Overconfidence and Aggressive Corporate Tax Policy

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ABSTRACT

We investigate whether firms with overconfident CEOs pursue more aggressive tax positions and yet assign high expectations of their final realizability, even if these positions were to be audited by a relevant taxing authority. In our empirical tests we first document positive associations between proxies for the aggressiveness of firms' tax positions and overconfidence. We then test for associations between overconfidence and the financial reporting of uncertain tax benefits under FIN 48. Prior tax aggressiveness research leads to the expectation of a similarly positive association with uncertain tax benefits. Instead, we find that the same group of firms with overconfident CEOs report lower uncertain tax benefits in the financial statements. This asymmetric result between tax policy choices and the financial reporting of those choices by firms with overconfident CEOs should be of interest to policy and rule makers, thus advancing the overconfidence, tax aggressiveness, and financial reporting literatures.

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I. INTRODUCTION

Our study examines the relation between corporate tax planning, CEO overconfidence, and financial reporting of tax positions. First, we test the association between tax choices and CEO overconfidence using measures common in the tax aggressiveness and executive overconfidence literatures. Next, we extend this analysis by taking advantage of recent accounting guidance mandated by the SEC under Financial Interpretation No. 48 (FIN 48). FIN 48 standardizes the measurement and public disclosure of income tax reserves in financial statements, allowing us to test the association between CEO overconfidence and tax reserves. An income tax reserve may be required when a firm is uncertain whether its tax positions (i.e. the transactions reported on its tax return) will result in an additional payment pursuant to a future tax audit, settlement, or lawsuit because tax authorities disallow the tax benefits originally claimed (Lisowsky, Robinson, and Schmidt, 2013). We argue that FIN 48 disclosures allow us to infer executives' own subjective probability assessments of the likelihood that tax positions the firm has taken will be upheld if audited by a relevant taxing authority. Combined, our tests provide us with an opportunity to document a potentially unexpected asymmetry between tax policy choices and probabilistic estimates of those choices in financial accounting. Leading up to its implementation, many academics and some policy makers suggested that the true ability of FIN 48 disclosures to reflect a firm's tax policy choices would critically hinge on executives' financial reporting policies (Hanlon and Heitzman, 2010). Our paper examines this issue in the context of a personality trait likely to be important in both tax policy and financial reporting choices.

Over-optimism is a theoretical manifestation of overconfidence that motivates many empirical studies of executive overconfidence (Hirshleifer, Low and Teoh, 2012; Hribar and

Yang, 2013; Malmendier and Tate, 2005, 2008; among others).[1] Overly optimistic individuals tend to overestimate the net discounted expected payoff from uncertain endeavors, either because of a general tendency to expect good outcomes, or because they overestimate their own efficacy in bringing about success (Hirshleifer et al., 2012; Weinstein, 1980). Accordingly, prior research has documented positive associations between CEO overconfidence and risk-taking behavior (Ben-David, Graham, and Harvey, 2013; Hirshleifer et al., 2012). With respect to corporate tax policy, we predict that over-optimism leads to higher levels of tax aggressiveness. This could be the result of managers overestimating returns to investments in tax planning, underestimating non-tax costs, or a combination of both. Documenting evidence in support of this prediction would help us better understand underlying behavioral explanations behind findings in the literature that suggest individual executives are associated with investment in tax aggressiveness (Dyreng, et al., 2010; Chyz, 2013). As a result we can respond to Hanlon and Heitzman (2010) who suggest that research on manager effects on tax avoidance represents a significant gap in the literature.

CEO overconfidence could also have important effects on estimates in financial reporting such as those required by FIN 48.[2] Under FIN 48, firms create a reserve for the tax benefits of positions taken on the tax return whose outcome is uncertain. This reserve for uncertain tax benefits is an accounting accrual subject to the judgment of management (Hanlon and Heitzman, 2010). More specifically, reporting under FIN 48 relies on managers' judgment and discretion as to the probability that tax positions will be sustained and/or upheld upon examination, including

[1] Another view is that over-optimism relates to outside events and over-confidence relates to internal assessments of ability. Our approach follows the majority of the literature in this area that uses the terms interchangeably.
[2] While the CEO may not be directly involved in tax planning or financial reporting, we expect the CEO to influence lower-level managers through "tone at the top" (Dyreng, Hanlon, and Maydew, 2010; Gaertner, 2013). Similarly, Gabbionetta, Greenwood, Mazzola, and Minoja (2013) describe how networks of professionals become mutually overconfident.

related appeals, based on their technical merits (Blouin, Gleason, Mills and Sikes, 2007). According to upper echelons theory (Hambrick and Mason, 1994) when discretion is required, executive characteristics such as overconfidence have important effects (Hambrick and Finkelstein, 1987; Ge, Matsumoto, and Zhang, 2011). In the context of tax policy choices, firms with overconfident CEOs are likely to overestimate the likelihood that the tax positions they take will be sustained or upheld. All else equal, we predict that this overestimation will lead to lower reported tax reserves.

To empirically support these predictions we perform two related tests. First we examine associations between CEO overconfidence and proxies for the aggressiveness of firms' tax policy choices. CEOs are generally thought to have influence over the tax consequences of the firm by setting the "tone at the top" with regards to firms' tax activities. We focus on CEOs because they likely have the greatest influence on corporate tone (Dyreng et al., 2010; Gaertner, 2013).[3] Using CEO overconfidence measures based on each CEO's overexposure to the idiosyncratic risk of their firm (Hirshleifer et al., 2012; Hribar and Yang, 2013; Malmendier and Tate, 2005, 2008; Malmendier, Tate, and Yan, 2011) and investment behavior (Ahmed and Duellman, 2013; Schrand and Zechman, 2012) we document a positive relation that is both statistically and economically significant.[4] These results provide support for the presence of over-optimism within our sample of overconfident CEOs, consistent with prior studies that find evidence of positive associations between CEO overconfidence and risk-taking behavior (Ben-David et al., 2013; Hirshleifer et al., 2012).

[3] We repeat our analysis with CFO overconfidence and continue to document consistent results. See Section 4.4 for more details.

[4] In sub-section 3.2.2 below we explain why our proxies of managerial overconfidence are not simply capturing risk-seeking behavior of CEOs.

In our second set of tests, we examine the relation between CEO overconfidence and FIN 48 tax reserves. Prior research suggests that tax aggressiveness typically increases the uncertainty underlying firms' corporate tax policy choices (Hanlon and Heitzman, 2010; Lisowsky et al., 2013). Because FIN 48 disclosures were in part meant to capture and quantify this uncertainty, given our first set of findings documenting positive associations between CEO overconfidence and tax aggressiveness, it would not be surprising to document similar positive associations within the same group of overconfident CEOs. However, given the role that CEO overconfidence plays in subjective probability assessments as documented by prior research, we hypothesize that within our sample of firms there will be a negative association between CEO overconfidence and FIN 48 tax reserves. Consistent with this prediction, we document statistically and economically significant results.

Both sets of our results are robust to a variety of specifications. They hold in univariate correlations and in multivariate ordinary least squares specifications controlling for common determinants of tax aggressiveness, year and industry effects. They hold under a variety of alternative sample selection criteria; including eliminating financials and utilities, eliminating observations during the financial crisis, and eliminating firms with negative pretax income. They hold after unrestricting data restrictions and allowing for different sample sizes across models. They also hold over different specifications of our overconfidence measures. Our results continue to hold after controlling for a variety of CEO incentives (delta, vega, ratio of vested options), CEO characteristics (tenure, age), and governance elements (CEO ownership, institutional ownership, percentage of outside directors). They also hold after controlling for additional measures of investment (R&D, capital expenditures, inventory). Our results hold after controlling for earnings management incentives using discretionary accruals from a

performance-adjusted modified Jones (1991) model. They also hold after controlling for excess tax benefits from stock options issued before the enactment of FAS 123R. They also hold in within-firm specifications where we include firm rather than industry fixed effects, easing concerns over selection bias.

While our introduction of firm fixed effects mitigates endogeneity concerns, we cannot completely rule out the possibility that our results are driven by an omitted confounding variable. Therefore we seek to quantify how large of an effect such a variable would need to have to invalidate the statistical validity of our results. To do so we use Frank (2000)'s Impact Threshold for a Confounding Variable (ITCV) analysis. Our ITCV analysis suggests that a correlated omitted variable would need to have a correlation with both our dependent and overconfidence variables of interest of anywhere from 0.171 to 0.400 (depending on which model), after accounting for our control variables, to invalidate our statistical inferences. This implies that such a variable would generally need to have an impact that is between 2.25 – 6.9 times higher than the most impactful control variable already included in our multivariate models. We also employ a different technique introduced in Frank (2000) which provides an estimate of the fragility of our results to correlated omitted variables, and find that our various sets of results are robust to potential coefficient bias of 57 percent – 88 percent. While it is difficult to rule out every potential confound, the magnitude of the implied correlations from our ITCV analysis and the estimated robustness to percentage bias numbers provide reasonable assurances that our results are robust to correlated omitted variables.

According to Murphy (1999), "The CEO typically participates in all [compensation] committee deliberations, except for discussions specifically dealing with the level of CEO's pay." Consequently it is reasonable to believe that the impact of corporate tone coming from

overconfident CEOs should extend to other top executives. Nevertheless, to address concerns that other executives are more directly involved in the specifics of corporate tax policy, we repeat our main analysis after capturing CFO overconfidence and continue to document consistent results.

Our study contributes to the financial accounting and tax accounting literatures. In terms of the financial accounting literature, it documents that executive overconfidence has an important unintended effect on probabilistic estimates in financial accounting. Corporate tax policy is an appealing setting in which to study executive overconfidence because estimating future tax outcomes and the resulting tax reserve is inherently ambiguous and requires substantial managerial discretion. Our FIN 48 setting is representative of the highly uncertain, forward-looking estimates that are increasingly common and highly challenging for accounting professionals (Peecher, Solomon, and Trotman 2013), suggesting that our findings could be of interest in other financial reporting contexts that require uncertain and forward-looking estimates.

In terms of the tax literature, our paper contributes by documenting that that even under the new standard which was designed to increase reporting consistency of tax uncertainty, executive overconfidence creates diversity in financial reporting which could reduce the faithful representation and comparability of unrecognized tax estimates. This introduces the possibility that FIN 48 disclosures could be less informative to investors in the presence of overconfident CEOs. Along the same lines, our results provide a potential explanation for the variation across firms in FIN 48 reporting of identical tax positions documented by Robinson et al. (2014). Rule-making and regulation around corporate tax policy and financial reporting appears to adopt a view of executives as being replaceable agents whose idiosyncratic differences do not affect

corporate outcomes. However, given findings that executive traits do have a measurable and economically significant impact on financial reporting estimates, it becomes clear therefore that understanding the unique role that individual executives play, including their overconfidence, is important for effective regulation and rule-making.

Our paper also adds to the literature that examines the impact of individual executive traits on corporate outcomes. These include studies that link personal traits and tendencies such as CEO narcissism (Chatterjee and Hambrick, 2007), underlying psychological "attitudes" (Graham, Harvey, and Puri, 2013), personal tax aggressiveness (Chyz, 2013), past professional experience (Dittmar and Duchin, 2014) and personal leverage preferences (Cronqvist, Makhija, and Yonker, 2012) to corporate financial policy choices including debt ratios, debt maturity, investment and cash hoarding behavior, acquisition activity, leverage, and tax aggressiveness. Although not the primary motivation of their paper, to date only Dyreng, Hanlon, and Maydew (2010) attempt to link executive confidence and corporate tax policy (i.e. effective tax rates), without any statistically significant results. Given recent research on the suitability of the manager fixed effects methodology used by Dyreng et al. (2010), we employ an alternative research design to demonstrate that managerial overconfidence, a psychological trait that is grounded in theory, affects firms' corporate tax policy.[5] We also extend traditional tax research by documenting another important determinant of tax aggressiveness. This furthers our understanding of the cross-sectional variation in tax aggressiveness (Dyreng, Hanlon, and Maydew, 2008; Gupta and Newberry, 1997) and of why some firms do not pursue tax benefits more aggressively (Graham and Tucker, 2006; Shevlin, 2002).

[5] Fee, Hadlock, and Pierce (2013) and Wooldridge (2002) provide critical discussion of the manager fixed effects research design.

Finally, our paper extends and contributes to CEO overconfidence research that focuses on non-tax corporate decisions such as acquisitions, cash flow sensitivity, financial reporting, and non-tax risk taking behavior (Ahmed and Duellman, 2013; Ben-David et al., 2013; Hirshleifer et al., 2012; Malmendier and Tate, 2005, 2008; Schrand and Zechman, 2012;). Corporate tax policy choices provide a novel focal point because risk-taking with tax aggressiveness may result in unique negative externalities to the firm such as fines, penalties, losses in reputation, and tighter monitoring by external parties such as the Internal Revenue Service (Chyz, 2013).

We structure the remainder of this paper as follows. In Section 2, we place our study in the context of the existing literature and develop hypotheses. In Section 3, we describe the data, the proxies for tax aggressiveness, the proxies for CEO overconfidence, and the empirical design. In Section 4, we discuss our main results. We summarize our findings and conclude in Section 5.

II. INSTITUTIONAL BACKGROUND, RELATED LITERATURE AND HYPOTHESIS DEVELOPMENT

CEO Overconfidence

The role of overconfidence in corporate decisions and outcomes stems from the behavioral corporate finance literature. This stream of the literature allows for departures from the traditional economic model that executives are consistently rational under uncertainty. Although psychologists had routinely documented empirical evidence of economically irrational behavior under uncertainty (see, for example, Kahneman, Slovic, and Tversky, 1982; Oskamp, 1965; Tversky and Kahneman, 1981) this evidence was generally not incorporated into an empirical corporate finance context until Roll (1986). Roll (1986) postulated that executive

hubris was a contributing factor to overbidding and failed mergers. Roll's study thus formalized the role of overconfidence in the empirical corporate finance literature (Malmendier and Tate, 2008).

More recently, overconfidence research in finance and accounting has grown considerably with several empirical studies considering the role of executive overconfidence in corporate investment, forecasting behavior, financing and dividend policies (e.g., Ben-David et al., 2013; Cordeiro, 2009; Deshmukh, Goel, Howe, 2013; Hirshleifer et al., 2012; Libby and Rennekamp, 2012; Malmendier and Tate, 2008; Malmendier et al., 2011; among others). The hypotheses in these papers are typically implicitly or explicitly consistent with manifestations of overconfidence documented in the psychology literature and can be motivated by well-developed psychological and financial theory. These manifestations frequently include the above-average effect (Hayes and Schaefer, 2009), which is closely related to over-optimism (Alicke, 1985; Svenson, 1981; Taylor and Brown, 1988; Weinstein, 1980) and miscalibration (Brenner, Koehler, Liberman, and Tversky, 1996; Dawes and Mulford, 1996; Fischhoff, Slovic, and Lichtenstein, 1977, 1980). In the analytical model developed by Heaton (2002), overconfident managers are unrealistically optimistic and tend to "systematically overestimate the probability of good firm performance, and underestimate the probability of bad firm performance." Over-optimism can delay loss recognition (Ahmed and Duellman, 2012) and make executives prone to misstating earnings (Schrand and Zechman, 2012).

Tax aggressiveness and the uncertainty of corporate tax policy choices

The accounting and finance literatures typically characterize firms' tax outcomes as reflecting a strategic focus or "investment" in tax minimization or tax aggressiveness (Mills,

Erickson, and Maydew, 1998). In other words, managers expend resources to minimize taxes. Studies in this area have also suggested that variation in firms' tax policy choices reflect not only the economic environment in which the firm operates (see, for example, Atwood, Drake, Myers and Myers 2012; Chen, Chen, Cheng, and Shevlin, 2010; Cheung, Huang, Li, and Stanfield, 2012; Chyz, Leung, Li, and Rui, 2013; McGuire, Omer, and Wang, 2012), but also the traits, preferences, and incentives of the firm's management. For instance, Armstrong, Blouin, and Larcker (2012), Gaertner (2013), and Phillips (2003) find that effective tax rates are associated with executive incentive compensation. Rego and Wilson (2012) also examine executive incentive compensation but focus on "riskier" tax strategies. Dyreng et al. (2010) examine whether individual top executives have incremental effects on their firms' tax aggressiveness that cannot be explained by characteristics of the firm. Chyz (2013) links personal tax aggressiveness to more aggressive corporate tax sheltering and Law and Mills (2013) find that military backgrounds are associated with variation in corporate tax avoidance.

Given the characterization of tax aggressiveness as an investment, the documented links between investment and overconfidence, and the associations between executives and tax aggressiveness, it seems reasonable to expect that CEO overconfidence would be related to tax aggressiveness and the uncertainty of firms' corporate tax policy choices.[6]

The dominant underlying paradigm in many of the tax aggressiveness studies is the Scholes and Wolfson (1992) all parties, all taxes, all costs framework. Among other things, this framework suggests that, while investing in tax aggressiveness or aggressive corporate tax policy choices generate tax savings, doing so is not costless. Non-tax costs that could result from

[6] As previously noted, examining executives and not line-level managers is consistent with Dyreng et al. (2010) and Rego and Wilson (2012), who suggest CEOs have a significant impact on corporate policies and decision-making, including tax planning (even if they are not directly involved in the tax-planning process). This approach is consistent with the "upper echelons" perspective introduced by Hambrick and Mason (1984).

investment in aggressive corporate tax policy choices include tax strategy implementation costs (e.g., promoter and attorney fees), costs of IRS audits and subsequent litigation (e.g., accounting and legal fees), and reputational penalties (Gallemore, Maydew, and Thornock, 2014; Rego and Wilson, 2012).[7] Consequently, managers must trade-off these costs with the expected benefits from investing in tax aggressiveness. Similar to the rationale in Hirshleifer et al. (2012), we expect that overconfident CEOs will tend to overestimate the net discounted expected payoffs from investments in tax aggressiveness. This could be the result of an overestimation of the tax savings, an underestimation of non-tax costs, or some combination of both.[8] This leads to our first hypothesis:

Hypothesis 1: *CEO overconfidence is positively associated with tax aggressiveness.*

Evidence supporting Hypothesis 1 would be consistent with CEO overconfidence impacting corporate tax policy choices. This would add to the tax aggressiveness literature by identifying another important individual trait that helps to explain variation in observed levels of corporate tax aggressiveness.

While previously documented associations between firm outcomes and CEO overconfidence inform our prediction, documenting evidence in support of Hypothesis 1 is not assured. Using a setting and an empirical approach different from ours, Dyreng et al. (2010) are unable to reliably connect tax focused management styles with proxies for executive

[7] At least with respect to executives associated with firms accused of tax sheltering, Gallemore et al. (2013) find no evidence of any reputational penalties.

[8] Goel and Thakor (2008) create a model that suggests overconfident CEOs underinvest in information production. This tendency could contribute to imperfect information with respect to both the potential tax savings and non-tax costs from investments in corporate tax aggressiveness.

confidence.[9,10] In addition, Law and Mills (2014) find that firms using overall more negative words in their 10-K filings tend to be more tax aggressive. Unlike our study, Law and Mills (2014) assess the totality of the tone across the entire 10-K filing whereas we focus on the revealed preferences of CEOs through their option holding and investment behaviors. Lastly, the neoclassical view of the firm suggests managers are perfect substitutes. If this view is descriptive in our setting, personal traits and tendencies such as overconfidence should not be correlated with firm outcomes (Bertrand and Schoar, 2003).

FIN 48 and CEO assessments of corporate tax policy uncertainty

When a corporation files a tax return, it often pays less tax than the tax authorities and the courts might require if various positions related to exclusions, deductions, credits and valuations were challenged (Blouin et al., 2007). As a result, there could be a material amount of uncertainty regarding a firm's tax expense. Prior to the adoption of FIN 48, firms inconsistently reported and disclosed the presence and magnitude of this tax uncertainty. Consequently, financial statement users had little information to assess firms' uncertain tax benefits (Blouin et al., 2007). In June of 2006, the Financial Accounting Standards Board (FASB) issued FIN 48 in an effort to increase the transparency of firms' corporate tax policy choices. The disclosure standards and guidelines under FIN 48 became mandated for all Securities and Exchange Commission (SEC), i.e. "public" filers, for fiscal year-ends after December 15, 2006.

[9] Dyreng et al. (2010) regress executive fixed effects that come out of a first stage regression of effective tax rates on stationary and varying firm characteristics (for a set of executives that move between firms) on various executive traits including confidence. Their proxies for confidence are the average frequency the firm missed its own managerial forecast during the years the executive was employed and a count of the number of positive and negative words in the 10-K.

[10] Fee et al. (2013) and Wooldridge (2002) are critical of the Bertrand and Schoar (2003) approach used in Dyreng et al. (2010) where significant F-statistics are interpreted as supporting individual style effects. In addition, relative to Dyreng et al. (2010) our sample selection criteria are less restrictive and our proxies for overconfidence are more widely accepted in prior research.

FIN 48 explicitly requires firms to make two sets of probability assessments for each tax position taken. First, a determination is made whether it is more likely than not (typically thought to be a >50 percent chance), that the tax position will be sustained upon examination including related appeals or litigation, based on its technical merits (Blouin et al., 2007). In making this determination, firms must assume that the position will be audited by the relevant taxing authority. In other words, firms are not allowed to impound the chances of "winning the audit lottery" (i.e. having a tax position go unexamined by tax authorities) into their probability assessments.[11] If the more-likely-than-not threshold is not met, the firm must establish a tax reserve for 100 percent of the tax benefit. This is tantamount to a total derecognition of the tax benefit through an increased income tax expense or relevant deferred tax account. If the firm determines that the more-likely-than-not threshold has been met, they then determine a distribution of potential tax benefit amounts likely to be allowed upon audit, ranging from zero to the full benefit of the tax position taken. Each amount is assigned a probability that the outcome of negotiations with the relevant taxing authority would yield that amount. The tax reserve (i.e., the amount recognized as an increase in tax expense) is then the difference between the full value of the position's tax benefit, less the amount of tax benefit for which the firm expects to have at least a 50 percent chance of being upheld upon examination.

FIN 48 also standardized the way firms report and disclose tax uncertainty.[12] One key component of the standard requires firms to produce a roll-forward of tax reserves in a schedule of unrecognized tax benefits within the income tax footnote of Form 10-K. Debate and

[11] In reality, it seems reasonable to believe that many firms do impound audit lottery success into their probability assessments and that overconfident CEOs are more likely to overestimate their probability of winning the audit lottery. If this were the case, our predictions would remain the same.

[12] Though the FASB intended for FIN 48 to reduce the diversity in uncertain tax reporting, De Simone, Robinson, and Stomberg (2013) suggest that non-tax factors likely play a role FIN 48 reporting. Our study documents one such factor, overconfidence.

controversy surrounding the implementation of FIN 48 was fierce with opponents suggesting this disclosure would undercut firms' bargaining power in tax disputes and essentially provide a "roadmap" to the IRS and other tax authorities by guiding them to firms that make aggressive tax policy choices (Spatt, 2007; Yoon, 2006). Critics feared that the new disclosures would increase tax authority audits and audit penalties, thereby decreasing shareholder benefits of tax planning. Proponents of FIN 48 suggested that disclosing the existence and magnitude of uncertain tax benefits was instrumental for investors to properly value firms and thus improve efficient capital allocation. However, many academics and some policy makers suggested that the true ability of FIN 48 disclosure to reflect a firm's tax policy choices would critically hinge on executives' financial reporting policies (Hanlon and Heitzman, 2010). More importantly, the amount of any uncertain tax benefit recorded for financial accounting purposes is an accounting estimate subject to the judgment of management. Though this view of the FIN 48 reserve can prove problematic in other settings, particularly when researchers are trying to use FIN 48 disclosures to assess firms' unconditional tax aggressiveness, it is advantageous in our study. Overconfident executives are more likely to assign higher probabilities of success to their tax positions. We use FIN 48 disclosure as a way to view executives' assessments of their firms' corporate tax policy riskiness and probabilities of success.

Our first hypothesis predicts a positive relation between CEO overconfidence and proxies for the aggressiveness of a firm's tax policy choices. This would be due, at least in part, to firms with overconfident CEOs underestimating the uncertainty inherent in their corporate tax policy choices. Because FIN 48 disclosures are a proxy for firms' private assessment of that uncertainty, within the same group of executives we expect to find a negative relation between uncertain tax benefits and CEO overconfidence. This leads to our second hypothesis:

Hypothesis 2: *CEO overconfidence is negatively associated with reported levels of uncertain tax benefits.*

Although we refer to Hypothesis 1 in motivating Hypothesis 2, it is not necessary that Hypothesis 1 holds for Hypothesis 2 to be supported. One can infer from the discussion in Griffin and Tversky (1992) that overconfident CEOs are more confident in their judgments than is warranted by the facts. Therefore, given the same facts, overconfident managers would expect better outcomes and report smaller unrecognized tax benefits. Consequently it could be that within our sample proxies for the aggressiveness of firms' tax policy choices do not vary with CEO overconfidence, yet firms with overconfident CEOs could systematically underestimate uncertainty relative to peers, leading to lower tax reserves on average. At the same time it is possible that we will not document any support for Hypothesis 2 because of two mechanisms that could limit the influence of overconfidence on uncertain tax benefit reporting. First, uncertain tax benefits must pass scrutiny by the firm's external auditor. The audit function may attenuate any effect of overconfidence. Second, accounting standards guide the financial reporting process. The probability thresholds outlined by FIN 48 are presumably intended to reduce managerial discretion, which could also limit any effect of overconfidence.

III. DATA, MEASURES, AND RESEARCH DESIGN

Data

Our data comes from Compustat's XpressFeed and Execucomp files. Table 1 outlines our sample selection procedure. We begin with the intersection of all US observations available on Computat XpressFeed and Execucomp from 2007 to 2012, to coincide with availability of FIN 48 disclosures. FIN 48 was mandated for all SEC filers with fiscal years ending after December 15, 2006; and full Compustat coverage begins in 2007, while 2012 is the last full year of

Compustat coverage available. We then eliminate observations missing the data necessary for our empirical tests. Our final sample comprises 5,675 firm-year observations over 1,328 unique firms. In additional tests we examine the robustness of our results to common variations in the sample selection criteria, and overall find similar results (see Section 4.4).

Measures

Measures of Tax Aggressiveness and Uncertain Tax Benefits

We are interested in examining the effect of overconfidence on both tax aggressiveness as well as firms' assessments of tax uncertainty. We use four different variables to capture tax aggressiveness that are consistent with prior literature.[13] Our first measure, *Cash ETR*, captures the annual cash taxes paid for every dollar of pretax book income. Consistent with Chen et al. (2010) and Chyz et al. (2013), *Cash ETR* is cash taxes paid (#TXPD) divided by pretax income (#PI).[14] Following Robinson, Sikes, and Weaver (2010) we constrain *Cash ETR* to lie between 0 and 1, and set it to 0 for firms with tax refunds and positive income, and to 1 for firms with positive taxes and negative or zero income. Observations with tax refunds and non-positive income are eliminated from the sample as their interpretation is unclear. To allow for the same direction of relation across all tax aggressiveness proxies, we multiply *Cash ETR* by -1 so that a higher number translates into higher tax aggressiveness. Per Dyreng et al. (2010) the *Cash ETR* is a clearer signal of tax avoidance relative to other effective tax rate specifications due in part to its ability to capture actual cash tax savings. The *Cash ETR* measure is helpful in our study because it will be positively associated with aggressive tax policy choices targeted at both

[13] Unless stated otherwise, all data references correspond to Compustat XpressFeed data items.
[14] Our results are unchanged if we subtract special items (SPI) from pretax book income and/or drop firms with negative pretax income (see Section 4.4).

permanent items and timing differences (i.e. deferring taxable income or accelerating taxable deductions relative to GAAP income). That being said, the *Cash ETR* does not specifically isolate more or less aggressive tax policy choices, but instead will capture a continuum of corporate tax policy choices. Nevertheless, more aggressive realizations (i.e. higher with our -1 transformation) of the *Cash ETR* are likely to result in higher FIN 48 reserves in the absence of frictions such as overconfidence.[15]

To better isolate potentially more aggressive corporate tax policy choices, we employ the *Tax shelter score* (also known as the *SSCORE*) as our second measure of tax aggressiveness. This measure comes from Rego and Wilson (2012) and Wilson (2009), and represents the inferred probability that a firm engages in a tax shelter. The measure is estimated with the following equation: *Tax shelter score* = $\frac{1}{1+e^{-(\alpha+\beta X)}}$, where $\alpha + \beta X$ = -4.30 + 6.63*BTD – 1.72*Leverage + 2.26*ROA + 1.62*ForeignIncome + 1.56*R&D.[16] Because the *Tax shelter score* is an inferred probability, it suffers from some limitations. Most importantly, the *Tax shelter score* can capture probabilities of tax sheltering but not direct evidence of tax sheltering. Consequently, our tests are designed to assess whether overconfident CEOs are more or less likely to be engaging in tax sheltering, but we cannot say for certain whether or not they are.

[15] The GAAP ETR is another alternative that is relatively common in the tax aggressiveness literature. We do not use this measure in our study because of the potential for a mechanical relation between FIN 48 reserves and the GAAP ETR. In addition, the GAAP ETR is not able to measure variation in tax aggressiveness that focuses on deferral strategies.

[16] In estimating *Tax shelter score*, BTD is pretax book income (#PI) less estimated taxable income scaled by total assets (#AT), where estimated taxable income is (current federal tax expense, #TXFED, plus current foreign tax expense, #TXFO)/0.35, less the change in tax loss carryforwards, #TLCF. Leverage is total debt (#DLTT+#DLC) scaled by total assets (#AT). ROA is pretax book income (#PI) scaled by total assets (#AT). ForeignIncome is foreign pretax income (#PIFO) scaled by total assets (#AT); and 0 if #PIFO is missing. Finally, R&D is R&D expenses (#XRD) scaled by total assets (#AT); and 0 if #XRD is missing.

Conceptually, tax shelters should have the lowest chance of meeting the more-likely-than-not threshold, leading to 100 percent derecognition (Lisowsky et al., 2013). Absent frictions such as overconfidence, this should translate into a positive relation with FIN 48 reserves.

We use *Book-tax differences* as our third measure of tax aggressiveness. Book-tax differences capture the gap between financial and taxable incomes, and are generally viewed as a signal of the extent to which firms avoid taxes (Chen et al., 2010; Chyz et al., 2013; Mills, 1998; Wilson, 2009).

Book-tax differences captures differences between financial reporting and taxable income that are both temporary (i.e. reflect differences in the timing of tax payments) and permanent. To separate these two components, we also include *Permanent book-tax* differences as our fourth measure of tax aggressiveness. Tax policy choices that result in permanent differences are generally viewed as preferred tax vehicles given that they reduce taxable income without a corresponding decrease in income reported to shareholders (Shevlin, 2002).

Because *Cash ETR*, *Tax shelter score*, *Book-tax differences*, and *Permanent book-tax* differences are not accounting accruals they are unlikely to be directly impacted by managerial judgment. Uncertain tax benefits are purely accounting accruals and are therefore more likely to directly reflect managerial judgment. This attribute is helpful when we attempt to document evidence of an asymmetry in associations between overconfidence and these measures versus our proxy for tax uncertainty. Like all proxies for tax aggressiveness in the extant literature, our measures are likely to pick up the construct of tax aggressiveness with some noise. However, documenting consistent results across our measures gives us comfort that overconfident CEOs do engage in more aggressive corporate tax policy choices and that our measures appropriately reflect the construct of interest.

Lastly, we construct *Uncertain tax benefits* as a proxy for the assessments of uncertainty in corporate tax policy choices and confidence in the ultimate realization of tax savings from tax positions taken. Consistent with Lisowsky et al. (2013), *Uncertain tax benefits* is the ending unrecognized tax benefit balance (#TXTUBEND) scaled by total assets (#AT).[17] The ending balance of the unrecognized tax benefit is a contingent liability that reflects the dollar amount of tax benefits related to all open tax positions that may ultimately be disallowed and should increase in the level of uncertainty about a tax position (Lisowsky et al., 2013). As noted above, *Uncertain tax benefits* is more likely to be directly impacted by managerial judgment and is designed to capture confidence in the ultimate realization of tax savings from tax positions taken, even if subjected to examination from a relevant authority.[18]

Measures of Overconfidence

Prior literature generally measures overconfidence along two different dimensions: compensation and investment. Thus, we construct two different measures of confidence along these two dimensions.

We first construct an option-based measure of confidence consistent with prior literature (Campbell, Gallmeyer, Johnson, and Rutherford, 2011; Hirshleifer et al., 2012; Malmendier and Tate, 2005, 2008). To do so, for each firm-year, we obtain the average value per unexercised exercisable CEO stock option (Execucomp #OPT_UNEX_EXER_EST_VAL divided by Execucomp #OPT_UNEX_EXER_NUM). From this, we subtract the stock price at fiscal year-

[17] We find similar results if we use the raw values or log transformations of uncertain tax benefit values.
[18] Lisowsky et al. (2013) find that uncertain tax benefits are, on average, associated with tax sheltering. In addition, other studies use uncertain tax benefits as a proxy for tax aggressiveness. Tests of unconditional correlations between our proxies for tax aggressiveness and uncertain tax benefits are generally positive and statistically significant (see Table 2), which is consistent with prior research. As our tests reveal however, the association between other measures of tax aggressiveness and uncertain tax benefits appears partly dependent on the presence of overconfident CEOs. This is the essence of our study.

end (#PRCC_F) to obtain the average exercise price per option. Lastly, we divide the average value per option by the average price per option. When this ratio, which represents the average moneyness of options, is greater than 67 percent we set *Overconfidence (options)* to 1 and otherwise 0.[19] *Overconfidence (option)* is based on CEO option exercise timing behavior, and is used as a measure of the CEO's belief about his or her abilities to generate superior returns. Since CEOs have large amounts of wealth invested in the firm (in the forms of salary, bonus compensation, equity holdings, deferred compensation, and human capital), the rational decision is typically to exercise stock options as they become exercisable. Holding exercisable options signifies overinvestment in the firm. We expect overconfident CEOs' elevated self-image to lead to the expectation that their firms' stock prices will increase more than is rationally justified. Therefore, as a result, overconfident CEOs will tend to postpone option exercise to benefit personally from the future gains they see themselves as generating, even if the amount in-the-money is beyond an economically rational benchmark.

Different studies in the overconfidence literature examine confidence as either an individual-specific trait that does not vary much over time or a time-varying trait. Unlike Malmendier and Tate (2005, 2008), *Overconfidence (options)* varies by firm-year. Thus, we implicitly assume that overconfidence varies over time, consistent with Billett and Qian (2008) as well as Hilary and Menzly (2006). However, in subsequent analysis we examine the robustness of our results to specifying overconfidence as an individual time-invariant trait (see Section 4.4) and continue to document support for our predictions.

Our second measure of confidence, *Overconfidence (investment)*, is based on investment behavior. Following Ahmed and Duellman (2013) and Schrand and Zechman (2012),

[19] Our proxy for confidence is consistent with Malmendier and Tate (2005, 2008), but varies slightly from their specification because we use Execucomp rather than their proprietary database.

Overconfidence (investment) is based on the amount of excess investment in assets from the residual of a regression of total asset growth on sales growth by industry-year. If the residual from the excess investment regression is greater than 0, we set *Overconfidence (investment)* equal to 1, and 0 otherwise. This second proxy follows the logic and findings in Ben-David et al. (2013) and Malmendier and Tate (2005). Using alternative measures of overconfidence, Ben-David et al. (2013) find that CEO overconfidence is positively associated with capital expenditure, investment, and acquisition activity, while Malmendier and Tate (2005) find that overconfident managers tend to overinvest in capital projects. Intuitively, managers are overinvesting in their company if asset growth relative to sales growth exceeds that of peer firms.

Our overconfidence measures aid in differentiating the construct of overconfidence from risk seeking behavior. Executives' risk seeking behavior would predict overinvestment in high-risk, high-return assets, but it would not predict overinvestment in one's own firm whether at a personal level (*Overconfidence (options)*) or at the firm level (*Overconfidence (investment*)). This is because the better-than-average effect combined with miscalibration would lead overconfident executives to *underestimate* the risk-return profile of their own firm to a greater extent than external investment opportunities (e.g., Ben-David et al., 2013). Hence, if overconfident managers were risk seekers they would be more likely to overinvest in external assets rather than in their own firm.

Research design

We examine the relation between overconfidence and both tax aggressiveness and managers' assessments of tax uncertainty by using the following model:[20]

[20] Subscript *i* denotes firm while subscript *t* denotes year. Throughout the paper, all variables are defined as of time *t* unless stated otherwise.

$$Y_{i,t} = \beta_0 + \beta_1 Overconfidence_{i,t} + \beta X_{i,t} + \beta Z_{j,t} + \beta T_t + \varepsilon_{i,t} \quad (1),$$

where *Y* is either one four proxies for tax aggressiveness (*Cash ETR, Tax shelter score*, *Book-tax differences, Permanent book-tax differences*) or our measure of uncertain tax benefits (*Uncertain tax benefits*) Overconfidence is one of two measures; *Overconfidence (options)* or *Overconfidence (investment). X* is a vector of control variables consistent with prior literature, *Z* is a vector of industry fixed effects following the Fama-French 48 industry grouping, *T* is a vector of year fixed effects, and ε is a disturbance term with mean zero.

Hypothesis 1 predicts that firms with overconfident CEOs are more tax aggressive. In Equation (1) this would be supported by a positive and significant β_1 coefficient when the dependent variable is either *Cash ETR, Tax shelter score, Book-tax differences,* or *Permanent book-tax differences.*[21] Hypothesis 2 predicts that firms with overconfident CEOs report lower uncertain tax benefits. This would be supported by a negative and significant β_1 coefficient when the *Uncertain tax benefit* is the dependent variable.

We control for several determinants of tax aggressiveness from prior literature (e.g., Chen et al., 2010; Chyz et al., 2013); cash flows, leverage, net operating losses (*NOL*), the one-year change in NOLs *(*Δ*NOL*), foreign income, property, plant, and equipment (*PP&E*), intangibles, equity income in earnings, size, and market-to-book ratio. *Cash flows* is (#OANCF+#TXPD) / #AT, *Leverage* is (#DLC+#DLTT) / #AT, *NOL* is #TLCF / #AT, Δ*NOL* is ($\#TLCF_t$ - $\#TLCF_{t-1}$) / $\#AT_t$, *Foreign income* is #PIFO / #AT, *PP&E* is #PPENT / #AT, *Intangibles* is #INTAN / #AT, *Equity income* is #ESUB / #AT, *Size* is the natural log of #AT, and *Market-to-book* is (#PRCC_F*#CSHO) / #CEQ. *NOL*, Δ*NOL*, *Foreign income*, *Intangibles*, and *Equity income* are set to 0 when missing.

[21] Note that we expect a positive coefficient on *Cash ETR* because we have multiplied it by -1.

IV. EMPIRICAL RESULTS

Descriptive statistics

Table 2 presents descriptive statistics of our primary sample. The average firm in our sample pays 35.7 percent of its pretax income in taxes (i.e. *Cash ETR* = 0.357), consistent with other studies that include loss firms (e.g. Robinson et al., 2010).[22] The mean firm has a 62.4 percent likelihood of participating in a tax shelter (i.e., *Tax shelter score* = 0.624), and has unrecognized tax benefits of 1.3 percent of total assets (i.e. *Uncertain tax benefits* = 0.013). Mean levels of both book-tax difference measures are less than 1 percent of total assets (*Permanent book-tax differences* = 0.001; *Book-tax differences* = 0.001). Overall, descriptive data for our tax measures appear comparable to prior research.

The mean of *Overconfidence (options)* is equal to 0.278. Because *Overconfidence (options)* is an indicator variable, this suggests that when overconfidence is based on option-holding behavior, 27.8 percent of the firm-years in our sample are identified as having an overconfident CEO present. Similarly, when overconfidence is based on investment behavior the mean of *Overconfidence (investment)* is equal to 0.317 suggesting that 31.7 percent of the firm-years in our sample are identified as having an overconfident CEO present. Relative to prior research, the proportion of CEOs identified as overconfident appear reasonable.

Correlations

Table 3 presents Spearman correlation coefficient for the main variables in our study. *Cash ETR*, *Book-tax differences*, *Permanent book-tax differences*, and *Tax shelter score* all

[22] Excluding loss firms, the mean cash ETR is approximately 27 percent, consistent with other studies that exclude loss firms.

exhibit positive and statistically significant correlations with both measures of overconfidence. These correlations suggest that overconfident CEOs are positively associated with tax aggressiveness, providing preliminary support for Hypothesis 1.

We also document that *Uncertain tax benefits* is negatively associated with both measures of CEO overconfidence and significantly associated with *Overconfidence (options)*; consistent with recognitions of lower uncertain tax benefits when CEOs are overconfident. These univariate results provide some support for Hypothesis 2. Combined with the univariate results supporting Hypothesis 1, we begin to document evidence of an asymmetry between tax aggressiveness and FIN48 reporting for overconfident CEOs. In Section 4.3 we examine whether this asymmetry holds in a multivariate setting.

Correlations between *Book-tax differences*, *Permanent book-tax differences*, *Tax shelter score* and *Uncertain tax benefits* are positive and statistically significant; demonstrating that within our sample tax aggressiveness is accompanied by higher levels of uncertain tax benefits. *Cash ETR* is positively associated with uncertain tax benefits, though this association is not statistically significant at conventional levels. These correlations are again generally consistent with prior research.

Multivariate results

Table 4 reports regression results testing Hypothesis 1 and Hypothesis 2. Panel A reports regressions of each of our proxies for tax aggressiveness (Hypothesis 1) and uncertain tax positions (Hypothesis 2) on *Overconfidence (options)*. Panel B repeats this procedure with *Overconfidence (investment).*

In Table 4, Panel A we document a consistently positive and statistically significant association between *Overconfidence (options)* and all proxies for tax aggressiveness. Our results also appear to be economically meaningful. We find that overconfidence is associated with a decrease in cash effective tax rates (*Cash ETR*) of 6.6 percent a 2.4 percent increase in the likelihood of engaging in a tax shelter (*Tax shelter score*), as well as a 1.5 percent increase in both total and permanent book-tax differences (*Book tax differences* and *Permanent book tax differences*). We also document a negative and significant association between *Overconfidence (options)* and *Uncertain tax benefits*. Panel A of Table 4 shows that overconfidence is associated with a decrease of 0.2 percent in the ratio of uncertain tax benefits over assets. Because the average sized firm in our sample (based on total assets) is approximately $13.8 billion, the 0.2 percent decrease equals approximately $27.7 million fewer uncertain tax benefits recognized in firms' financial statements given overconfident CEOs. For the average firm in our sample, this represents approximately 1.55 percent of annual cash flows.

We document a similar pattern in Panel B of Table 4 when *Overconfidence (investments)* is our independent variable of interest. Using this measure of overconfidence we find that overconfidence is associated with a decrease in cash effective tax rates of 7.9 percent (*Cash ETR*), a 4.1 percent increase in the likelihood of engaging in a tax shelter (*Tax shelter score*), a 2.9 percent increase in total book-tax differences (*Book-tax differences*), a 3.2 percent increase in permanent book-tax differences (*Permanent book-tax differences*), as well as a 0.2 percent decrease in uncertain tax benefits as a percentage of assets.

These multivariate regression results support Hypothesis 1 and Hypothesis 2 and are suggestive of two things; First, overconfident CEOs are more tax aggressive (i.e. appear to be taking more aggressive tax positions). Second, within the same sample of firms-years,

overconfident CEOs have more confidence that aggressive tax positions they have taken will ultimately be supported even upon audit (i.e. they are more certain about the ultimate realization of accrued tax benefits).

We interpret the documented positive association with tax aggressiveness as support for over-optimism with respect to corporate tax policy, a result that has not been documented in the literature. The negative association with uncertain tax benefits further supports over-optimism with respect to probability assessments about expected payoffs from tax policy choices subsequent to an audit or examination by a relevant taxing authority.[23] We believe that the asymmetric associations between tax policy choices and the reporting of those choices are interesting within the context of both the tax aggressiveness and CEO overconfidence literatures.

CFO analysis

There is some mixed prior evidence on the extent to which CEOs are involved in the tax planning process. For example, Phillips (2003) and Armstrong et al. (2012) are not able to document evidence linking CEO compensation to corporate tax outcomes. On the other hand, both Rego and Wilson (2012) and Gaertner (2013) provide consistent evidence suggesting that CEO compensation has an economically significant effect on corporate tax behavior. The results in Rego and Wilson (2012) and Gaertner (2013) suggest that CEOs are indeed involved in the tax planning process. Even if CEOs are not directly involved in tax planning, prior research has asserted that CEOs assert a "tone at the top" with regards to firms' tax activities. For instance Dyreng et al. (2010) consider the effects of tone at the top in a tax avoidance setting by studying CEOs and CFOs and find that "The F-statistics are usually largest for CEO fixed effects, both in

[23] As we note early in our paper, it is difficult to rule out the possibility that overconfident CEOs are over-optimistic with respect to the final resolution of tax positions taken.

the full model and when each executive group is tested individually, which might be expect if CEOs (and future CEOs) have the most influence on the firm's policies." Notwithstanding this prior evidence for a role of CEOs in the tax planning process, we repeat our main analyses after reconstructing our options-based overconfidence variable at the CFO level. It is reasonable to believe that CFOs would be involved in both tax policy and financial reporting and would therefore lead to similar associations that we document with our tests of overconfident CEOs. Thus, our predictions of positive associations with tax aggressiveness and negative associations with *Uncertain tax benefits* remain constant.

The results of our CFO overconfidence tests are reported in Table 6. We find positive and statistically significant associations between CFO overconfidence and tax aggressiveness. The coefficient estimate on *Cash ETR* suggests that the *Cash ETR*s of firms with overconfident CFOs are nearly 5 percentage points lower than those of other firms. Moving to our second hypothesis, we find a negative and statistically significant coefficient estimate on CFO overconfidence, suggesting that firms with overconfident CFOs report significantly lower total *Uncertain tax benefits* relative to other firms. The magnitude of this effect is approximately 15 percent of the total tax reserve. We conclude that firms with overconfident CFOs, much like those with overconfident CEOs, take more aggressive tax positions. Similarly overconfident CFOs assign higher subjective probabilities of the realizability for the tax positions they have taken. These results support both a tone at the top argument and a role for CFOs in our setting.

Additional analysis

We perform a variety of additional tests to ensure the robustness of our results. Unless stated otherwise these tests are not reported for brevity, but their results are available from the

authors upon request. First, some prior tax studies eliminate financials and utilities on the premise that these firms are regulated and thus face different financial rules. This concern is mitigated in our study by our addition of industry fixed effects, however we delete firms with SIC codes 60-70 and find similar results.

Second, our study period overlaps with a macroeconomic recession in the United States, which may have affected both our overconfidence and tax measures. According to the National Bureau of Economic Research, the US recession began in December 2007 and ended in June 2009, which represents half of our sample period. This concern is mitigated in by our addition of year fixed effects. However, we also limit our sample to 2010 to 2012 and find similar results.

Third, we also delete all observations with negative pretax income to ensure that our results are not driven by loss firms. We again find similar results.

Fourth, we ease our sample restrictions. Our main analysis uses a common sample that requires all variables across all models to have available data. We restrict the sample in this manner to ensure that the differential impacts of overconfidence on tax aggressiveness and uncertain tax positions are not driven by sample differences throughout the model. Restricting the sample also ensures that results across different models of overconfidence are not driven by differences in the sample. However, when we estimate models using all available data we again find similar results.

Fifth, we attempt to address endogeneity concerns by exploring the sensitivity of our results to the inclusion of additional control variables. We find similar results after further controlling for a variety of CEO incentives (delta, vega, the ratio of vested options), CEO characteristics (tenure, age), governance elements (CEO ownership, institutional ownership, percentage of outside directors), and additional measures of investment and growth opportunities

(R&D, capital expenditures, inventory, Tobin's q). Our tests also hold after controlling for excess tax benefits from stock options issued before the enactment of FAS 123R.

Sixth, we consider the impact of earnings management incentives on our results. Executives could manage earnings using tax accounts (Dhaliwal, Gleason, and Mills, 2004). In particular, given evidence in Frank, Lynch, and Rego (2009) that tax aggressiveness is positively associated with financial reporting aggressiveness, it is important to test whether our results are robust to the inclusion of a proxy for earnings management. Therefore, we add performance-adjusted modified Jones (1991) model discretionary accruals to our slate of control variables (Dechow, Sloan, and Sweeney, 1995). Our results continue to hold in its presence.

Seventh, to further mitigate concerns over endogeneity, we also include firm fixed effects. The inclusion of firm fixed carries both a benefit and a cost.[24] Their inclusion changes identification from within-industry to within-firm, which alleviates concerns over endogeneity by controlling for time-invariant firm characteristics. However, to the extent to which overconfidence is an individual trait (as has been assumed to be in several prior studies), their inclusion also likely removes the effect we are trying to capture, given that CEO tenure generally spans between 4 and 8 years. We find that our results still hold.

Eighth, to the extent to which our results still might be affected by endogeneity, we seek to quantify how large of an effect a correlated omitted variable would have to have to invalidate our results. We address concerns over correlated omitted variables by estimating the smallest

[24] Malmendier and Tate (2005) discuss the limitations of using fixed-effects in settings similar to ours. Specifically the authors note: "Our measures require a long tenure within the firm in order to identify a CEO as overconfident, identifying the effect only from time-series variation within the firm is typically not feasible. That is, there are an insufficient number of cases of overconfident and non-overconfident CEOs in the same firm to draw a robust inference from any estimations. The lack of identifiable cases points to a potentially severe sample selection bias from including fixed effects in panel regressions and identifying solely out of somewhat anomalous firms with multiple short-tenured CEOs. Nevertheless, where there is enough within-firm variation in CEO overconfidence to interact firm-fixed effects with cash flow, we report the results".

correlation such a variable would have to have with both our dependent variable and with our measures of overconfidence to invalidate our statistical inferences. Frank (2000) derives an estimate to assess the robustness of multivariate regression coefficients in the presence of potential correlated omitted variables, known as the Impact Threshold for a Confounding Variable (hereafter, ITCV). This approach has been previously used in academic literature (e.g., Blaylock, Gaertner, and Shevlin, 2014; Larcker and Rusticus, 2010). Thus, while we are not able to control for every possible confounding effect, we can estimate how large such an effect would have to be to invalidate our results and inferences.

The ITCV is defined as the lowest product of the partial correlation between Y and the confounding variable and the partial correlation between X and the confounding variable that would cause the observed statistical relation between X and Y to become insignificant. Table 5 reports ITCV values corresponding to our results from Table 4. For example, as shown in Table 5, using our main regression model where *Cash ETR* is the dependent variable and *Overconfidence (options)* is our variable of interest, we find an ITCV of 0.114 (see values under "ITCV") for *Overconfidence (options)*. This value implies that a potential correlated omitted variable would need to have a correlation of at least 0.338 (0.114^0.5), *after* considering our control variables, with both *Cash ETR* and *Overconfidence (options)* to cause the positive correlation between *Cash ETR* and *Overconfidence (options)* to become insignificant at the 5 percent level (see values under "ICTV implied correlations"). As a benchmark, Table 5 also reports the impact score for the control variable from Equation (1) with the highest impact score for each given model (see value under "Highest impact score"). The impact score is the product of the partial correlation between each dependent variable and the correlation between each confidence and the control variable; and is directly comparable to the ITCV. Therefore, the

control variable with the highest impact in the model with *Cash ETR* as the dependent variable and *Overconfidence (options)* as the dependent variable has an impact of 0.017. Therefore, the ITCV for that model suggests that a possible correlated omitted variable would have to influence the results roughly 6.6 times more than the control variable from Table 4 with the largest impact.

Generally, the ITCV implied correlation values suggest that potential omitted correlated variables would have to have a very high correlation with both X and Y (between 0.171 and 0.400) after portioning out the effects of our current control variables; which include *Cash flows*, *Leverage*, *NOL*, *ΔNOL*, *Foreign income*, *PP&E*, *Intangibles*, *Equity income*, *Size*, *Market-to-book*, industry effects, and year effects. Therefore, we conclude that our main results are reasonably robust to potential correlated omitted variables.[25]

Ninth, we use an additional approach from Frank (2000) to quantity the percentage of bias that must be present for the true coefficients on *Overconfidence (options)* and *Overconfidence (investment)* to be insignificant. This is reported in Table 5 under the heading "Robustness to % bias". Our analysis indicates that, (depending on the model), our results are robust to between 56.7 percent to 87 percent bias before our t-stats would become insignificant.

Tenth, we examine the robustness of our results to three additional measures of overconfidence. While our definitions of option behavior vary by firm-year, Malmendier and Tate (2005, 2008) assume overconfidence to be a time-invariant individual trait. Therefore, in robustness tests we re-specify *Overconfidence (options)*, to take the value of 1 for CEOs who exhibit overconfident behavior (i.e., when CEO options in-the-money is greater than 0.67) at

[25] Our reported ITCVs are generally much higher than the highest impact score from our control variables with one exception. The highest impact score for the model testing the relation between the *Tax shelter score* and *Overconfidence (options)* is quite high (0.084). However, this is largely driven by the large positive correlation between the *Tax shelter score* and *Size* due to the fact that the score is mechanically related to *Size*. The highest impact factor for a control variable not included in the calculation of *Tax shelter score* has an impact factor of 0.028, which is about 2.3 times less than the ITCV for that model.

least twice, and 0 otherwise. A value of 1 is given the first time the CEO exhibits overconfidence and remains throughout his or her tenure. We also use a specification consistent with Malmendier and Tate (2008), that takes the value of 1 for CEOs who exhibit overconfident behavior (i.e., when CEO options in-the-money is greater than 0.67) at least once, and 0 otherwise. We assign a value of 1 to a firm-year the first time the CEO exhibits overconfidence and do not change this assignment throughout his or her tenure. We find consistent results using both specifications.

We also employ an additional specification of overconfidence based on investment. Following Ahmed and Duellman (2013), we create an indicator that equals 1 for firms in the top 80th percentile of $CAPX_t$ / $PP\&E_{t-1}$ for each industry-year and again find results consistent with Table 4.

Finally, we also vary the cutoff of option moneyness used to classify CEOs as overconfident. We find similar results after classifying CEOs as overconfident at moneyness ratios of 100 percent, 150 percent, 200 percent, and 250 percent.

V. SUMMARY AND CONCLUSIONS

We advance the overconfidence, tax aggressiveness, and financial reporting literatures by examining the role of CEO overconfidence in corporate tax policy. Using CEO overconfidence measures based on both observed option holding and investment behavior and multiple measures of tax aggressiveness, we document consistently positive and statistically significant relations between CEO overconfidence and tax aggressiveness. To extend these findings, we test for associations between CEO overconfidence and uncertain tax benefits disclosed in accordance with the newly mandated FIN 48. This second set of tests allows us to gain insight into

managers' own assessments of the likelihood that aggressive tax positions they take will be upheld upon audit by a taxing authority. Consistent with our hypothesis, this relation is negative and significant. Thus, it appears that firms with overconfident CEOs, on average, take more aggressive tax positions. At the same time, firms with overconfident CEOs, on average, estimate and report that more of the tax positions they take will be successfully upheld even upon audit by a relevant taxing authority. The asymmetric outcome in findings from our tests is informative to policy-makers, rule-makers, capital market participants and other academics who have studied tax aggressiveness and CEO overconfidence.

In developing our hypotheses we introduce the possibility that our tests capture two distinct manifestations of overconfidence: over-optimism and miscalibration. To the extent miscalibration is present in our results, we contend that it is likely to be a factor in our uncertain tax benefit tests. That being said, it is possible that both manifestations are present in each result. It is also unclear whether the positive associations we document between tax aggressiveness and CEO overconfidence arise from an over-estimation of the returns to investments in aggressive tax policy choices, an underestimation of the associated non-tax costs, or a combination of the two. We have also remained agnostic with respect to the firm value implications of our findings. Finally, to the extent overconfidence impacts financial reporting estimates generally, the findings in our study could also apply to other financial statement items that require substantial subjectivity in estimating the impact of future events (i.e. contingent liabilities, pension expense and liabilities, bad debt expense, etc.). These are unanswered questions and issues that could be addressed in future research.

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TABLE 1
Sample Selection

		Firm-years	Firms
All US observations from 2007-2012 on the intersection of Compustat and Execucomp		8,896	1,877
Less:	*Cash ETR*	230	29
	Tax shelter score	1,207	224
	Book-tax differences	0	0
	Permanent book-tax differences	18	3
	Uncertain tax benefits	1,679	271
	Overconfidence (options)	0	0
	Overconfidence (investment)	0	0
	Cash flow	0	0
	Leverage	0	0
	NOL	0	0
	ΔNOL	0	0
	Foreign income	0	0
	PP&E	83	21
	Intangibles	0	0
	Equity income	0	0
	Size	0	0
	Market-to-book ratio	4	1
Total		5,675	1,328

Table 1 reports our sample selection procedure. *Cash ETR* is cash paid for taxes divided by pre-tax income. *Cash ETR* is constrained to lie between 0 and 1, and is set to 0 for firms with tax refunds and to 1 for firms with positive taxes and negative or zero income. *Cash ETR* is multiplied by -1 so that higher amounts correspond to greater tax avoidance. *Tax shelter score* is the probability of engaging in a tax shelter, consistent with Wilson (2009). *Book-tax differences* is pretax income, minus income tax expense divided by 35%, scaled by assets. *Permanent book-tax differences* is equal to book-tax differences, minus deferred tax expense divided by 35%, scaled by assets. *Uncertain tax benefits* is the unrecognized tax benefit accrual scaled by assets. *Overconfidence (options)* is 1 if the ratio of CEO options in the money is greater than 67% and 0 otherwise. *Overconfidence (investment)* is obtained by regressing the change in assets on the change in sales at the industry-year level; and assigning a value of 1 for observations with a residual greater than 0. *Cash flow* is pretax operating income scaled by assets. *Leverage* is the sum of current and long-term debt scaled by assets. *NOL* is tax loss carryforwards scaled by assets. *ΔNOL* is the one-year change in *NOL*. *Foreign income* is foreign income scaled by assets. *PP&E* is net property, plant, and equipment scaled by assets. *Intangibles* is intangible assets scaled by assets. *Equity income* is equity income in earnings scaled by assets. *Size* is the natural log of assets. *Market-to-book* is market value of equity divided by book value of equity.

TABLE 2
Descriptive Statistics

Variable	N	Mean	Std. Dev.	10th	25th	50th	75th	90th
Cash ETR	5,675	-0.357	0.318	-1.000	-0.417	-0.275	-0.136	-0.012
Tax shelter score	5,675	0.624	0.230	0.310	0.473	0.654	0.807	0.910
Book-tax differences	5,675	0.001	0.094	-0.068	-0.010	0.016	0.040	0.071
Permanent book-tax differences	5,675	0.001	0.093	-0.048	-0.002	0.009	0.027	0.056
Uncertain tax benefits	5,675	0.013	0.017	0.001	0.003	0.007	0.016	0.031
Overconfidence (options)	5,675	0.278	0.448	0.000	0.000	0.000	1.000	1.000
Overconfidence (investment)	5,675	0.317	0.465	0.000	0.000	0.000	1.000	1.000
Cash flow	5,675	0.129	0.093	0.028	0.074	0.121	0.175	0.245
Leverage	5,675	0.214	0.192	0.000	0.042	0.188	0.319	0.475
NOL	5,675	0.55	0.50	0.00	0.00	1.00	1.00	1.00
ΔNOL	5,675	0.007	0.065	-0.017	0.000	0.000	0.002	0.034
Foreign income	5,675	0.021	0.040	0.000	0.000	0.005	0.036	0.073
PP&E	5,675	0.227	0.208	0.029	0.070	0.157	0.326	0.561
Intangibles	5,675	0.226	0.206	0.002	0.044	0.175	0.360	0.542
Equity income	5,675	0.001	0.004	0.000	0.000	0.000	0.000	0.002
Size ($)	5,675	13,843	85,069	284	672	1,870	6,074	20,738
Market-to-book ratio	5,675	2.554	3.482	0.795	1.277	1.987	3.102	5.154

Table 2 presents descriptive statistics for the full sample. *Cash ETR* is cash paid for taxes divided by pre-tax income. *Cash ETR* is constrained to lie between 0 and 1, and is set to 0 for firms with tax refunds and to 1 for firms with positive taxes and negative or zero income. *Cash ETR* is multiplied by -1. *Tax shelter score* is the probability of engaging in a tax shelter, consistent with Wilson (2009). *Book-tax differences* is pretax income, minus income tax expense divided by 35%, scaled by assets. *Permanent book-tax differences* is equal to book-tax differences, minus deferred tax expense divided by 35%, scaled by assets. *Uncertain tax benefits* is the unrecognized tax benefit accrual scaled by assets. *Overconfidence (options)* is 1 if the ratio of CEO options in the money is greater than 67% and 0 otherwise. *Overconfidence (investment)* is obtained by regressing the change in assets on the change in sales at the industry-year level; and assigning a value of 1 for observations with a residual greater than 0. *Cash flow* is pretax operating income scaled by assets. *Leverage* is the sum of current and long-term debt scaled by assets. *NOL* is an indicator variable equal to one if a firm has a capital loss carryover and zero otherwise. *ΔNOL* is the one-year change in *NOL*. *Foreign income* is foreign income scaled by assets. *PP&E* is net property, plant, and equipment scaled by assets. *Intangibles* is intangible assets scaled by assets. *Equity income* is equity income in earnings scaled by assets. *Size* is the natural log of assets. *Market-to-book* is market value of equity divided by book value of equity.

TABLE 3
Correlations

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) *Cash ETR*	**0.22**	**0.56**	**0.31**	0.01	**0.09**	**0.08**	**0.03**	0.01	**0.05**	**-0.08**	**0.13**	**0.03**	**-0.05**	**0.05**	**0.03**	**0.11**
(2) *Tax shelter score*		**0.46**	**0.39**	**0.11**	**0.05**	**0.05**	**0.21**	0.02	**-0.03**	**-0.06**	**0.38**	**0.03**	**0.06**	**0.14**	**0.81**	**0.21**
(3) *Book-tax differences*			**0.58**	**0.03**	**0.16**	**0.13**	**0.34**	**-0.03**	0.01	**-0.15**	**0.29**	**0.06**	**0.03**	**0.08**	**0.09**	**0.27**
(4) *Permanent book-tax differences*				**0.14**	**0.15**	**0.15**	**0.36**	**-0.11**	0.00	**-0.13**	**0.42**	**-0.05**	**0.04**	**0.07**	**0.08**	**0.35**
(5) *Uncertain tax benefits*					**-0.07**	-0.02	**0.08**	**-0.07**	**0.07**	-0.01	**0.27**	**-0.10**	**0.06**	0.00	**0.05**	**0.12**
(6) *Overconfidence (options)*						**0.12**	**0.21**	**-0.08**	**-0.03**	**-0.06**	**0.07**	**-0.02**	0.01	0.00	**-0.07**	**0.33**
(7) *Overconfidence (investment)*							**0.06**	0.00	**-0.03**	**-0.03**	**0.04**	**-0.03**	-0.02	**0.02**	-0.02	**0.10**
(8) *Cash flow*								**-0.17**	**-0.08**	**-0.12**	**0.19**	**0.16**	-0.01	-0.02	**-0.03**	**0.44**
(9) *Leverage*									**0.06**	**0.05**	**-0.05**	**0.23**	**0.23**	**0.12**	**0.40**	**-0.07**
(10) *NOL*										**0.16**	**0.09**	**-0.05**	**0.11**	0.01	0.00	**-0.03**
(11) *ΔNOL*											**-0.06**	**0.02**	0.01	0.00	**0.02**	**-0.06**
(12) *Foreign income*												**-0.07**	**0.12**	**0.10**	**0.20**	**0.21**
(13) *PP&E*													**-0.31**	**0.13**	**0.13**	0.00
(14) *Intangibles*														**0.02**	**0.14**	0.04
(15) *Equity income*														1.00	0.16	0.01
(16) *Size*															1.00	0.03
(17) *Market-to-book ratio*																1.00

Table 3 presents Spearman correlation coefficients for the full sample (N = 5,675). Coefficients statistically significant at the 10% level are presented in bold. *Cash ETR* is cash paid for taxes divided by pre-tax income. *Cash ETR* is constrained to lie between 0 and 1, and is set to 0 for firms with tax refunds and to 1 for firms with positive taxes and negative or zero income. *Cash ETR* is multiplied by -1. *Tax shelter score* is the probability of engaging in a tax shelter, consistent with Wilson (2009). *Book-tax differences* is pretax income, minus income tax expense divided by 35%, scaled by assets. *Permanent book-tax differences* is equal to book-tax differences, minus deferred tax expense divided by 35%, scaled by assets. Uncertain tax positions is the unrecognized tax benefit accrual scaled by assets. *Overconfidence (options)* is 1 if the ratio of CEO options in the money is greater than 67% and 0 otherwise. *Overconfidence (investment)* is obtained by regressing the change in assets on the change in sales at the industry-year level; and assigning a value of 1 for observations with a residual greater than 0. *Cash flow* is pretax operating income scaled by assets. *Leverage* is the sum of current and long-term debt scaled by assets. *NOL* is an indicator variable equal to one if a firm has a capital loss carryover and zero otherwise. *ΔNOL* is the one-year change in *NOL*. *Foreign income* is foreign income scaled by assets. *PP&E* is net property, plant, and equipment scaled by assets. *Intangibles* is intangible assets scaled by assets. *Equity income* is equity income in earnings scaled by assets. *Size* is the natural log of assets. *Market-to-book* is market value of equity divided by book value of equity.

TABLE 4
CEO Overconfidence, Tax Aggressiveness, and Uncertain Tax Positions

Panel A: Overconfidence measured using *Overconfidence (options)*

	H1 (+)								H2 (–)	
	Cash ETR		*Tax shelter score*		*Book-tax differences*		*Permanent book-tax differences*		*Uncertain tax benefits*	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Overconfidence (options)	0.066	7.12 ***	0.024	6.41 ***	0.015	6.54 ***	0.015	6.29 ***	-0.002	-3.80 ***
Cash flow	0.429	6.41 ***	0.460	16.35 ***	0.214	9.24 ***	0.216	9.00 ***	0.001	0.13
Leverage	-0.002	-0.07	-0.311	-21.41 ***	-0.018	-1.82 *	-0.013	-1.42	0.004	1.07
NOL	0.014	1.30	0.005	1.37	0.004	1.35	0.001	0.55	0.000	0.22
ΔNOL	-0.394	-4.52 ***	-0.229	-6.53 ***	-0.209	-6.01 ***	-0.211	-5.23 ***	0.013	2.58 ***
Foreign income	1.330	9.91 ***	1.022	15.39 ***	0.618	10.22 ***	0.601	10.20 ***	0.060	5.05 ***
PP&E	0.052	1.20	-0.012	-0.70	0.031	3.00 ***	0.000	-0.03	-0.014	-4.83 ***
Intangibles	-0.029	-0.93	0.011	0.90	0.020	2.41 **	0.013	1.59	-0.009	-3.58 ***
Equity income	1.137	0.77	-0.166	-0.19	0.156	0.32	0.525	1.05	0.147	1.14
Size ($)	0.007	1.87 *	0.116	65.68 ***	0.004	3.85 ***	0.004	3.70 ***	0.000	0.57
Market-to-book ratio	0.000	0.09	0.000	0.50	0.000	-1.03	0.000	-0.49	0.000	-0.24
Industry fixed effects	Yes		Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes		Yes	
N	5,675		5,675		5,675		5,675		5,675	
R-squared	0.133		0.797		0.266		0.245		0.178	

TABLE 4, continued
CEO Overconfidence, Tax Aggressiveness, and Uncertain Tax Positions

Panel B: Overconfidence measured as *Overconfidence (investment)*

	H1 (+)								H2 (–)	
	Cash ETR		*Tax shelter score*		*Book-tax differences*		*Permanent book-tax differences*		*Uncertain tax benefits*	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Overconfidence (investment)	0.079	9.29 ***	0.041	13.42 ***	0.029	12.98 ***	0.032	13.58 ***	-0.002	-3.97 ***
Cash flow	0.461	6.84 ***	0.469	16.92 ***	0.219	9.53 ***	0.220	9.24 ***	-0.001	-0.09
Leverage	-0.012	-0.32	-0.315	-21.82 ***	-0.020	-2.09 **	-0.016	-1.70 *	0.004	1.15
NOL	0.015	1.49	0.006	1.65	0.004	1.63	0.002	0.87	0.000	0.17
ΔNOL	-0.390	-4.52 ***	-0.226	-6.63 ***	-0.206	-6.07 ***	-0.208	-5.28 ***	0.013	2.60 ***
Foreign income	1.315	9.97 ***	1.006	15.52 ***	0.605	10.27 ***	0.584	10.19 ***	0.060	5.01 ***
PP&E	0.067	1.54	-0.005	-0.30	0.036	3.48 ***	0.005	0.46	-0.014	-4.93 ***
Intangibles	-0.021	-0.64	0.013	1.16	0.022	2.63 ***	0.014	1.79 *	-0.009	-3.69 ***
Equity income	0.802	0.56	-0.308	-0.36	0.061	0.13	0.427	0.89	0.158	1.23
Size ($)	0.006	1.63	0.116	66.33 ***	0.004	3.83 ***	0.004	3.75 ***	0.000	0.73
Market-to-book ratio	0.001	0.39	0.000	0.69	0.000	-0.93	0.000	-0.47	0.000	-0.40
Industry fixed effects	Yes		Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes		Yes	
N	5,675		5,675		5,675		5,675		5,675	
R-squared	0.140		0.801		0.280		0.264		0.177	

TABLE 4, continued
CEO Overconfidence, Tax Aggressiveness, and Uncertain Tax Positions

Table 4 presents regression estimates for our main analysis (Equation (1)). Panel A uses an option-based measure of overconfidence while Panel B uses an investment-based measure. Industry indicators based on Fama-French 48 industry groupings and year indicators are included but not reported. Standard errors are robust to heteroskedastic errors and are clustered by firm. Models under H1 examine the relation between confidence and tax aggressiveness (which Hypothesis 1 predicts to be positive), while the last model examines the relation between confidence and firms' assessments of tax risk (which Hypothesis 2 predicts to be negative). *Cash ETR* is cash paid for taxes divided by pre-tax income. *Cash ETR* is constrained to lie between 0 and 1, and is set to 0 for firms with tax refunds and to 1 for firms with positive taxes and negative or zero income. *Cash ETR* is multiplied by -1. *Tax shelter score* is the probability of engaging in a tax shelter, consistent with Wilson (2009). *Book-tax differences* is pretax income, minus income tax expense divided by 35%, scaled by assets. *Permanent book-tax differences* is equal to book-tax differences, minus deferred tax expense divided by 35%, scaled by assets. *Uncertain tax benefits* is the unrecognized tax benefit accrual scaled by assets. *Overconfidence (options)* is 1 if the ratio of CEO options in the money is greater than 67% and 0 otherwise. *Overconfidence (investment)* is obtained by regressing the change in assets on the change in sales at the industry-year level; and assigning a value of 1 for observations with a residual greater than 0. *Cash flow* is pretax operating income scaled by assets. *Leverage* is the sum of current and long-term debt scaled by assets. *NOL* is an indicator variable equal to one if a firm has a capital loss carryover and zero otherwise. *ΔNOL* is the one-year change in *NOL*. *Foreign income* is foreign income scaled by assets. *PP&E* is net property, plant, and equipment scaled by assets. *Intangibles* is intangible assets scaled by assets. *Equity income* is equity income in earnings scaled by assets. *Size* is the natural log of assets. *Market-to-book* is market value of equity divided by book value of equity. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels respectively for one-sided tests examining H1 and H2 and for two-sided tests for the remaining variables.

TABLE 5
Impact Threshold for a Confounding Variable Analysis

	H1				H2
Model	*Cash ETR*	*Tax shelter score*	*Book-tax differences*	*Permanent book-tax differences*	*Uncertain tax benefits*
			ITCV		
(1) *Overconfidence (options)*	0.114	0.065	0.067	0.063	0.029
(2) *Overconfidence (investment)*	0.103	0.158	0.152	0.160	0.032
			ITCV implied correlations		
(1) *Overconfidence (options)*	0.338	0.254	0.258	0.252	0.171
(2) *Overconfidence (investment)*	0.321	0.397	0.390	0.400	0.178
			Highest Impact Score		
(1) *Overconfidence (options)*	0.017	0.084	0.029	0.028	0.010
(2) *Overconfidence (investment)*	0.015	0.031	0.025	0.024	0.010
			Robustness to % bias		
(1) *Overconfidence (options)*	0.768	0.742	0.748	0.739	0.567
(2) *Overconfidence (investment)*	0.822	0.876	0.871	0.877	0.585

Table 5 assesses the impact of possible correlated omitted variables (or unobservable confounding variables) on the results reported in Table 4, following Frank (2000). Model (1) corresponds to results in Table 4 Panel A, while Model (2) corresponds to results in Table 4 Panel B. The first two rows under "ITCV" reports the Impact Threshold for a Confounding Variable, which is the lowest product of the partial correlation between the dependent variable and the confounding variable and the partial correlation between confidence and the confounding variable which makes the coefficient on the confidence variable statistically insignificant at the 5% level. The third and fourth rows under "ITCV implied correlations" reports the minimum correlation a confounding variable must have between both each dependent variable and confidence to make the coefficient on confidence insignificant. The fifth and sixth rows under "Highest Impact Score" reports the impact score for the control variable from Equation (1) with the highest impact score. The impact score is the product of the partial correlation between each dependent variable and the correlation between confidence and the control variable. The seventh and eighth rows under "Robustness to % bias" reports the percentage of bias that must be present for the true coefficients on confidence to be statistically insignificant at the 5% level.

TABLE 6
CFO Overconfidence, Tax Aggressiveness, and Uncertain Tax Positions

	H1 (+)								H2 (–)	
	Cash ETR		*Tax shelter score*		*Book-tax differences*		*Permanent book-tax differences*		*Uncertain tax benefits*	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Overconfidence (CFO options)	0.049	4.91 ***	0.023	6.24 ***	0.014	6.12 ***	0.016	6.57 ***	-0.002	-3.76 ***
Cash flow	0.455	6.74 ***	0.467	16.69 ***	0.219	9.45 ***	0.219	9.13 ***	0.000	0.03
Leverage	-0.005	-0.15	-0.312	-21.50 ***	-0.018	-1.87 *	-0.014	-1.44	0.004	1.08
NOL	0.014	1.32	0.005	1.40	0.004	1.37	0.002	0.58	0.000	0.21
ΔNOL	-0.402	-4.60 ***	-0.232	-6.63 ***	-0.211	-6.07 ***	-0.213	-5.29 ***	0.013	2.64 ***
Foreign income	1.360	10.09 ***	1.030	15.47 ***	0.623	10.31 ***	0.604	10.23 ***	0.059	4.99 ***
PP&E	0.052	1.19	-0.012	-0.74	0.031	2.98 ***	-0.001	-0.08	-0.014	-4.79 ***
Intangibles	-0.024	-0.76	0.012	1.00	0.021	2.50 **	0.013	1.65 *	-0.009	-3.61 ***
Equity income	1.058	0.73	-0.181	-0.21	0.145	0.29	0.520	1.05	0.149	1.16
Size ($)	0.007	1.68 *	0.116	65.82 ***	0.004	3.78 ***	0.004	3.70 ***	0.000	0.60
Market-to-book ratio	0.000	0.34	0.000	0.66	0.000	-0.88	0.000	-0.42	0.000	-0.29
Industry fixed effects	Yes		Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes		Yes	
N	5,675		5,675		5,675		5,675		5,675	
R-squared	0.131		0.796		0.264		0.244		0.177	

TABLE 6, continued
CFO Overconfidence, Tax Aggressiveness, and Uncertain Tax Positions

Table 6 presents regression estimates for our main analysis (Equation (1)) when using an options-based measure of CFO overconfidence. Industry indicators based on Fama-French 48 industry groupings and year indicators are included but not reported. Standard errors are robust to heteroskedastic errors and are clustered by firm. Models under H1 examine the relation between confidence and tax aggressiveness (which Hypothesis 1 predicts to be positive), while the last model examines the relation between confidence and firms' assessments of tax risk (which Hypothesis 2 predicts to be negative). *Cash ETR* is cash paid for taxes divided by pre-tax income. *Cash ETR* is constrained to lie between 0 and 1, and is set to 0 for firms with tax refunds and to 1 for firms with positive taxes and negative or zero income. *Cash ETR* is multiplied by -1. *Tax shelter score* is the probability of engaging in a tax shelter, consistent with Wilson (2009). *Book-tax differences* is pretax income, minus income tax expense divided by 35%, scaled by assets. *Permanent book-tax differences* is equal to book-tax differences, minus deferred tax expense divided by 35%, scaled by assets. *Uncertain tax benefits* is the unrecognized tax benefit accrual scaled by assets. *Overconfidence (CFO options)* is 1 if the ratio of CFO options in the money is greater than 67% and 0 otherwise. *Cash flow* is pretax operating income scaled by assets. *Leverage* is the sum of current and long-term debt scaled by assets. *NOL* is an indicator variable equal to one if a firm has a capital loss carryover and zero otherwise. *ΔNOL* is the one-year change in *NOL*. *Foreign income* is foreign income scaled by assets. *PP&E* is net property, plant, and equipment scaled by assets. *Intangibles* is intangible assets scaled by assets. *Equity income* is equity income in earnings scaled by assets. *Size* is the natural log of assets. *Market-to-book* is market value of equity divided by book value of equity. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels respectively for one-sided tests examining H1 and H2 and for two-sided tests for the remaining variables.