Financial Accounting Effects of Tax Aggressiveness: Contracting and Measurement*

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1. Introduction

The financial accounting consequences of tax-reporting decisions are of first-order importance. Numerous papers have documented the importance of the effect of a tax-reporting decision on a firm's financial accounting earnings in understanding firm behavior, as reviewed by Shackelford and Shevlin (2001) and Hanlon and Heitzman (2010). We investigate two related issues in this study. First, we ask why managers focus on the financial accounting consequences instead of the cash flow consequences of tax-reporting decisions. Second, we compare two accounting measures—one based on cash taxes paid (CTP) and the other based on the liability for unrecognized tax benefits (UTB)—to determine which accounting measure will better reflect differences in tax aggressiveness across firms.

Firms can take tax-reporting positions that would reduce CTP, but later may be challenged by the tax authority. Our focus is on tax-reporting positions that generate permanent book-tax differences. We examine a setting in which a firm delegates the task of identifying and evaluating tax return-reporting positions to a tax manager. The manager can identify reporting positions that create permanent book-tax differences by reducing taxes without reducing pretax book income, and learn the degree to which the facts and the law support these positions by exerting unobservable costly effort. For example, the manager could identify research expenditures that qualify for a tax credit instead of a tax deduction. In our model, there may be strong, weak, or zero support for a tax-reporting position. All firms want to take positions with strong support; no firm wants to take positions with zero support. We distinguish two types of reporting strategies when the support is weak. Firms that take the position when the support is weak are *aggressive*; firms that do not take the position when the support is weak are *conservative*. Whether a firm chooses to be aggressive or conservative in our model depends on the nontax cost a firm incurs by being associated with taking tax positions with weak support.

Financial Accounting Standard Board (FASB) Interpretation No. 48, *Accounting for Uncertainty in Income Taxes* (FIN 48), provides rules for recognizing a tax benefit in current accounting earnings even though that benefit could be lost (in whole or in part) due to a subsequent audit. The difference between the reduction in CTP and the reduction in book-tax expense is the UTB. Paragraph 21(a)(2) of FIN 48 requires that firms disclose the UTB that arise as a result of uncertain tax positions taken during the current period.

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We first analyze an agency model in which the firm must provide incentives to the manager to identify and evaluate tax-reporting positions, and then use the information in the way that the firm prefers. This requires a delicate balancing of incentives, so that the manager both works and takes the reporting positions that the firm would prefer if it had the information. We find that the optimal use of contemporaneous financial accounting measures of tax reporting enables the firm to motivate the manager to both engage in costly effort and make the tax-reporting decision that the firm prefers, even though the firm is not able to observe the manager's actions.

We show that, both for the aggressive and for the conservative firm, the manager's optimal compensation contract features a bonus for reducing the firm's CTP and a penalty for increasing the firm's UTB. This combination of payments provides the manager with incentives to acquire information and claim only those uncertain tax benefits that the firm would take if it had the manager's information. The financial accounting system's recognition of a liability for UTBs allows the firm to efficiently attain the level of tax avoidance it prefers, even though it cannot contract on the manager's action directly.

As a consequence of the optimal contract, managers care both about reducing CTP and book-tax expense; taking a position that reduces CTP but does not reduce book-tax expense would weakly reduce the manager's compensation. This preference for lower book-tax expense does not reflect functional fixation on accounting earnings; rather, it reflects the fact that the accounting accrual of UTB is a useful source of information in the design of the optimal compensation contract.

We also find that the optimal contracts used by conservative and aggressive firms are qualitatively different. Both contracts feature a lower bound on both the bonus and the penalty, but the contract used by the aggressive firm also features an upper bound on both. The penalty used by an aggressive firm cannot be too large; otherwise, the manager of the aggressive firm would not take an uncertain tax position with weak support. Therefore, the manager of the conservative firm faces a more "high-powered" incentive arrangement than does the manager of the aggressive firm.

We then extend our analysis to examine the relation between a firm's tax aggressiveness and two accounting measures—CTP and the UTB. The first measure is often normalized by pretax financial accounting income to yield an effective tax rate (ETR).

The empirical literature on tax aggressiveness focuses on permanent book-tax differences (Dyreng, Hanlon and Maydew 2010; Lisowsky 2010). Although temporary differences are also important, they reverse over time. Accordingly, the empirical literature tends to measure the long-run ETR.[1] In contrast, the UTB reflects both permanent and temporary book-tax differences. Because we only consider permanent book-tax differences, when we refer to UTB it is understood that we refer to the portion of UTB that, if recognized, would reduce the firm's ETR.

We ask whether UTB or CTP is better able to distinguish a conservative firm from an aggressive firm. We find that neither measure dominates the other; which measure is better depends jointly on (i) the likelihood that uncertain tax positions are detected and successfully challenged by the tax authority and (ii) the extent to which firms comply with FIN 48. CTP is the better measure when the ability of the tax authority to detect and successfully challenge uncertain tax positions is sufficiently low, and becomes less effective as the tax authority's ability increases. In contrast, an increase in FIN 48 compliance could either increase or decrease the ability of UTB to distinguish a conservative firm from an aggressive firm.

1. The ETR can be measured using either book-tax expense (GAAP ETR) or CTP (CASH ETR) in the numerator. The difference between these two measures vanishes over a sufficiently long time horizon as temporary differences reverse. Because we evaluate ETR on a long-term basis, we focus on just one of these measures, the CASH ETR.

Section 2 discusses how our results relate to the empirical literature on performance measures used to evaluate tax managers and on measures of tax aggressiveness. We present the model in section 3. In section 4, we characterize an efficient compensation contract for the tax manager of a conservative and an aggressive firm, respectively. Section 5 examines the measures of tax aggressiveness. Section 6 concludes.

2. Related literature

Our results relate to the empirical literature on performance measures used to evaluate tax directors. Dyreng et al. (2010) show that individual executives may have an effect on the level of tax avoidance. Although "tone at the top" is one way of influencing tax manager decisions, an alternative is for the firm to provide financial incentives to the tax manager to behave in the way that top management prefers. Robinson, Sikes and Weaver (2010) and Armstrong, Blouin and Larcker (2012) find that tax directors are evaluated based on GAAP ETR, which reflects both the reduction in CTP and the UTB. We find that the optimal contract is based on both the reduction in CTP and the UTB; however, the weights on these two measures need not be the same. Our results are consistent with Brown, Drake and Martin (2011). They find that bonuses paid to CEOs and CFOs are higher when a firm's CASH ETR is lower, but that bonuses are lower when UTB is higher.

Our paper also relates to the empirical literature on measures of tax aggressiveness. The CASH ETR is a commonly used measure of tax aggressiveness in the empirical literature. Dyreng et al. (2010) use both the GAAP ETR and CASH ETR in their study of the role of individual executives in determining the level of tax avoidance that firms undertake. Chen et al. (2010) use both measures, as well as two book-tax difference measures, in their study on the difference in tax aggressiveness exhibited by family and nonfamily firms. Balakrishnan, Blouin, and Guay (2011) use both the GAAP ETR and CASH ETR to measure tax aggressiveness in their study of tax aggressiveness and financial reporting transparency. Cazier et al. (2009) and Dunbar and Schultz (2009) examine the levels and changes in a firm's UTB.

Our focus is on the relations between the firm's tax aggressiveness and accounting measures of tax aggressiveness.[2] The empirical literature has investigated the relations between participation in tax shelters and permanent book-tax differences (which cause the GAAP ETR to diverge from the statutory tax rate), CASH ETR, and UTB. Lisowsky (2010) finds no significant relation between participation in tax shelters and discretionary permanent book-tax differences or between participation in tax shelters and the long-run CASH ETR. Lisowsky, Robinson and Schmidt (2013) examine the extent to which participation in a tax shelter is reflected in an increase in the firm's UTB, and find that the UTB is positively associated with the use of tax shelters. Rego and Wilson (2012) use both CASH ETR and UTB as measures of tax-reporting aggressiveness in their study on the association between equity risk incentives and risky tax strategies. Frank, Lynch and Rego (2009) use discretionary permanent book-tax differences as a measure of tax aggressiveness. That paper finds that their tax aggressiveness measure is highly correlated with a firm's decision to participate in a tax shelter. Wilson (2009) also measures tax aggressiveness using book-tax differences, and finds a significant correlation between his tax aggressiveness measure and tax shelter activity.

3. Model

Tax-reporting decision

We consider a firm that reports its financial accounting information using U.S. Generally Accepted Accounting Principles. The firm can take tax-return reporting positions that reduce its current taxes paid but which, if challenged by the tax authority, could be

2. Mills, Robinson, and Sansing (2010) focus on how accounting measures of tax aggressiveness affect the strategic interaction between the firm and the tax authority.

rejected in whole or in part. We refer to these positions as uncertain tax positions. There can be strong, weak, or zero support for an uncertain tax position. The dollar value of each position with strong support is the realization of a random variable $S > 0$. The firm has N_s positions with strong support available to it during the year, so the expected value of all strong positions available to the firm during the year is $N_s E[S] = \hat{S}$. The dollar value of each position with weak support is the realization of a random variable $W > 0$. The firm has N_w positions with weak support available to it during the year, so the expected value of all weak positions available to the firm during the year is $N_w E[W] = \hat{W}$. The dollar value of each position with zero support is the realization of a random variable $Z > 0$. The firm has N_z positions with zero support available to it during the year, so the expected value of all such positions available to the firm during the year is $N_z E[Z] = \hat{Z}$.[3]

The extent to which a claimed tax benefit is retained after the tax authority has had an opportunity to challenge the position depends on the strength of the position. We let $\phi \in \{s, w, z\}$ indicate whether a position has strong, weak, or zero support. The fraction of the value retained by the taxpayer is a random variable T_ϕ. The realization of T_ϕ reflects the joint probability that an uncertain tax position is both identified and successfully challenged by the the tax authority, as well as the possible outcome if the tax authority challenges the claimed tax benefit. We assume that T_s is independent of S, T_w is independent of W, and T_z is independent of Z.

If a position with strength ϕ is detected and successfully challenged, the firm retains a fraction X_ϕ of the position, where X_ϕ itself is a random variable. If a position with strength ϕ is not detected or not successfully challenged, then the firm retains the entire claimed benefit. We assume that

$$E[X_z] < E[X_w] \leq 0 < E[X_s] \leq 1.$$

Therefore, conditional on an uncertain tax position being detected and challenged by the tax authority, the taxpayer will retain, on average, a positive amount of the tax benefit claimed when the position is strong. When the position has weak or zero support, on average the taxpayer will lose more than the claimed benefit when the position is detected and challenged. This implies that the taxpayer will sometimes pay a negligence penalty when it takes a position with weak or zero support.

Firm aggressiveness

In addition to the tax and potential penalty costs associated with uncertain tax positions, firms face nontax costs from being associated with a detected position with weak or zero support. These costs reflect any damage to a firm's public image from being associated with an uncertain tax position that does not have strong support. Firms differ with respect to the level of these costs. For example, Hanlon and Slemrod (2009) find that retail firms suffer larger negative stock price reactions to news regarding involvement in corporate tax shelters. There are no image costs associated with taking a position with strong support.

Whether a firm wants to take an uncertain tax position depends jointly on the detection probability, the expected retained tax benefit, and the expected image costs. In order to be able to investigate (in section 5) how the sensitivity of tax aggressiveness measures depends on the effectiveness of the audit process, we focus on sets of firms that face similar detection probabilities. We let η denote the detection probability.

Because there are no image costs associated with an audited position with strong support, the expected payoff per dollar of tax benefit claimed from a position with strong support is

3. We assume that the number of each type of position is deterministic for expositional convenience only. Our results generalize to a setting in which the number of positions available to a firm is a random variable.

$$E[T_s] = \eta \cdot E[X_s] + 1 - \eta > 0,$$

which is strictly positive because $E[X_s] > 0$. Therefore, all firms take positions with strong support.

Because each firm incurs an image cost per dollar of tax benefit claimed if a position with weak or zero support is audited, and because this image cost is firm-specific, firms can differ with respect to the expected benefit from taking positions with weak support or zero support. Let $k_i > 0$ denote the image cost for firm i. Then, the expected payoff per dollar of tax benefit claimed by firm i from a position with weak or zero support is

$$E[T_\phi] - \eta k_i = \eta \cdot (E[X_\phi] - k_i) + 1 - \eta, \quad \text{for} \quad \phi \in \{w, z\}. \tag{1}$$

Therefore, whether firm i wants to take a position of strength $\phi \in \{w, z\}$ depends jointly on the firm-specific image cost k_i, and the effectiveness of the audit process, which in turn depends on the detection rate η and the expected retained tax benefit $E[X_\phi] < 0$. We assume that the audit process is sufficiently effective to deter all firms from taking positions with zero support, but is not sufficiently effective to deter firms with no image cost (i.e., firms with $k_i = 0$) from taking positions with weak support. This implies that $E[T_z] < 0 \leq E[T_w]$, or, equivalently,

$$\frac{1}{1 - E[X_z]} < \eta \leq \frac{1}{1 - E[X_w]} \leq 1. \tag{2}$$

Then, no firm wants to take positions with zero support; whether a firm wants to take an uncertain tax position with weak support depends on the level of the firm's image costs k_i. We let k^* denote the value of k_i for which firm i would be indifferent between taking and not taking a position with weak support, that is,

$$k^* = \frac{E[T_w]}{\eta} = \frac{1}{\eta} - (1 - E[X_w]) \geq 0. \tag{3}$$

For firms with low values of k, $0 \leq k_i < k^*$, the expected payoff per dollar of tax benefit claimed from a weak position, $E[T_w] - \eta k_i$, is positive, so they will claim tax benefits with weak support; for firms with high values of k, $k_i > k^*$, the expected payoff is negative, so they will not claim tax benefits with weak support.

Therefore, all firms take positions with strong support and no firm takes positions with zero support, but firms differ with respect to whether they take positions with weak support. We refer to firms that take positions with weak support as aggressive and to firms that do not take positions with weak support as conservative. When the audit process becomes more efficient because either η increases or the expected retained tax benefit $E[X_w]$ becomes more negative, the critical value k^* from (3) decreases, so that fewer firms will be aggressive.

Tax manager compensation

The firm delegates the task of identifying and evaluating tax-saving reporting positions to a tax manager. The manager can identify and evaluate all of the uncertain tax positions available to the firm during the year at a personal cost $c > 0$. Evaluating the uncertain tax positions means the manager can determine whether the position has strong, weak, or zero support. This allows the manager to condition the firm's tax-reporting decision on the strength of the position. If the manager does not engage in costly effort, no tax-saving reporting positions are identified. The contract must compensate the tax manager for the cost of effort so that the manager identifies and evaluates tax-saving reporting positions, and must provide incentives to the manager to make the tax-reporting decision that the firm prefers.

Financial reporting

Firms are required to report the effects of any uncertain tax benefits on their financial statements in accordance with FASB Interpretation No. 48, *Accounting for Uncertainty in Income Taxes* (FIN 48).[4] Although claiming the tax benefit reduces the firm's taxes paid when the tax return is filed, FIN 48 requires the firm to record a liability for financial reporting purposes for a UTB to account for the possibility that the tax benefit could be lost (in whole or in part) if it is challenged by the tax authority. In this subsection, we consider the financial reporting consequences of an uncertain tax position in the year in which the position is taken, as well as in the year in which the uncertainty is resolved. We focus on tax-reporting positions that generate permanent book-tax differences. Therefore, the reduction in CTP is completely reflected in the firm's financial statement via a reduction in the book-tax expense and/or an increase in the UTB.

We let $\Delta CTP_{\phi,\text{new}}$ denote the *decrease* in CTP in the year in which an uncertain tax position of strength ϕ is taken, and we let $\Delta CTP_{\phi,\text{res}}$ denote the change in CTP in the year in which the position is resolved. When a position of strength $\phi \in \{s, w, z\}$ is resolved, the taxpayer pays $1 - T_{\phi}$ per dollar of claimed tax benefit to the tax authority, and hence, CTP increases by a fraction $1 - T_{\phi}$ of the original dollar amount claimed. For example, if a weak position with dollar amount W is taken, then CTP decreases by $\Delta CTP_{w,\text{new}} = W$ in the year in which the position is taken, and changes by $\Delta CTP_{w,\text{res}} = -(1 - T_w)W$ in the year in which it is resolved.

The firm recognizes a part of the reduction in CTP in its accounting earnings in the year in which the position is taken as a reduction in the book-tax expense. We let the random variables H, L, and Q represent the fraction of the tax benefit claimed by the firm that reduces book-tax expense for positions with strong, weak, and zero support, respectively. For example, if the firm takes a weak position of dollar amount W, then the book-tax expense decreases by LW in the year in which the position is taken. The book-tax expense changes by $-(L - T_w)W$ in the year in which the uncertainty is resolved.

Finally, we let $\Delta UTB_{\phi,\text{new}}$ represent the increase in the UTB that the firm recognizes on its balance sheet in the year in which an uncertain position of strength ϕ is taken, and we let $\Delta UTB_{\phi,\text{res}}$ represent the change in the UTB in the year in which the uncertainty is resolved. When an uncertain tax position is taken, the UTB increases by the fraction of the tax benefit claimed for which no reduction in book-tax expense is recorded, that is, it increases by $(1 - H)S$, $(1 - L)W$, and $(1 - Q)Z$ for positions with strong, weak, and zero support, respectively. When the position is resolved, the corresponding UTB is reduced to zero. For example, if a weak position with dollar amount W is taken by a firm, then the UTB increases by $\Delta UTB_{w,\text{new}} = (1 - L)W$ in the year in which the position is taken, and changes by $\Delta UTB_{w,\text{res}} = -(1 - L)W$ in the year in which it is resolved.

In Table 1, we summarize the random variables that reflect the effects on CTP and UTB from the generation and resolution of uncertain tax benefits with strong, weak, and zero support.

4. Prior to the adoption of FIN 48, uncertain tax positions were treated for financial reporting purposes as contingent liabilities. The UTB recognized by FIN 48 was not available to serve as a contracting variable. Although an optimal contract could have been designed using other (possibly internal) information prior to adoption of FIN 48, FIN 48 provided the information needed to evaluate the tax manager at no additional cost.

TABLE 1
Financial reporting outcomes for a single position

Strength	$\Delta CTP_{\phi,\text{new}}$	$\Delta CTP_{\phi,\text{res}}$	$\Delta UTB_{\phi,\text{new}}$	$\Delta UTB_{\phi,\text{res}}$
$\phi = s$	S	$-(1 - T_s)S$	$(1 - H)S$	$-(1 - H)S$
$\phi = w$	W	$-(1 - T_w)W$	$(1 - L)W$	$-(1 - L)W$
$\phi = z$	Z	$-(1 - T_z)Z$	$(1 - Q)Z$	$-(1 - Q)Z$

Notes:

$\Delta CTP_{\phi,\text{new}}$ and $\Delta UTB_{\phi,\text{new}}$ show the effects on cash taxes paid and the unrecognized tax benefit of a single uncertain tax position of strength ϕ in the period in which it is taken. $\Delta CTP_{\phi,\text{res}}$ and $\Delta UTB_{\phi,\text{res}}$ show the effects on cash taxes paid and the unrecognized tax benefit of a single uncertain tax position in the period in which it is resolved.

FIN 48 compliance

The realizations of the random variables H, L, and Q represent the fraction of the tax benefit claimed that reduces book-tax expense. The realizations reflect both the financial reporting rules under FIN 48 and how effectively these rules are followed in practice.

Under FIN 48, the amount of the uncertain tax benefit that the taxpayer recognizes as a reduction in book-tax expense when the tax return is filed is determined by applying a two-step process: recognition and measurement. In the recognition step, taxpayers may only recognize tax benefits that are more than 50 percent likely to be sustained by the court of last resort based solely on the technical merits of the filing position. Only strong positions should pass the recognition step. Therefore, $L = Q = 0$ if the firm fully complies with FIN 48.

For strong positions, the measurement step determines the amount of the tax benefit that should be recognized in the firm's financial statements. The tax benefit recognized in the financial statements is the largest tax benefit that cumulatively is greater than 50 percent likely to be sustained on audit, taking into account likely settlements with the government, assuming that the position is audited. For example, if a strong position is more likely than not to be retained in full, then $H = 1$ under FIN 48. A strong position may yield $H < 1$. FIN 48 provides an example in paragraphs A21–22 in which a taxpayer takes an uncertain tax position resulting in a benefit of \$100. The taxpayer believes that if the position is audited, the taxpayer will retain the full benefit 5 percent of the time, \$80 of the benefit 25 percent of the time, \$60 of the benefit 25 percent of the time, and \$50 or less of the benefit 45 percent of the time. Therefore, the taxpayer recognizes a reduction in tax expense of \$60, which is the median retained tax benefit in this example, and accrues an UTB of \$40. The value of H would be 0.6 in this case.

We allow for the financial reporting and auditing processes to be imperfect. For example, firms could in practice overstate or understate the reduction in book-tax expense relative to the rules provided in FIN 48. Although $L = Q = 0$ in the special case of full compliance with FIN 48, it is possible for the realizations of L or Q to be greater than zero. Similarly, the realization of H may deviate from the retained tax benefit under FIN 48. We assume that

$$E[Q] \leq E[L] < E[H] \leq 1,$$

so the expected reduction in book-tax expense is the highest for strong positions and the lowest for positions with zero support. We also assume that H is independent of S, L is independent of W, and Q is independent of Z. We emphasize that the extent to which the reduction in book-tax expense complies with FIN 48 is not controlled by the tax manager, but rather reflects the decisions of the CFO, CEO, and the auditing firm.

4. Accounting measures of tax manager performance

The contracting problem

The firm delegates the task of identifying and evaluating tax-saving reporting positions to a tax manager. The conservative firm wants the manager to only take tax-reporting positions with strong support; the aggressive firm wants the manager to also take tax-reporting positions with weak support. The firm, however, cannot observe the manager taking the costly action and choosing the tax-return position that the firm prefers. Instead, the firm must design a contract that induces the manager to work to identify and evaluate tax-reporting opportunities, and then make the decision that the firm prefers. If the firm could wait until either the tax position is audited or the statute of limitations expires to compensate the manager, then a contract that induces the preferred actions could be written on the basis of the eventual cash flows. Given the length of time between when a tax return is filed and the statute of limitations has expired, this approach is impractical. We seek a contract that is based on current financial accounting information.

Brown et al. (2011) find that tax managers are compensated on the basis of both reduction in CTP and UTB accrued. Accordingly, we consider a compensation contract in which the manager receives a fixed salary, F; a bonus that is proportional to the reduction in CTP associated with new positions; and a penalty that is proportional to the increase in the firm's UTB associated with new positions. Both the manager and the firm are risk neutral. The manager chooses the actions to maximize the expected cash compensation less the cost of effort c. The firm designs a contract that minimizes its expected cash compensation payments given that the contract induces the manager to engage in costly effort and make the tax-planning choice that the firm prefers.

Conservative firm contract

The expected aggregate reduction in CTP for all strong positions available to the firm in a given year is $N_s E(S) = \hat{S}$. Moreover, the increase in the UTB is a fraction $1 - H$ of the dollar value for a position with strong support, a fraction $1 - L$ of the dollar value for positions with weak support, and $1 - Q$ of the dollar value for positions with zero support. Therefore, the optimal contract offered by the conservative firm solves the following program:

$$
\begin{array}{lll}
\min\limits_{F,B,P} & \{F + B\hat{S} - P(1 - E[H])\hat{S}\} & \\
\text{s. t.} & F + B\hat{S} - P(1 - E[H])\hat{S} - c \geq U & (PC) \\
 & F + B\hat{S} - P(1 - E[H])\hat{S} - c \geq F & (IC1) \\
 & B - P(1 - E[H]) \geq 0 & (IC2) \\
 & B - P(1 - E[L]) \leq 0 & (IC3) \\
 & B - P(1 - E[Q]) \leq 0 & (IC4)
\end{array}
$$

The participation constraint (PC) ensures that the contract provides an expected payment that is at least as high as the manager's cost of effort, c, plus the manager's reservation utility, U. The four incentive compatibility constraints provide the manager with the incentives to work hard to identify and evaluate the tax-reporting opportunities, and to use the information to make the decision that the firm prefers. $IC1$ ensures that the expected payment is at least as high as the payment the manager could get from not working; not working ensures that no tax reporting opportunities are identified, in which case the manager would receive F. $IC2$ ensures that once the manager has learned that the support for the position is strong, the manager prefers to claim the tax benefit. $IC3$ ensures that once the manager has learned that the support for the position is weak, the manager prefers to not claim the tax benefit. Finally, $IC4$ ensures that once the manager has learned that there is zero support for the position, the manager prefers to not claim the tax benefit. We present a solution to this problem in Proposition 1.

PROPOSITION 1. *The following contract is optimal for a conservative firm:*

$$F = U$$

$$B \geq \frac{c(1 - E[L])}{(E[H] - E[L])\hat{S}}$$

$$P = \frac{B\hat{S} - c}{(1 - E[H])\hat{S}}$$

The expected cost of compensation is $U + c$.

Substituting the values of F, B, and P into the constraints shows that all the constraints are satisfied. The fact that the expected cost is $U + c$ implies that the contract is optimal, because the expected cost must be at least $U + c$ to satisfy the participation constraint (PC). Substituting the lower bound on B into the expression for P yields a lower bound for the penalty rate of

$$P \geq \frac{c}{\hat{S}(E[H] - E[L])}.$$

The lower bounds of both the bonus rate B and the penalty rate P each reflect $E[H] - E[L]$, the extent to which the financial reporting of uncertain tax positions distinguishes between strong and weak positions. In addition, the lower bound of the bonus rate B reflects $E[L]$, the expected reduction in book-tax expense per dollar of tax benefit claimed for an uncertain tax position of weak support.

Aggressive firm contract

The expected aggregate reduction in CTP for all positions available to the firm in a given year is $N_s E(S) = \hat{S}$ for strong positions, and $N_w E(W) = \hat{W}$ for weak positions. As in the case of the conservative firm contract, the increase in UTB is a fraction $1 - H$ of the dollar value for positions with strong support, a fraction $1 - L$ of the dollar value for positions with weak support, and a fraction $1 - Q$ of the dollar value for positions with with zero support. Therefore, the optimal contract offered by the aggressive firm solves the following program:

$$\min_{F,B,P} \quad \{F + B(\hat{S} + \hat{W}) - P[(1 - E[H])\hat{S} + (1 - E[L])\hat{W}]\}$$

$$\begin{aligned}
\text{s. t.} \quad & F + B(\hat{S} + \hat{W}) - P[(1 - E[H])\hat{S} + (1 - E[L])\hat{W}] - c \geq U && (PC) \\
& F + B(\hat{S} + \hat{W}) - P[(1 - E[H])\hat{S} + (1 - E[L])\hat{W}] - c \geq F && (IC1) \\
& B - P(1 - E[H]) \geq 0 && (IC2) \\
& B - P(1 - E[L]) \geq 0 && (IC3) \\
& B - P(1 - E[Q]) \leq 0 && (IC4)
\end{aligned}$$

The difference between this program and the preceding program is that the aggressive firm must give the manager an incentive to take the tax-reporting position when the facts are weak (see (*IC*3)). We present a solution to this problem in Proposition 2.

PROPOSITION 2. *The following contract is optimal for an aggressive firm:*

$$F = U$$

$$\frac{c(1 - E[Q])}{(E[H] - E[Q])\hat{S} + (E[L] - E[Q])\hat{W}} \leq B \leq \frac{c(1 - E[L])}{(E[H] - E[L])\hat{S}}$$

$$P = \frac{B(\hat{S} + \hat{W}) - c}{(1 - E[H])\hat{S} + (1 - E[L])\hat{W}}$$

The expected cost of compensation is $U + c$.

Substituting the values of F, B, and P into the constraints shows that all the constraints are satisfied. The fact that the expected cost is $U + c$ implies that the contract is optimal. Substituting the upper and lower bounds on B into the expression for P yields upper and lower bounds for the penalty of

$$\frac{c}{(E[H] - E[Q])\hat{S} + (E[L] - E[Q])\hat{W}} \leq P \leq \frac{c}{(E[H] - E[L])\hat{S}}.$$

Unlike the contract used by the conservative firm, the bonus and penalty have both upper and lower bounds. The upper bounds are needed to ensure that the manager claims the tax benefit when the position is weak; the lower bounds are needed to ensure that the manager does not claim the tax benefit when the position has zero support.

As in the case of the conservative firm, the bonus and penalty rates reflect the informativeness of the financial reporting of uncertain tax positions. The upper bounds reflect $E[H] - E[L]$; the lower bounds reflect both the extent to which the financial reporting of uncertain tax positions distinguishes between positions with strong and zero support ($E[H] - E[Q]$), and the extent to which it distinguishes between positions with weak and zero support ($E[L] - E[Q]$). In addition, the bounds of the bonus rate B reflect $E[L]$ and $E[Q]$, the expected reduction in book-tax expense per dollar of tax benefit claimed for uncertain tax positions for which no reduction should be claimed under FIN 48.

Comparing the bounds on the bonus and the penalty rates for the two contracts shows that both the bonus rate B and the penalty rate P are larger in the contract used by the conservative firm in Proposition 1 than they are in the contract used by the aggressive firm in Proposition 2. Therefore, the manager of the conservative firm faces a more "high-powered" incentive arrangement than does the manager of the aggressive firm. The aggressive firm can have weaker incentives in its optimal contract because it only wants to deter the manager from taking tax positions that have zero support, whereas the conservative firm wants to deter the manager from taking tax positions unless they have strong support.

We conclude this section by discussing how contracting is affected by financial reporting errors. For both types of firms, financial reporting errors have ambiguous effects on the bonus and penalty rates needed to induce the manager to take the desired actions. Overstatements of the tax benefit for uncertain tax positions that the firm wants the manager to take (i.e., increasing $E[H]$ for conservative firms and increasing $E[H]$ or $E[L]$ for aggressive firms) reduces the minimum required bonus and penalty rates. Less high-powered incentives are needed because it is easier to motivate the manager to take the positions that the firm wants to take. In contrast, overstatements of the tax benefit for uncertain tax positions that the firm does not want the manager to take (i.e., increasing $E[L]$ or $E[Q]$ for conservative firms and increasing $E[Q]$ for aggressive firms), weakly increases the minimum required bonus and penalty rates. More high-powered incentives are needed because it is more difficult to deter the manager from taking uncertain tax positions that the firm does not want to take. Combined, these results imply that for both types of firms, financial reporting errors have ambiguous effects on the optimal contract.

5. Measuring tax aggressiveness

In this section, we consider the relations between tax aggressiveness and two financial accounting measures, the UTB and CTP, from the perspective of a researcher who observes aggregate financial statement disclosures, but not specific transactions. We ask whether the UTB or CTP is a better measure of tax aggressiveness. Recent empirical literature often measures tax aggressiveness as the GAAP or CASH ETR over multiple years (see, e.g., Dyreng et al. 2010). Aggregating these measures over multiple years reduces noise. When the time period over which they are aggregated is sufficiently long, aggregate book-tax expense and aggregate CTP will be similar because they will predominantly reflect the effect of resolved positions. We, therefore, focus our analysis on the comparison between long-term CTP and the UTB.

We consider a firm facing similar tax-planning opportunities each period. All the tax-planning opportunities we consider generate permanent book-tax differences. For expositional purposes only, we consider the case in which uncertain tax positions generated in one period are resolved in the next period. The levels of detail regarding CTP and UTB are different. The disclosure of CTP does not allow the researcher to separate changes due to new positions taken from changes due to the resolution from prior year positions; only the net change in CTP is observable. In contrast, the disclosure of UTB does allow the researcher to separate changes due to new positions taken from changes due to the resolution from prior year positions. The gross increase in UTB, a balance sheet measure, is disclosed in the footnotes to the financial statements.[5] We, therefore, let ΣCTP denote the aggregate change in CTP in periods $\{t, t+1, \ldots, t+J\}$ due to the net effect of the generation of new positions in these periods, and resolutions of positions taken in periods $\{t-1, t, \ldots, t+J-1\}$. We let ΣUTB reflect the aggregate increase in the UTB in periods $\{t, t+1, \ldots, t+J\}$ from the generation of new uncertain tax positions taken in these periods. We rank the two accounting measures of tax aggressiveness that we consider in terms of how sensitive these measures are as to whether a firm is conservative or aggressive.

Measuring the sensitivity of tax aggressiveness measures

For each measure $M \in \{\Sigma CTP, \Sigma UTB\}$, we let M_A denote the value of the measure for an aggressive firm, and let M_C denote the value of the measure for a conservative firm. A measure is more sensitive to tax aggressiveness if the probability that the measure yields a higher outcome for aggressive firms than for conservative firms is higher, that is, if

$$\Pr(M_A > M_C) = \Pr(M_A - M_C > 0),$$

is higher.

Because all firms face many independent opportunities, the measures M_A and M_C are independent and approximately normally distributed. Therefore, the difference $M_A - M_C$ has a normal distribution with mean $\mu(M_A - M_C) = \mu(M_A) - \mu(M_C)$ and with standard deviation $\sigma(M_A - M_C)$. This implies that:

5. The gross increase in *UTB* reported in the firm's financial statements includes both permanent and temporary differences; our model only considers transactions that create permanent differences.

$$\Pr(M_A > M_C) = \Pr\left(\frac{M_A - M_C - \mu(M_A - M_C)}{\sigma(M_A - M_C)} > \frac{-\mu(M_A - M_C)}{\sigma(M_A - M_C)}\right), \\ \approx \Pr\left(Z > \frac{-\mu(M_A - M_C)}{\sigma(M_A - M_C)}\right), \tag{4}$$

where Z is a standard normal random variable. Therefore, we define the sensitivity to tax aggressiveness of measure M by

$$S(M) = \frac{\mu(M_A - M_C)}{\sigma(M_A - M_C)} = \frac{\mu(M_A) - \mu(M_C)}{\sqrt{V(M_A) + V(M_C)}}, \tag{5}$$

Note that $S(M)$ is the signal-to-noise ratio of $M_A - M_C$.

A larger mean difference increases the sensitivity to tax aggressiveness, because it implies that in expectation the measure will be higher for an aggressive firm than for a conservative firm. In contrast, a higher variance implies that there is more noise in the measure, which makes it more difficult to distinguish aggressive and conservative firms.

We first determine the sensitivity of ΣCTP. In the multiperiod setting we consider, ΣCTP reflects the aggregate net reduction in CTP in the periods $\{t, t + 1, \ldots, t + J\}$ of all uncertain positions taken in these periods, and the resolution of all positions taken in periods $\{t - 1, t, \ldots, t + J - 1\}$. Because there are N_ϕ positions of strength $\phi \in \{s, w\}$ available each period, ΣCTP reflects the effect of N_ϕ positions for which only the resolution is included in the data set (because the generation occurred in period $t - 1$), $j{\cdot}N_\phi$ positions for which both the generation and the resolution are included in the data set (because they were generated in periods $\{t, t + 1, \ldots, t + J - 1\}$), and N_ϕ positions for which only the generation is included in the data set (because they were generated in the last measurement period $t + J$). We let $\Delta CTP_{\phi,\text{res}}$ denote the change in CTP due to the resolution of a position of strength ϕ, $\Delta CTP_{\phi,\text{net}}$ denote the net effect of the generation and the resolution of a position of strength ϕ, and $\Delta CTP_{\phi,\text{new}}$ denote the effect of the generation of a new position of strength ϕ. Then, the mean and the variance of the aggregate change in CTP when positions of strength ϕ are taken are given by

$$N_\phi \cdot \mu(\Delta CTP_{\phi,\text{res}}) + J \cdot N_\phi \cdot \mu(\Delta CTP_{\phi,\text{net}}) + N_\phi \cdot \mu(\Delta CTP_{\phi,\text{new}}), \tag{6}$$

$$N_\phi \cdot V(\Delta CTP_{\phi,\text{res}}) + J \cdot N_\phi \cdot V(\Delta CTP_{\phi,\text{net}}) + N_\phi \cdot V(\Delta CTP_{\phi,\text{new}}). \tag{7}$$

We first determine the mean and the variance of the change in CTP due to a single new position, a single resolved position, and the net effect of a new position and its resolution in the next year, for strong and weak positions, respectively. The results are displayed in Table 2.

The numerator of $S(CTP)$ reflects the expected difference between ΣCTP for aggressive and conservative firms, that is, the mean of $\Sigma CTP_A - \Sigma CTP_C$. As both conservative and aggressive firms take strong positions, but only aggressive firms take weak positions, this expected difference reflects the expected net change in CTP due to N_w weak positions taken by the aggressive firm each period, that is, it reflects the expectation from (6) for weak positions. The denominator of $S(CTP)$ reflects the standard deviation of $\Sigma CTP_A - \Sigma CTP_C$, which is equal to $\sigma(\Sigma CTP_A - \Sigma CTP_C) = \sqrt{V(\Sigma CTP_A) + V(\Sigma CTP_C)}$. Because both firms take all strong positions and the aggressive firm in addition takes all weak positions, $V(\Sigma CTP_A) + V(\Sigma CTP_C)$ equals twice the variance from (7) for strong positions plus the variance from (7) for weak positions. Using (6), (7), and Table 2 yields that the sensitivity of ΣCTP equals:

TABLE 2
Mean and variance of ΔCTP for a single position

Strength	$\phi = s$	$\phi = w$
$\mu(\Delta CTP_{\phi,\text{new}})$	$E[S]$	$E[W]$
$\mu(\Delta CTP_{\phi,\text{res}})$	$-E[1 - T_s]E[S]$	$-E[1 - T_w]E[W]$
$\mu(\Delta CTP_{\phi,\text{net}})$	$E[T_s]E[S]$	$E[T_w]E[W]$
$V(\Delta CTP_{\phi,\text{new}})$	$V[S]$	$V[W]$
$V(\Delta CTP_{\phi,\text{res}})$	$V[(1 - T_s)S]$	$V[(1 - T_w)W]$
$V(\Delta CTP_{\phi,\text{net}})$	$V[T_sS]$	$V[T_wW]$

Notes:

The first three rows show the mean of the change in cash taxes paid due to the generation of an uncertain tax position ($\mu(\Delta CTP_{\phi,\text{new}})$), the resolution of an uncertain tax position ($\mu(\Delta CTP_{\phi,\text{res}})$), and the net effect of the generation and the resolution ($\mu(\Delta CTP_{\phi,\text{net}})$). The last three rows show the corresponding variances. The $\phi = s$ ($\phi = w$) column corresponds to positions with strong (weak) support.

$$S(CTP) = \frac{(J+1)\cdot N_w \cdot E(T_w)\cdot E(W)}{\sqrt{\begin{array}{l}2N_s\{V(S) + J\cdot V(T_sS) + V[(1-T_s)S]\}\\ \quad + N_W\{V(W) + J\cdot V(T_wW) + V[(1-T_w)W]\}\end{array}}}. \tag{8}$$

We now determine the sensitivity of ΣUTB. For an aggressive firm, the aggregate increase in the UTB in periods $\{t, t + 1, \ldots, t + J\}$ reflects the effect of the generation of $(J + 1) \cdot N_s$ new strong positions and $(J + 1) \cdot N_w$ new weak positions; for a conservative firm, it reflects the effect of the generation of $(J + 1) \cdot N_s$ new strong positions. The mean and the variance of the aggregate increase in the UTB due to the generation of $(J + 1) \cdot N_\phi$ positions of strength ϕ are given by

$$(J+1)\cdot N_\phi \cdot \mu(\Delta UTB_{\phi,\text{new}}), \tag{9}$$

$$(J+1)\cdot N_\phi \cdot V(\Delta UTB_{\phi,\text{new}}), \tag{10}$$

where $\Delta UTB_{\phi,\text{new}}$ denotes the increase in the UTB due to the generation of a single new position of strength ϕ. In Table 3, we illustrate the mean and variance of the increase in UTB due to the generation of a single strong and weak position for aggressive and conservative firms.

TABLE 3
Mean and variance of ΔUTB for a single position

Strength	$\phi = s$	$\phi = w$
$\mu(\Delta UTB_{\phi,\text{new}})$	$(1 - E[H])E[S]$	$(1 - E[L])E[W]$
$V(\Delta UTB_{\phi,\text{new}})$	$V[(1 - H)S]$	$V[(1 - L)W]$

Notes:

The first row shows the mean of the unrecognized tax benefit for an uncertain tax position of strength ϕ ($\mu(\Delta UTB_{\phi,\text{new}})$). The second row shows the corresponding variance. The $\phi = s$ ($\phi = w$) column corresponds to positions with strong (weak) support.

The numerator of $S(UTB)$ reflects the mean of $\Sigma UTB_A - \Sigma UTB_c$, which is equal to the expected aggregate UTB recorded by aggressive firms for weak positions, that is, the expectation from (9) for weak positions. The denominator reflects the the standard deviation of $\Sigma UTB_A - \Sigma UTB_C$, which is equal to $\sqrt{V(\Sigma UTB_A) + V(\Sigma UTB_C)}$. The aggregate variance of all positions taken by the aggressive and the conservative firm is equal to twice the variance from (10) for strong positions plus the variance from (10) for weak positions. Using (9), (10), and Table 3 yields that the sensitivity of ΣUTB equals:

$$S(UTB) = \frac{\sqrt{J+1}N_w[1-E(L)]E(W)}{\sqrt{2N_sV[(1-H)S] + N_wV[(1-L)W]}}. \tag{11}$$

The sensitivity measures $S(CTP)$ and $S(UTB)$ are both positive. It, therefore, follows from (4) that for both measures, the probability that the measure has a higher value for an aggressive firm than for a conservative firm is higher than 50 percent, so that they both capture tax aggressiveness to some extent. We note that ΣUTB is informative regarding whether a firm is aggressive or conservative even when the financial reporting does not distinguish between strong and weak positions, that is, when $L = H$. This occurs because ΣUTB is informative regarding firm type if and only if ΣUTB in expectation is higher for aggressive firms than for conservative firms (because then $S(UTB)$ is strictly positive). This holds true if the expected fraction of the tax benefit for which aggressive firms record a UTB for weak positions is positive, that is, if $E(L) < 1$.

Ranking the measures

In this subsection, we show how $S(UTB)$ and $S(CTP)$ are affected by the effectiveness of the audit process, as measured by the probability that the tax authority detects and successfully challenges uncertain tax positions, and by the quality of financial reporting, as measured by the probability of noncompliance with FIN 48. The effectiveness of the audit process affects $S(CTP)$ but not $S(UTB)$. The quality of financial reporting affects $S(UTB)$ but not $S(CTP)$.

The following proposition shows that ΣCTP becomes a less sensitive measure as the probability that the tax authority detects and successfully challenges uncertain tax positions (η) increases. This, in turn, implies that ΣUTB is the better measure for sufficiently high values of η. We let $\eta_{\max} = 1/(1 - E[X_w])$ denote the upper bound on η from (2).

PROPOSITION 3. *$S(CTP)$ is decreasing in η, and there exists an $0 \leq \hat{\eta} < \eta_{\max}$ such that:*

(a) $S(CTP) > S(UTB)$ if $\eta < \hat{\eta}$;

(b) $S(CTP) < S(UTB)$ if $\eta > \hat{\eta}$.

Proposition 3 shows that the sensitivity of ΣCTP is monotonically decreasing in η. The reason is that when the probability of detection is higher, in expectation a larger fraction of the reduction in CTP originally claimed for weak positions by the aggressive firms will not be retained upon audit. This implies that the expected difference in ΣCTP between aggressive and conservative firms (the numerator of $S(CTP)$) decreases. Although an increase in the detection probability can also decrease the noise in the difference in ΣCTP between aggressive and conservative firms (the denominator of $S(CTP)$), the effect of a lower expected difference always dominates. This implies that the two measures can be ranked unambiguously based on η. Because $S(UTB)$ is not affected by η, and $S(CTP)$ is monotonically decreasing in η and equal to zero when $\eta = \eta_{\max}$, it holds that ΣUTB is the better measure if the detection rate is sufficiently high.

In contrast, the effect of the degree of compliance with FIN 48 on the ranking of $S(UTB)$ and $S(CTP)$ is ambiguous. A lower degree of compliance with FIN 48 decreases the expected difference in ΣUTB between aggressive and conservative firms, but it can also decrease the noise in the difference. In contrast to the effect of η, which effect is dominant is ambiguous in this case. Therefore, ΣUTB is not necessarily a poor measure when financial reporting quality is low, nor is it necessarily a good measure when financial reporting quality is high. We illustrate this with an example. The example also shows how the two measures can be ranked unambiguously in terms of the effectiveness of the audit process (i.e., the detection rate η), as discussed in Proposition 3.

We consider the case in which for positions with strong support, a fraction m of the tax benefit is retained in case of audit, so $X_s = m$; for positions with weak support, the tax benefits are lost in their entirety in case of audit, so $X_w = 0$. For tractability, we assume that the dollar amounts S and W are constants, so $V(S) = V(W) = 0$. The fractions H and L of a tax benefit for which a reduction in book-tax expense is recorded are determined jointly by the rules prescribed by FIN 48 and the extent to which the firm complies with these rules. We assume that with probability $1 - \varepsilon$ the firm complies with FIN 48. Because for strong positions, a fraction m of the tax benefit of retained in case of audit ($X_s = m$), a position with strong support increases UTB by the fraction $1 - m$ of the tax benefit claimed under FIN 48. A position with weak support increases UTB by the full amount of the tax benefit claimed under FIN 48. Hence, the reduction in book-tax expense in case of compliance with FIN 48 is $H = m$ for strong positions and $L = 0$ for weak positions. With probability ε, the firm does not comply with FIN 48. We assume that for tax positions with strong support, the full tax benefit claimed is recognized as a reduction in book-tax expense; uncertain tax positions with weak support are mischaracterized as uncertain tax positions with strong support, reducing book-tax expense by a fraction m of the tax benefit claimed. So, the reduction in book-tax expense in case of noncompliance with FIN 48 is $H = 1$ for strong positions and $L = m$ for weak positions.

We first determine the expressions for $S(CTP)$ and $S(UTB)$ and show how they are affected by the probability that the tax authority detects and successfully challenges uncertain tax positions, η, as well as the probability of financial reporting errors, ε. We then rank the two measures in terms of their sensitivity to tax aggressiveness.

We first determine the sensitivity of ΣCTP. Under the above assumptions, it holds that

$$E[T_w] = 1 - \eta,$$
$$V[T_s S] = V[(1 - T_s)S] = \eta(1 - \eta)(1 - m)^2 S^2,$$
$$V[T_w W] = V[(1 - T_w)W] = \eta(1 - \eta)W^2.$$

Substituting this into the expression for $S(CTP)$ from (8) yields

$$S(CTP) = \frac{\sqrt{(J+1)(1-\eta)}N_w W}{\sqrt{2N_s\eta(1-m)^2S^2 + N_w\eta W^2}} = a\sqrt{\frac{1-\eta}{\eta}}, \tag{12}$$

where $a = \frac{\sqrt{(J+1)}N_w W}{\sqrt{2N_s(1-m)^2S^2 + N_w W^2}} > 0$. Differentiating (12) shows that $S(CTP)$ is monotonically decreasing in η (Proposition 3).

Next, we determine the sensitivity of ΣUTB. The above assumptions imply that $E[L] = \varepsilon m$,

$$V[(1 - H)S] = \epsilon(1 - \epsilon)(1 - m)^2 S^2, \tag{13}$$
$$V[(1 - L)W] = \epsilon(1 - \epsilon)m^2 W^2. \tag{14}$$

Substituting this into the expression for $S(UTB)$ from (11) yields

$$S(UTB) = \frac{\sqrt{(J+1)}N_w(1-\epsilon m)W}{\sqrt{2N_s\epsilon(1-\epsilon)(1-m)^2S^2 + N_w\epsilon(1-\epsilon)m^2W^2}} = b\frac{(1-\epsilon m)}{\sqrt{\epsilon(1-\epsilon)}} \tag{15}$$

where $b = \frac{\sqrt{(J+1)}N_w W}{\sqrt{2N_sS^2(1-m)^2+N_w W^2m^2}} > 0$. Differentiating (15) shows that the effect of ε on $S(UTB)$ is not monotone in this example. The first derivative of $S(UTB)$ with respect to ε is positive for ε > 1/(2 − m) and negative for ε < 1/(2 − m). This implies that Σ*UTB* is more sensitive to tax aggressiveness for values of ε sufficiently close to zero or one than it is for intermediate values of ε. To understand the intuition, suppose for example that ε = 1, that is, all firms always misreport. Then, Σ*UTB* is a perfect measure of tax aggressiveness because the Σ*UTB* recorded by an aggressive firm is always positive, whereas the Σ*UTB* recorded by a conservative firm is always zero. For intermediate values of ε, however, some firms will comply with FIN 48 whereas others will not. In that case, Σ*UTB* is no longer a perfect measure because the *UTB* recorded by a conservative firm that complies with FIN 48 can be higher than the *UTB* recorded by an aggressive firm that does not comply with FIN 48. Hence, intermediate values of ε increase the noise in Σ*UTB* in this case, making it a less sensitive measure.

We conclude by showing how $S(UTB)$ and $S(CTP)$ can be ranked. Comparing the expressions for $S(UTB)$ and $S(CTP)$ shows that $S(UTB) > S(CTP)$ if and only if

$$\eta > \hat{\eta} = \frac{\epsilon(1-\epsilon)}{\epsilon(1-\epsilon) + \left(\frac{b}{a}\right)^2(1-\epsilon m)^2} \in [0,1]. \tag{16}$$

Therefore, (16) shows that the ranking of the two measures is monotone in the detection rate η. For any given degree of noncompliance with FIN 48 (i.e., for any value of ε), Σ*UTB* is the better measure if and only if η is sufficiently high (Proposition 3). In contrast, because $S(UTB)$ is not monotone in ε, the effect of the degree of noncompliance with FIN 48 on the ranking between the two measures can be nonmonotone. For sufficiently small values of η, (16) is satisfied when ε is either close to zero or close to one, but not for intermediate values of ε. Therefore, when η is small, the ranking of the two measures is not monotone in ε; Σ*UTB* is the better measure for sufficiently low and sufficiently high values of ε, and Σ*CTP* is the better measure for intermediate values of ε.

The example considered a setting in which there is no uncertainty regarding the dollar amounts of strong and weak positions, and noncompliance with FIN 48 results in understatement of the UTB. In the more general case in which there is variation in the dollar amounts of weak and strong positions (i.e., when $V(S) > 0$ and $V(W) > 0$), and in which noncompliance with FIN 48 may result in overstatement of the UTB, the expressions for $S(UTB)$ and $S(CTP)$ become more complex. However, the qualitative result that a higher degree of noncompliance can make Σ*UTB* a better measure still holds. Depending on the degree of noise in the recorded UTBs, it is possible for $S(UTB)$ to be either nonmonotone, monotonically increasing, or monotonically decreasing in ε. Hence, in contrast to what is sometimes assumed in empirical literature (e.g., Cazier et al. 2009; Lisowsky et al. 2013), our results suggest that the informativeness of the *UTB* with respect to tax-reporting aggressiveness does not necessarily decrease when the quality of financial reporting decreases.

We conclude by discussing the implications of our results. Our results show that both measures are sensitive to tax aggressiveness. Which of the two measures is better able to distinguish aggressive and conservative firms is context-specific. The effectiveness of the audit process affects ΣCTP but not ΣUTB. The quality of financial reporting affects ΣUTB but not ΣCTP. Our results show that when the probability that the tax authority successfully challenges uncertain tax positions is high, ΣCTP becomes less suitable, and so ΣUTB is more likely to be the better measure for tax aggressiveness. Our results also suggest that financial reporting quality is not a suitable criterion to select one of the measures. The UTB is not necessarily a good measure when financial reporting quality is high, nor is it necessarily a poor measure when financial reporting quality is low. These results suggest that for samples with firms that are heterogeneous with regard to the effectiveness of the audit process or the quality of the financial reporting, it is unlikely that either of the two measures would uniformly be the better proxy for tax aggressiveness. Because both measures capture tax aggressiveness to some extent, it is useful to check the robustness of the results by using both measures.

6. Conclusions

Prior tax research has clearly established the importance of financial reporting effects of tax-reporting decisions. This study shows that a compensation system that rewards tax managers for tax-reporting positions that decrease CTP, and penalizes tax managers for increasing the liability for UTB, provides the right incentives for a tax manager. Specifically, the system induces an effort-averse manager to work hard to identify and evaluate tax-saving reporting positions, and take the positions that the firm prefers, while at the same time refraining from taking positions that the firm finds unattractive due to the possibility of future penalties and the nontax costs of detected tax aggressiveness. The use of financial accounting measures of tax expense allows the firm to efficiently attain the level of tax avoidance it prefers, despite the fact that the consequences of the tax reporting decision will occur in the future.

Although our study has focused on the use of accounting accruals for motivating tax managers to take the uncertain tax positions that the firm desires, our approach applies more generally to the use of accounting accruals in a variety of contracting settings. For example, a manager who is responsible for extending credits to customers could be evaluated both on sales revenue and the bad debt expense associated with current year sales in order to encourage a preferred level of aggressiveness when extending credit.

This study also investigates the extent to which two financial reporting measures of tax avoidance are sensitive to a firm's level of tax aggressiveness. The two measures we examine are the reduction in CTP, the basis for the CASH ETR, and the increase in the UTB. We find that neither measure dominates the other. Which measure is more sensitive depends jointly on the likelihood that uncertain tax positions are detected and successfully challenged by the tax authority and the extent to which firms comply with FIN 48. An increase in the ability of the tax authority to detect and successfully challenge uncertain tax positions decreases the sensitivity of the reduction in CTP, whereas an increase in the probability that a firm complies with FIN 48 could increase or decrease the sensitivity of the UTB.

Appendix 1

ϕ: Strength of an uncertain tax position, $\phi \in \{s, w, z\}$
S: Dollar value of a position with strong support
W: Dollar value of a position with weak support
Z: Dollar value of a position with zero support
N_{ϕ}: Number of tax positions of strength ϕ available to the taxpayer during each year
A: Index for an aggressive firm
C: Index for a conservative firm
H: Fraction of tax benefit claimed that reduces book-tax expense for positions with strong support
L: Fraction of tax benefit claimed that reduces book-tax expense for positions with weak support
Q: Fraction of tax benefit claimed that reduces book-tax expense for positions with zero support
F: Fixed salary paid to the tax manager
B: Bonus per dollar of reduced book-tax expense
P: Penalty per dollar of unrecognized tax benefit
c: Personal cost to tax manager of identifying and evaluating all uncertain tax positions available during the year
X_{ϕ}: Tax benefit retained by the taxpayer, given a position of strength ϕ is detected and successfully challenged by the tax authority
η: Probability that an uncertain tax position is detected and successfully challenged by the tax authority
T_{ϕ}: Tax benefit retained by the taxpayer after the uncertainty regarding the tax position of strength ϕ is resolved
$\Delta CTP_{\phi,\text{new}}$: Reduction in cash taxes paid from the generation of an uncertain tax position of strength ϕ
$\Delta CTP_{\phi,\text{res}}$: Reduction in cash taxes paid from the resolution of an uncertain tax position of strength ϕ
$\Delta CTP_{\phi,\text{net}}$: Reduction in cash taxes paid from the net effect of the generation and the resolution of an uncertain tax position of strength ϕ
$\Delta UTB_{\phi,\text{new}}$: Increase in unrecognized tax benefit from the generation of an uncertain tax position of strength ϕ
$\Delta UTB_{\phi,\text{res}}$: Increase in unrecognized tax benefit from the resolution of an uncertain tax position of strength ϕ
ΣCTP_i: The aggregate net change in cash taxes paid during the researcher's measurement period, for firm type $i \in \{A, C\}$
ΣUTB_i: The aggregate gross change in the unrecognized tax benefits during the researcher's measurement period, for firm type $i \in \{A, C\}$
$\mu(M_i)$: Mean of tax aggressiveness measure M for firm type $i \in \{A, C\}$
$V(M_i)$: Variance of tax aggressiveness measure M for firm type $i \in \{A, C\}$
$S(M)$: Sensitivity of tax aggressiveness measure M
J: Number of periods over which a tax aggressiveness measure M is aggregated

Appendix 2

PROOF OF PROPOSITION 3

Because T_{ϕ} is a random variable that equals 1 with probability $1 - \eta$, and equals a draw from X_{ϕ} with probability η, it holds that $E(T_w) = 1 - \eta(1 - E(X_w))$. It, therefore, follows from (8) that $S(CTP) = 0$ at $\eta = \eta_{\max} = 1/(1 - E(X_w))$, and that $S(CTP) > 0$ for $\eta < \eta_{\max}$. Therefore, it is sufficient to show that $S^2(CTP)$ is decreasing in η.

The numerator of $S^2(CTP)$ (from (8)) is given by

$$f(\eta) = [(J+1)N_w[1 - \eta(1 - E(X_w))]E(W)]^2, \tag{B1}$$

which is convex in η. We now show that the denominator of $S^2(CTP)$ is concave in η. Because T_{ϕ} is a random variable that equals 1 with probability $1 - \eta$, and equals a draw from X_{ϕ} with probability η, it follows that

$$V[(1 - T_s)S] = \eta V[(1 - X_s)S] + \eta(1 - \eta)E[(1 - X_s)S]^2$$
$$V[T_s S] = \eta V[X_s S] + (1 - \eta)V(S) + \eta(1 - \eta)E[(1 - X_s)S]^2$$
$$V[(1 - T_w)W] = \eta V[(1 - X_w)W] + \eta(1 - \eta)E[(1 - X_w)W]^2$$
$$V[T_w W] = \eta V[X_w W] + (1 - \eta)V(W) + \eta(1 - \eta)E[(1 - X_w)W]^2.$$

These expressions are concave in η. Because the other terms in the denominator of $S^2(CTP)$ do not depend on η, the denominator of $S^2(CTP)$ is concave in η. Therefore, $S^2(CTP)$ is of the form $f(\eta)/g(\eta)$, where f is convex and g is concave, and the sign of the derivative of $S^2(CTP)$ is the same as the sign of

$$h(\eta) = f'g - g'f.$$

It remains to show that $h(\eta) < 0$ for all η. Differentiating h yields

$$h'(\eta) = f''g - g''f > 0. \tag{B2}$$

Then, it follows from (2) and (B1) that $f(\eta_{\max}) = f(\eta_{\max}) = 0$, and, hence, $h(\eta_{\max}) = 0$. Combined with (B2), this implies that $h(\eta) < 0$ for all $\eta < \eta_{\max}$. Therefore, $S^2(CTP)$ is decreasing in η. Because $S(CTP) > 0$, we can conclude that $S(CTP)$ is decreasing in η.

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