTAX, and Cash effective tax rate (CETR). The total book-tax difference is calculated by book income less taxable income scaled by lagged assets (*at*). DDBTD is Desai and Dharmapala (2006) residual book-tax difference, which is equal to the residual from the following fixed effects regression:

$$BTD_{i,t}=\beta_1 TACC_{i.t} + \mu_i + \varepsilon_{i,t},$$

where BTD is the total book-tax difference and TACC is the total accruals measured using the cash flow method per Hribar and Collins (2002). Both variables are scaled by lagged total assets. We remove observations with total assets less than $1 million and observations with negative taxable income (*txfed*<0). SHELTER is the estimated probability that a firm engages in a tax shelter based on Wilson's (2009) tax sheltering model. DTAX is based on Frank, Lynch, and Rego (2009), which is measured by a firm's residual from the following regression, estimated by industry and year:

$$ETRDIFF_{it}= \beta_0+\beta_1\, INTANG_{it} + \beta_2\, EQIN_{it} + \beta_3\, MI_{it} + \beta_4\, TXS_{it} + \beta_5\, \Delta NOL_{it} + \beta_6\, LAGETRDIFF_{it} + \varepsilon_i,$$

where ETRDIFF is based on Frank, Lynch, and Rego (2009) and Kim et al. (2011), which is calculated as (PI - ((TXFED + TXFO)/STR)) - (TXDI/STR), scaled by lagged assets (*at*). INTANG is goodwill and other intangible assets(*intan*), scaled by lagged assets(*at*); EQIN is income (loss) reported under the equity method (*esub*), scaled by lagged assets (*at*); MI is income (loss) attributable to minority interest (*mii*), scaled by lagged assets(*at*); TXS is current state tax expense(*txs*), scaled by lagged assets; ΔNOL is change in net operating loss carry forwards (*tlcf*), scaled by lagged assets (*at*); LAGETRDIFF is ETRDIFF in the previous fiscal year. CETR is cash effective tax rate based on Chen et al. (2010), calculated as cash taxes paid (*txpd*) divided by pre-tax income (*pi*). CETR is set to missing when the denominator is zero or negative. We winsorize CETR to the range [0, 1]. LnCoverage is the log of the total number of stock analysts following the firm during the year. SIZE is the log of the market value of equity (*csho × prcc_f*), Q is calculated as the market value of assets over book value of assets: (*at − ceq + csho × prcc_f*)/*at*, and PPE is defined as property, plant, and equipment (*ppegt*) divided by total assets. FI is calculated as foreign income (*pifo*) divided by total assets (*at*). Other variable definitions are given in Appendix A. All the regressions include firm and year fixed effects. The estimations correct the error structure for heteroskedasticity and within-firm error clustering, and the standard errors are reported in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 2, continued

	BTD	DDBTD	SHELTER	DTAX	CETR
	(1)	(2)	(3)	(4)	(5)
LnCoverage	-0.014**	-0.015*	-0.343***	-0.014*	0.014**
	[0.007]	[0.009]	[0.062]	[0.008]	[0.006]
Firm size (SIZE)	-0.002	-0.008	0.962***	-0.017	-0.006
	[0.007]	[0.009]	[0.075]	[0.011]	[0.007]
Tobin's Q (Q)	-0.004	-0.004	-0.191***	-0.001	0.000
	[0.004]	[0.005]	[0.044]	[0.006]	[0.003]
Tangibility (PPE)	0.032	0.048	-0.943***	-0.031	0.038
	[0.034]	[0.043]	[0.365]	[0.033]	[0.024]
Foreign income (FI)	0.174	0.323**	6.106***	-0.583***	-1.032***
	[0.128]	[0.156]	[1.114]	[0.148]	[0.156]
ROA	0.659***	0.501***	3.626***	0.827***	-0.474***
	[0.035]	[0.046]	[0.297]	[0.062]	[0.037]
Leverage (LEV)	0.016	-0.047	-0.906***	-0.056	-0.037
	[0.038]	[0.041]	[0.317]	[0.044]	[0.025]
NOL	0.031***	0.031***	0.188***	-0.007	0.018**
	[0.007]	[0.010]	[0.062]	[0.009]	[0.007]
ΔNOL	0.002***	0.002***	0.012***	0.000***	0.000***
	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]
Intangibility (INTAN)	0.021	0.081**	1.338***	-0.008	0.031*
	[0.026]	[0.038]	[0.204]	[0.044]	[0.017]
EQINC	0.935	2.330**	8.439	-1.337	-0.644
	[0.764]	[1.090]	[6.318]	[0.988]	[0.898]
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	23,475	20,481	18,572	18,853	14,836
Adjusted R^2	0.593	0.307	0.742	0.449	0.352

Table 3
Difference-in-Differences Analysis of Tax Avoidance

This table presents the main Difference-in-Differences estimates for our measures of tax avoidance following broker closures or broker mergers. The sample consists of 1,415 treated firms that experience an exogenous drop in analyst coverage between 2000 and 2010, and the same number of control firms. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms in the year before the broker termination based on a set of firm characteristics. Both groups of firms are publicly traded non-finance and non-utility firms. Panel A reports the summary statistics for matched samples prior to broker terminations, based on Abadie and Imbens (2006) bias corrected average treated effect matching estimator. The matching variables include firm size (SIZE), Tobin's Q (Q), tangibility (PPE), foreign income (FI), analyst coverage (COV), Fama-French 48 industry, and fiscal year. Panel B reports the Difference-in-Differences results using Abadie and Imbens (2006) matching. Panel C reports the Difference-in-Differences results for tax avoidance using nearest-neighbor logit propensity score matching. SIZE is the log of the market value of equity (*csho × prcc_f*), Q is calculated as the market value of assets over book value of assets: (*at − ceq + csho × prcc_f*)/*at*, and PPE is defined as property, plant, and equipment (*ppegt*) divided by total assets. FI is calculated as foreign income (*pifo*) divided by total assets (*at*), and COV is the total number of stock analysts following the firm during the year. Other variable definitions are given in Appendix A. Heteroskedasticity-consistent standard errors are reported in brackets below the estimates. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A. Summary Statistics for Matched Samples prior to Broker Terminations

Variable	Treated Firms			Matched Control Firms			Difference in Means	T-Stat.
	Mean	Std.	Med.	Mean	Std.	Med.		
SIZE	7.476	1.806	7.395	7.446	1.782	7.312	0.031	[0.49]
Q	2.754	2.101	2.080	2.718	2.073	2.032	0.035	[0.49]
PPE	0.439	0.346	0.339	0.427	0.343	0.322	0.012	[1.01]
FI	0.012	0.030	0.000	0.014	0.031	0.000	-0.001	[-1.18]
COV	11.701	7.253	10	11.556	7.261	10	0.145	[-0.21]

Table 3, continued

Panel B. DID Results Using Abadie and Imbens (2006) Matching

	Average Treated Difference (year t+1 vs. t-1)	Average Control Difference (year t+1 vs. t-1)	Diff-in-Diffs (Treated vs. Control)
BTD	0.037**	0.014	0.023**
	[0.015]	[0.012]	[0.010]
DDBTD	0.056***	0.025**	0.031***
	[0.016]	[0.010]	[0.009]
SHELTER	0.259***	0.141	0.118
	[0.095]	[0.092]	[0.085]
DTAX	0.065***	0.010	0.055*
	[0.022]	[0.019]	[0.029]
CETR	-0.007	0.017*	-0.025**
	[0.010]	[0.009]	[0.011]

Panel C. DID Results Using Propensity Score Matching

	Average Treated Difference (year t+1 vs. t-1)	Average Control Difference (year t+1 vs. t-1)	Diff-in-Diffs (Treated vs. Control)
BTD	0.033***	-0.018***	0.052***
	[0.009]	[0.005]	[0.010]
DDBTD	0.048***	0.007	0.041***
	[0.008]	[0.004]	[0.009]
SHELTER	0.164**	-0.013	0.177*
	[0.078]	[0.046]	[0.091]
DTAX	-0.004	-0.028***	0.024**
	[0.009]	[0.006]	[0.011]
CETR	0.007**	0.016***	-0.009*
	[0.003]	[0.003]	[0.005]

Table 4
Difference-in-Differences Analysis of Tax Avoidance: Alternative Measures of Tax Avoidance

This table presents the Difference-in-Differences estimates using alternative measures of tax avoidance following broker closures or broker mergers. The sample consists of 1,415 treated firms that experience an exogenous drop in analyst coverage between 2000 and 2010, and the same number of control firms. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms in the year before the broker termination based on a set of firm characteristics. Both groups of firms are publicly traded non-finance and non-utility firms. Panel A reports the Difference-in-Differences results using Abadie and Imbens (2006) matching. Panel B reports the Difference-in-Differences results for tax avoidance using nearest-neighbor logit propensity score matching. The matching variables include firm size (SIZE), Tobin's Q (Q), tangibility (PPE), foreign income (FI), analyst coverage (COV), Fama-French 48 industry, and fiscal year. SIZE is the log of the market value of equity (*csho × prcc_f*), Q is calculated as the market value of assets over book value of assets: (*at* − *ceq* + *csho* × *prcc_f*)/*at*, and PPE is defined as property, plant, and equipment (*ppegt*) divided by total assets. FI is calculated as foreign income (*pifo*) divided by total assets (*at*), and COV is the total number of stock analysts following the firm during the year. Other variable definitions are given in Appendix A. Heteroskedasticity-consistent standard errors are reported in brackets below the estimates. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 4, continued

Panel A. DID Results Using Abadie and Imbens (2006) Matching

	Average Treated Difference (year t+1 vs. t-1)	Average Control Difference (year t+1 vs. t-1)	Diff-in-Diffs (Treated vs. Control)
MPBTD	0.056**	0.026*	0.030**
	[0.022]	[0.014]	[0.011]
ETRDIFF	0.055***	0.027*	0.028***
	[0.020]	[0.015]	[0.009]
ETR	-0.019***	-0.003	-0.016*
	[0.006]	[0.007]	[0.009]
CFETR	-0.048***	-0.033***	-0.015**
	[0.008]	[0.008]	[0.006]

Panel B. DID Results Using Propensity Score Matching

	Average Treated Difference (year t+1 vs. t-1)	Average Control Difference (year t+1 vs. t-1)	Diff-in-Diffs (Treated vs. Control)
MPBTD	0.056***	-0.008**	0.064***
	[0.008]	[0.004]	[0.009]
ETRDIFF	0.058***	-0.010**	0.067***
	[0.009]	[0.004]	[0.010]
ETR	-0.011**	-0.007	-0.004
	[0.005]	[0.007]	[0.009]
CFETR	-0.034***	-0.014**	-0.020**
	[0.007]	[0.007]	[0.010]

Table 5
Difference-in-Differences Analysis of Tax Avoidance: Alternative Matching Criteria

This table presents the Difference-in-Differences estimates for our measures of tax avoidance following broker closures or broker mergers, using alternative matching criteria. The sample consists of 1,415 treated firms that experience an exogenous drop in analyst coverage between 2000 and 2010, and the same number of control firms. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms in the year before the broker termination based on a set of firm characteristics. Both groups of firms are publicly traded non-finance and non-utility firms. Nearest-neighbor logit propensity score matching is adopted for various combinations of the following matching variables: BTD, COV, SIZE, Q, PPE, FI, ROA, LEV, NOL, ΔNOL, INTAN, EQINC. SIZE is the log of the market value of equity (*csho × prcc_f*), Q is calculated as the market value of assets over book value of assets: (*at − ceq + csho × prcc_f*)/*at*, and PPE is defined as property, plant, and equipment (*ppegt*) divided by total assets. FI is calculated as foreign income (*pifo*) divided by total assets (*at*), and COV is the total number of stock analysts following the firm during the year. ROA is return on assets, measured as operating income (*pi - xi*) divided by lagged assets. LEV is long-term leverage, defined as long-term debt (*dltt*) divided by total assets (*at*). NOL is a dummy variable coded as one if loss carry forward (tlcf) is positive, and zero otherwise. ΔNOL is defined as the change in loss carry forward, INTAN is calculated as intangible assets (*intan*), scaled by lagged assets, and EQINC is equity income in earnings (*esub*) divided by lagged assets. Other variable definitions are given in Appendix A. Heteroskedasticity-consistent standard errors are reported in brackets below the estimates. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 5, continued

	BTD	DDBTD	DTAX	CETR
	(1)	(2)	(3)	(4)
Simple-matched	0.021**	0.013*	0.056***	-0.015**
	[0.009]	[0.008]	[0.018]	[0.007]
BTD/COV-matched	0.050***	0.024**	0.033**	-0.018**
	[0.013]	[0.012]	[0.016]	[0.008]
SIZE/COV-matched	0.032**	0.033**	0.135**	-0.013*
	[0.014]	[0.014]	[0.067]	[0.007]
SIZE/Q/PPE/COV-matched	0.028**	0.025*	0.040***	-0.012*
	[0.014]	[0.014]	[0.015]	[0.007]
SIZE/Q /PPE/FI/ROA/LEV/COV-matched	0.026*	0.031**	0.028*	-0.017**
	[0.014]	[0.012]	[0.015]	[0.007]
SIZE/Q /PPE/FI /ROA/LEV /NOL/ΔNOL/COV-matched	0.034**	0.029**	0.055	-0.015**
	[0.013]	[0.012]	[0.058]	[0.007]
SIZE/Q /PPE/FI/ROA/LEV /NOL/ΔNOL/INTAN/EQINC/COV-matched	0.028**	0.012***	0.012***	-0.012***
	[0.014]	[0.011]	[0.014]	[0.007]

Table 6
Difference-in-Differences Analysis of Tax Avoidance: Conditional on Initial Analyst Coverage

This table presents the Difference-in-Differences estimates for our measures of tax avoidance following broker closures or broker mergers, conditional on initial analyst coverage. The sample consists of 1,415 treated firms that experience an exogenous drop in analyst coverage between 2000 and 2010, and the same number of control firms. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms in the year before the broker termination based on a set of firm characteristics. Both groups of firms are publicly traded non-finance and non-utility firms. Nearest-neighbor logit propensity score matching is adopted. The sample is divided into subsamples according to the initial analyst coverage prior to broker terminations. Columns (1) and (2) partition the sample using arbitrary numbers of analysts following the firm before broker terminations: five and 15, and Column (1) consists of 870 firm-year observations while Column (2) consists of 646 firm-year observations. Columns (3) and (4) divide the sample according to the terciles sorted on initial analyst coverage, where the firms defined as with high initial analyst coverage are those in the top tercile of the sample, and firms defined as with low initial analyst coverage are in the bottom tercile of the sample. Column (3) consists of 932 firm-year observations while Column (4) consists of 948 firm-year observations. Other variable definitions are given in Appendix A. Heteroskedasticity-consistent standard errors are reported in brackets below the estimates. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 6, continued

	Diff-in-Diffs (Treated vs. Control)			
	Analyst Coverage (COV)			
	<=5	>=15	Low	High
	(1)	(2)	(3)	(4)
BTD	0.118***	0.007	0.100***	0.005
	[0.028]	[0.014]	[0.023]	[0.012]
DDBTD	0.103***	0.008	0.069***	0.017*
	[0.025]	[0.013]	[0.021]	[0.010]
SHELTER	0.278	0.229	0.153	0.102
	[0.228]	[0.141]	[0.198]	[0.123]
DTAX	0.075***	0.028*	0.083***	-0.006
	[0.029]	[0.014]	[0.025]	[0.013]
CETR	-0.030***	-0.016*	-0.017**	-0.010
	[0.009]	[0.009]	[0.008]	[0.008]

Table 7
Difference-in-Differences Analysis of Tax Avoidance: Conditional on Levels of Financial Constraints

This table presents the Difference-in-Differences estimates for our measures of tax avoidance following broker closures or broker mergers, conditional on levels of financial constraints. The sample consists of 1,415 treated firms that experience an exogenous drop in analyst coverage between 2000 and 2010, and the same number of control firms. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms in the year before the broker termination based on a set of firm characteristics. Both groups of firms are publicly traded non-finance and non-utility firms. Nearest-neighbor logit propensity score matching is adopted. The sample is partitioned into low or high financial constraint subsamples according to Hadlock and Pierce (2010) financial constraint index (HP index), Whited and Wu (2006) financial constraint index (WW index), whether the firm has an investment grade rating, and whether the firm pays out dividend in the year. For example, high HP index is a dummy variable with one indicating the firm's HP index is in the top tercile of the sample, and low HP index is also a dummy variable with one indicating the firm's HP index is in the bottom tercile of the sample. Investment grade is a dummy variable that equals one if the S&P rating is BBB or higher and zero otherwise. Firms with higher HP index, higher WW index, non-investment grade and firms do not pay out dividend are generally regarded as firms with higher levels of financial constraints. Column (1) consists of 892 firm-year observations while Column (2) consists of 892 firm-year observations. Both Columns (3) and (4) consist of 880 firm-year observations, respectively. Column (5) consists of 442 firm-year observations while Column (6) consists of 2,388 firm-year observations. Column (7) consists of 858 firm-year observations while Column (8) consists of 1,968 firm-year observations. Other variable definitions are given in Appendix A. Heteroskedasticity-consistent standard errors are reported in brackets below the estimates. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 7, continued

	Diff-in-Diffs (Treated vs. Control)							
	HP Index		WW Index		Investment Grade		Dividend Payout	
	Low	High	Low	High	Yes	No	Yes	No
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BTD	-0.002	0.123***	0.001	0.093***	0.013	0.059***	0.010	0.070***
	[0.008]	[0.025]	[0.011]	[0.022]	[0.010]	[0.012]	[0.008]	[0.014]
DDBTD	-0.007	0.114***	-0.011	0.053***	-0.005	0.049***	-0.017*	0.065***
	[0.007]	[0.024]	[0.009]	[0.016]	[0.008]	[0.011]	[0.009]	[0.013]
SHELTER	-0.076	0.585***	-0.103	0.840***	0.025	0.203*	0.008	0.244**
	[0.083]	[0.213]	[0.089]	[0.209]	[0.089]	[0.105]	[0.084]	[0.122]
DTAX	0.006	0.078***	-0.000	0.056**	-0.003	0.029**	-0.007	0.036**
	[0.011]	[0.026]	[0.012]	[0.023]	[0.015]	[0.013]	[0.010]	[0.015]
CETR	-0.011	-0.011	-0.007	-0.017*	-0.006	-0.023*	-0.009	-0.010*
	[0.008]	[0.008]	[0.009]	[0.009]	[0.005]	[0.012]	[0.009]	[0.005]

Table 8
Difference-in-Differences Analysis of Tax Avoidance: Conditional on Levels of Information Asymmetry

This table presents the Difference-in-Differences estimates for our measures of tax avoidance following broker closures or broker mergers, conditional on levels of information asymmetry. The sample consists of 1,415 treated firms that experience an exogenous drop in analyst coverage between 2000 and 2010, and the same number of control firms. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms in the year before the broker termination based on a set of firm characteristics. Both groups of firms are publicly traded non-finance and non-utility firms. Nearest-neighbor logit propensity score matching is adopted. The sample is partitioned into low or high information asymmetry subsamples according to firm size, firm age, whether the firm is included in S&P 500 index, whether the firm receives rating from S&P, and discretionary accruals. Discretionary accruals is the absolute value of discretionary accruals from the modified cross-sectional Jones model. For example, small is a dummy variable with one indicating the firm's size is in the bottom tercile of the sample, and zero indicating the firm's size is in the top tercile of the sample. Small, young, non-S&P 500, non-S&P rating firms and firms with higher discretionary accruals are generally regarded as more opaque firms. Column (1) consists of 944 firm-year observations while Column (2) consists of 942 firm-year observations. Column (3) consists of 978 firm-year observations while Column (4) consists of 732 firm-year observations. Column (5) consists of 568 firm-year observations while Column (6) consists of 2,262 firm-year observations. Column (7) consists of 970 firm-year observations while Column (8) consists of 1,860 firm-year observations. Both Columns (9) and (10) consist of 806 firm-year observations. Other variable definitions are given in Appendix A. Heteroskedasticity-consistent standard errors are reported in brackets below the estimates. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 8, continued

	Diff-in-Diffs (Treated vs. Control)									
	Small		Young		S&P 500		S&P Rating		Discretionary Accruals	
	No	Yes	No	Yes	Yes	No	Yes	No	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
BTD	0.005	0.126***	-0.003	0.170***	0.007	0.063***	0.013	0.072***	0.020	0.109***
	[0.012]	[0.024]	[0.009]	[0.031]	[0.012]	[0.012]	[0.011]	[0.015]	[0.014]	[0.026]
DDBTD	-0.010	0.098***	-0.011	0.158***	-0.005	0.053***	-0.010	0.065***	0.027**	0.051**
	[0.010]	[0.021]	[0.009]	[0.028]	[0.011]	[0.011]	[0.008]	[0.013]	[0.012]	[0.021]
SHELTER	-0.123	0.609***	-0.074	0.749***	0.060	0.206*	0.009	0.259**	-0.028	0.357*
	[0.099]	[0.206]	[0.092]	[0.271]	[0.096]	[0.111]	[0.093]	[0.128]	[0.118]	[0.217]
DTAX	0.004	0.080***	0.001	0.071**	-0.016	0.034***	0.010	0.031**	-0.004	0.040*
	[0.014]	[0.025]	[0.012]	[0.031]	[0.016]	[0.013]	[0.013]	[0.015]	[0.018]	[0.024]
CETR	-0.004	-0.003	-0.003	-0.016	-0.006	-0.019*	-0.005	-0.012**	-0.010	-0.032***
	[0.009]	[0.008]	[0.008]	[0.011]	[0.005]	[0.010]	[0.008]	[0.006]	[0.008]	[0.009]

Table 9
Difference-in-Differences Analysis of Tax Avoidance: Conditional on Corporate Governance

This table presents the Difference-in-Differences estimates for our measures of tax avoidance following broker closures or broker mergers, conditional on corporate governance. The sample consists of 1,415 treated firms that experience an exogenous drop in analyst coverage between 2000 and 2010, and the same number of control firms. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms in the year before the broker termination based on a set of firm characteristics. Both groups of firms are publicly traded non-finance and non-utility firms. Nearest-neighbor logit propensity score matching is adopted. The sample is partitioned into poor or good corporate governance subsamples according to institutional holding, product market competition, and CEO equity portfolio incentives. Institutional ownership is measured by the percentage of common shares owned by institutional investors. High institutional ownership is a dummy variable with one indicating the firm's institutional holding is in the top tercile of the sample, and low institutional ownership equals one if the firm's institutional holding is in the bottom tercile of the sample. More competition equals one if the industry's HHI index is in the bottom half of all 48 Fama-French industries, and less compensation equals one if HHI is in the top half of all 48 Fama-French industries. HHI is calculated as the sum of squared market shares of all Compustat firms in each industry, and higher values indicate greater concentration and lower product market competitiveness. CEO equity portfolio incentives measures the percentage change in the equity portfolio value held by the CEO of the firm for a 1% increase in stock price, which is calculated as the sum of all shares (restricted and unrestricted) and delta-weighted options (exercisable and unexercisable) held by the CEO divided by the total number of shares outstanding multiplied by 100, for a given fiscal year. The calculation of the delta-weighted options uses the detailed information on current and previous option grants to calculate the options' delta and multiplies the number of options held in each series by its delta. Firms with high CEO equity portfolio incentives are defined as firms with the value of CEO equity portfolio incentives higher than the median of the sample, and low CEO equity portfolio firms are those with the value lower than the median of the sample. Both Columns (1) and (2) consists of 942 firm-year observations. Column (3) consists of 1,412 firm-year observations while Column (4) consists of 1,418 firm-year observations. Column (5) consists of 726 firm-year observations while Column (6) consists of 724 firm-year observations. Other variable definitions are given in Appendix A. Heteroskedasticity-consistent standard errors are reported in brackets below the estimates. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 9, continued

	Diff-in-Diffs (Treated vs. Control)					
	Institutional Ownership		Product Market Competition		CEO equity portfolio incentives	
	Low	High	Less	More	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)
BTD	0.140***	-0.002	0.054***	0.050***	0.044***	-0.015
	[0.025]	[0.010]	[0.015]	[0.014]	[0.014]	[0.012]
DDBTD	0.106***	0.005	0.062***	0.021	0.001	0.006
	[0.023]	[0.009]	[0.014]	[0.013]	[0.013]	[0.011]
SHELTER	0.597***	-0.021	0.215*	0.134	0.395***	-0.064
	[0.229]	[0.107]	[0.130]	[0.123]	[0.141]	[0.111]
DTAX	0.078***	0.017	0.107**	0.087**	0.230***	0.123*
	[0.027]	[0.012]	[0.052]	[0.038]	[0.068]	[0.074]
CETR	-0.028***	-0.005	-0.012*	-0.005	-0.021**	0.002
	[0.008]	[0.008]	[0.007]	[0.007]	[0.008]	[0.009]

Table 10
Difference-in-Differences Analysis of the Information Content of Analyst Research

The table presents DID tests for the analysis of the information content of analyst reports using the matched control sample. The main variable of interest is the information content of analyst research. The construction of information content measuring the average informativeness of analyst reports, follows Frankel, Kothari, and Weber (2006) and Lehavy, Li, and Merkley (2011), which is defined as the percentage of a firm's stock return related to analyst forecast revisions to the total stock returns during the fiscal year (the time period between 10-K filing and the subsequent fiscal year-end). Specifically, we first sum the absolute size-adjusted returns on all the forecast revision dates for a firm in a given fiscal year. Then it is divided by the sum of the one-day, absolute size-adjusted returns for all the trading dates during the fiscal year. Finally, we divide this ratio by the number of analyst forecast revisions in a given fiscal year. Multiple reports issued in the same day are treated as a single report. We exclude analyst report dates that coincide with earnings announcement following Lehavy, Li, and Merkley (2011). Treated firms are matched using nearest-neighbor logit propensity score matching. The matching variables include Size (SIZE), Tobin's Q (Q), Leverage (LEV), Cash (CASH) and Coverage (COV). Size is the log of market capitalization of the firm. Tobin's Q is the market value of assets over book value of assets. Leverage refers to the leverage ratio, calculated as total debt divided by the market value of total assets. Cash is the ratio of cash and short-term investments to total assets. Coverage refers to the number of analysts covering the firm. Other variable definitions are given in Appendix A. The sample consists of 1,714 firm-years for the treatment sample and a same number of firm-years for the control sample. In Panel A, the summary statistics are presented. Panel B provides DID estimation results. Panel C shows the subsample DID results according to initial analyst coverage. Other variable definitions are given in Appendix A. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A. Summary Statistics for the Treatment Sample

	Mean	Std.
Information content	0.58%	0.21%

Panel B. DID Results

	Mean of diff-in-diffs (treatments vs. controls)
	Information Content
Matching on SIZE, Q, PPE, FI, and COV	
	-0. 04%***
(Standard error)	(0.0001)

Panel C. DID Results: Conditional on Initial Analyst Coverage

	Mean of diff-in-diffs (treatments vs. controls)
	Information Content
Matching on SIZE, Q, PPE, FI, and COV	
Low analyst coverage	-0.08%***
(Standard error)	(0.0002)
High analyst coverage	0.01%
(Standard error)	(0.0001)

Table 11
Difference-in-Differences Analysis of Tax Avoidance: Conditional on Tax Planning Capacity

This table presents the Difference-in-Differences estimates for our measures of tax avoidance following broker closures or broker mergers, conditional on firms' tax planning capacity. The sample consists of 1,415 treated firms that experience an exogenous drop in analyst coverage between 2000 and 2010, and the same number of control firms. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms in the year before the broker termination based on a set of firm characteristics. Both groups of firms are publicly traded non-finance and non-utility firms. Nearest-neighbor logit propensity score matching is adopted. The sample is partitioned into high and low tax planning capacity subsamples according to the number of segments or whether the firm is a multinational corporation or not. A high number of segments indicates that the firm's number of segments is in the top tercile of the sample, and low number of segments implies that the firm's number of segments is in the bottom tercile of the sample. The data for the number of segments come from Compustat's Business Segment files. A firm is defined as multinational if it realizes a positive foreign income. Other variable definitions are given in Appendix A. Heteroskedasticity-consistent standard errors are reported in brackets below the estimates. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	Diff-in-Diffs (Treated vs. Control)			
	#Segments		Multinational Firm	
	Low	High	No	Yes
	(1)	(2)	(3)	(4)
BTD	0.004	0.083***	0.007	0.072***
	[0.011]	[0.016]	[0.011]	[0.014]
DDBTD	-0.005	0.071***	-0.007	0.065***
	[0.009]	[0.015]	[0.009]	[0.013]
SHELTER	0.133	0.201	-0.148	0.336***
	[0.105]	[0.140]	[0.091]	[0.128]
DTAX	0.015	0.035**	0.005	0.033**
	[0.014]	[0.017]	[0.014]	[0.015]
CETR	-0.008	-0.011*	-0.007	-0.011*
	[0.008]	[0.006]	[0.008]	[0.006]

Appendix A
Variable Definitions

The table presents the definition and detailed calculation of the variables that are used in the paper. Compustat data codes are italicized in parentheses.

Variable	Definition *(Compustat data codes are italicized)*
Measures of tax avoidance	
Book-tax difference (BTD)	The total book-tax difference, which is calculated by book income less taxable income scaled by lagged assets (*at*). Book income is pre-tax income (*pi*) in year *t*. Taxable income is calculated by summing the current federal tax expense (*txfed*) and current foreign tax expense (*txfo*) and dividing by the statutory tax rate (STR) and then subtracting the change in net operating loss (NOL) carryforwards (*tlcf*) in year *t*. If the current federal tax expense is missing, the total current tax expense equals the total income taxes (*txt*) less deferred taxes (*txdi*), state income taxes (*txs*), and other income taxes (*txo*). We remove observations with total assets less than $1 million and observations with negative taxable income (*txfed*<0). Source: Compustat
Desai and Dharmapala (2006) residual book-tax difference (DDBTD)	Desai and Dharmapala (2006) residual book-tax difference, which equals the residual from the following fixed effects regression: $BTD_{i,t}=\beta_1 TACC_{i.t} + \mu_i + \varepsilon_{i,t}$, where BTD is the total book-tax difference and TACC is the total accruals measured using the cash flow method per Hribar and Collins (2002). Both variables are scaled by lagged total assets. We remove observations with total assets less than $1 million and observations with negative taxable income (*txfed*<0). Source: Compustat

SHELTER	Estimated probability that a firm engages in a tax shelter based on Wilson's (2009) tax sheltering model: *SHELTER= 4.86 + 5.20×BTD + 4.08×Discretionary Accruals - 1.41×Leverage + 0.76×AT + 3.51×ROA + 1.72×Foreign Income + 2.42×R&D,* where BTD is the total book-tax difference; Discretionary accruals is the absolute value of discretionary accruals from the modified cross-sectional Jones model; Leverage is the long-term leverage, defined as long-term debt (*dltt*) divided by total assets (*at*); AT is the total assets (*at*); ROA is the return on assets, measured as operating income (*pi* - *xi*) divided by lagged assets; Foreign income is an indicator variable set equal to one for firm observations reporting foreign income (*pifo*), and zero otherwise; and R&D is R&D expense (*xrd*) divided by lagged total assets. Source: Compustat
DTAX	A firm's residual from the following regression, estimated by industry and year: $ETRDIFF_{it}= \beta_0+\beta_1\ INTANG_{it} + \beta_2\ EQIN_{it} + \beta_3\ MI_{it} + \beta_4\ TXS_{it} + \beta_5\ \Delta NOL_{it} + \beta_6\ LAGETRDIFF_{it} + \varepsilon_i,$ where ETRDIFF is alculated as (PI - ((TXFED + TXFO)/STR)) - (TXDI/STR), scaled by lagged assets (at). PI is pre-tax book income (pi); TXFED is the current federal tax expense (txfed); TXFO is the current foreign tax expense (txfo); TXDI is the deferred tax expense (txdi). INTANG is goodwill and other intangible assets(*intan*), scaled by lagged assets(*at*); EQIN is income (loss) reported under the equity method (*esub*), scaled by lagged assets (*at*); MI is income (loss) attributable to minority interest (*mii*), scaled by lagged assets(*at*); TXS is current state tax expense(*txs*), scaled by lagged assets; ΔNOL is change in net operating loss carry forwards (*tlcf*), scaled by lagged assets (*at*); LAGETRDIFF is ETRDIFF in the previous fiscal year. Based on Frank, Lynch, and Rego (2009). Source: Compustat
Cash effective tax rate (CETR)	Calculated as cash taxes paid (*txpd*) divided by pre-tax income (*pi*). Based on Chen et al. (2010). CETR is set to missing when the denominator is zero or negative. We winsorize CETR to the range [0, 1]. Source: Compustat

Manzon and Plesko (2002) book-tax difference (MPBTD)	US domestic book-tax difference, which is calculated by US domestic book income less US domestic taxable income less state tax income (*txs*) less other tax income (*txo*) less equity in earnings (*esub*) scaled by lagged assets (*at*). US domestic book income is domestic pre-tax income (*pidom*) in year *t*. US domestic taxable income is calculated by the current federal tax expense (*txfed*) divided by the statutory tax rate (STR). We remove observations with total assets less than $1 million and observations with negative taxable income (txfed<0). Based on Manzon and Plesko (2002). Source: Compustat
ETR Differential (ETRDIFF)	Calculated as (PI - ((TXFED + TXFO)/STR)) - (TXDI/STR), scaled by lagged assets (*at*). PI is pre-tax book income (*pi*); TXFED is the current federal tax expense (*txfed*); TXFO is the current foreign tax expense (*txfo*); TXDI is the deferred tax expense (*txdi*). Based on Frank, Lynch, and Rego (2009) and Kim et al. (2011). Source: Compustat
Effective tax rate (ETR)	Calculated as Total tax expense (*txt*) less change in deferred tax (*txdi*), divided by operating cash flows (*oancf*). Based on Zimmerman (1983). ETR is set to missing when the denominator is zero or negative. We winsorize ETR to the range [0, 1]. Source: Compustat
Cash flow effective tax rate (CFETR)	Calculated as cash taxes paid (*txpd*) divided by operating cash flows (*oancf*). We winsorize CFETR to the range [0, 1]. Source: Compustat
Analyst coverage	
Coverage (COV)	Total number of stock analysts following the firm during the year. Source: I/B/E/S
Firm characteristics	
Firm size (SIZE)	Log of the market value of equity (*csho* × *prcc_f*). Source: Compustat
Tobin's Q (Q)	Market value of assets over book value of assets: (*at* − *ceq* + *csho* × *prcc_f*)/*at*. Source: Compustat
Tangibility (PPE)	Property, plant, and equipment (*ppegt*) divided by total assets. Source: Compustat
Foreign income (FI)	Foreign income (*pifo*) divided by total assets. Source: Compustat
ROA	Return on assets, measured as operating income (*pi* - *xi*) divided by lagged assets. Source: Compustat

Leverage (LEV)	Long-term leverage, defined as long-term debt (*dltt*) divided by total assets (*at*). Source: Compustat
NOL	Dummy variable coded as one if loss carry forward (*tlcf*) is positive. Source: Compustat
ΔNOL	Change in loss carry forward. Source: Compustat
Intangibility	Intangible assets (*intan*), scaled by lagged assets. Source: Compustat
EQINC	Equity income in earnings (*esub*) divided by lagged assets. Source: Compustat
Cash holdings (CASH)	Cash and short term investments (*che*) divided by total assets. Source: Compustat
Cash flow (CF)	Income before extraordinary items (*ibc*) divided by total assets (*at*). Source: Compustat
HP index	Hadlock and Pierce (2010) financial constraint index, with higher value indicating more financial constraint. Source: Compustat
WW index	Whited and Wu (2006) financial constraint index, with higher value indicating more financial constraint. Source: Compustat
Negative earnings	A dummy variable with one indicating that the summation of earnings before extraordinary items, interest expense, and income statement deferred taxes divided by assets is negative, and zero otherwise. Source: Compustat
Investment grade	A dummy variable that equals one if the S&P rating is BBB or better and zero otherwise.
Dividend payout	A dummy variable with one indicating the firm pays out dividend in a given year, and zero otherwise. Source: Compustat
Firm age	The number of years the firm is listed with a non-missing stock price from CRSP. Source: CRSP
Included in S&P 500	A dummy variable with one indicating the firm is included in the S&P 500 index in a given year, and zero otherwise.
S&P Rating	A dummy variable with one indicating the firm receives rating from S&P in a given year, and zero otherwise.
Discretionary accruals	The absolute value of discretionary accruals from the modified cross-sectional Jones model. Source: Compustat
Institutional ownership	Institutional ownership is measured by the percentage of common shares owned by institutional investors. Source: CDA/Spectrum Institutional 13(f) filings

Product market competition	More competition equals one if the industry's HHI index is in the bottom half of all 48 Fama-French industries, and less compensation equals one if HHI is in the top half of all 48 Fama-French industries. HHI is calculated as the sum of squared market shares of all Compustat firms in each industry, and higher values indicate greater concentration and lower product market competitiveness.
CEO equity portfolio incentives	It measures the percentage change in the equity portfolio value held by the CEO of the firm for a 1% increase in stock price, which is calculated as the sum of all shares (restricted and unrestricted) and delta-weighted options (exercisable and unexercisable) held by the CEO divided by the total number of shares outstanding multiplied by 100, for a given fiscal year. The calculation of the delta-weighted options uses the detailed information on current and previous option grants to calculate the options' delta and multiplies the number of options held in each series by its delta. Source: ExecuComp

Appendix B
Descriptive Statistics for Broker Terminations

The table presents the number of broker terminations and the number of affected firms in each year from 2000 to 2010 in our sample, with valid information on the measures of corporate tax avoidance and matching variables in Difference-in-Differences analysis framework.

Year	No. of Broker Terminations	No. of Affected Firms
2000	8	233
2001	8	293
2002	4	227
2003	2	22
2004	2	41
2005	7	156
2006	3	68
2007	5	195
2008	3	122
2009	3	17
2010	2	41
Total	47	1,415