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Tax Disputes – The Role of Technology and Controversy Expertise*

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Abstract

This study investigates how two practices to manage tax risk in firms, namely the use of tax technology for internal information provision and the use of a controversy manager who offers specific expertise in tax disputes, affect two key tax metrics for firms: the probability of unfavorable dispute outcomes and low final tax payments. Building on a Bayesian persuasion model, we find that the controversy manager has a tax reassurance and a tax planning effect. In a given dispute with a strategic tax authority, she directly decreases unfavorable dispute outcomes, which shields the tax manager from the costs of unfavorable outcomes. In equilibrium, the tax manager thus increases his tax planning effort, indirectly increasing the tax dispute probability and making the net effect on unfavorable outcomes ambiguous. Although we show that the controversy manager consistently enhances the probability for low final tax payments, the same is not true for tax technology quality. Taken together, our results indicate that using a controversy manager combined with an intermediate-quality tax technology is often beneficial for firms. Ultimately, the preferred quality depends on the firm's favored metric, tax manager characteristics, and the litigation-friendliness of the tax environment.

Keywords: tax disputes, tax risk management, tax technology, controversy experts, Bayesian persuasion
JEL classification: H25, H26, C72, K34

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1 Introduction

We study how using tax technology and a controversy expert affect a firm's tax planning and reporting, and the resolution of disputes with a tax authority. As tax authorities might disagree with reported tax positions, tax disputes with potentially unfavorable outcomes may emerge. Drawing upon a game-theoretic model with a tax manager engaging in risky tax planning, a controversy manager developing a tax opinion to persuade the tax authority in a tax dispute, and a strategically enforcing tax authority, we investigate how improving a firm's tax technology and employing the controversy manager interact and affect firms' tax outcomes.

This study is important and timely because the number and magnitude of corporate tax disputes have increased considerably in recent years (KPMG 2023; EY 2023; Lindsey et al. 2023), and so have resulting tax risks. Tax disputes entail significant tax risks, due to the unpredictability of their outcomes (Blaufus, Bob, et al. 2016), their financial uncertainties (Nessa et al. 2020; Lindsey et al. 2023), and potential reputational and compliance costs (Graham et al. 2014; Neuman et al. 2020; Brühne and Schanz 2022; Li and Okafor 2024). At the same time, tax risks also involve upside potential (Brühne and Schanz 2022). Thus, tax disputes are partly attributable to firms' attempts to enhance tax performance (e.g., Armstrong et al. 2012; Klassen et al. 2017), as the consistent avoidance of disputes can result in unexploited tax planning opportunities. Consistently, anecdotal and survey evidence highlight the necessity of "building [the] tax controversy department of the future" (EY 2021, p. 4).

Corporate tax disputes and their resolution have gained increased attention in recent years. Mandated tax-related disclosures (Mills et al. 2010; Bozanic et al. 2017; Joshi 2020) and more intensive, targeted risk-based tax audits (Eberhartinger et al. 2022; OECD 2023) have increased the salience of risky tax positions and, in turn, tax authorities' concerns. Alternative instruments to prevent disputes before they emerge, such as "enhanced relationship programs" (e.g., De Simone et al. 2013), advance tax rulings (e.g., Diller, Kortebusch, et al. 2017), and advance pricing agreements (e.g., De Waegenaere et al. 2007), often do not fully shield against tax risk. In addition, tight fiscal and tax authority budgets have put more pressure on tax collection (Nessa et al. 2020; Blaufus, J. Reineke, and Trenn 2023) and have increased the probability of (unilateral) corrections of firms' tax positions (Martini et al. 2025; Diller, Lorenz, et al. 2024).

Compared with civil disputes, tax disputes tend to be more complex, and the burden of proof lies more heavily on the (corporate) taxpayer (Spier 2007; Tran-Nam and Walpole 2012; Tran-Nam and Walpole 2016). Therefore, practices to manage tax risk and improve tax dispute outcomes matter to firms (Brühne and Schanz 2022; Blaufus, J. Reineke, and Trenn 2023). We follow Dyreng and Maydew's (2018) call to look inside the black box of firms' tax strategies. Within tax risk management, two practices have received considerable attention.[1]

As a first practice, firms implement and improve tax technologies generating information about tax positions. We focus on the information provided about *risky* (i.e., uncertain or ambiguous) tax positions that are likely to result in a tax dispute. Consider, for example, a typical risky tax position concerning the deductibility of specific expenses (Mills et al. 2010; De Waegenaere et al. 2015) and the tax technology encompassing (generative) artificial intelligence (Krupa and Mullaney 2024; EY 2024) or a digitized process support (Brühne and Schanz 2022). The tax technology aggregates information and provides a tax manager with a red flag (nondeductible) or a green flag (deductible). The technology could be designed to always indicate a red flag if the slightest tax risk arises, which reduces the likelihood of tax disputes. However, this would also inhibit tax saving opportunities if the tax conditions favor the deductibility. Therefore, in our setting, a low-quality tax technology conservatively indicates unfavorable conditions, while a high-quality tax technology can indicate favorable conditions.

As a second practice, firms can consult controversy managers such as external attorneys or tax advisors, or internal controversy experts. While consulting attorneys or tax advisors has long been a key part of firms' tax controversy strategies (Acito and Nessa 2021; Niemann and Sailer 2023), employing a controversy expert only recently became widespread. KPMG reports that 14% of worldwide firms have appointed a "global head of controversy", noting that this "may become a leading practice in the years to come" (KPMG 2019, p. 9). EY (2023) reports that 50% of worldwide firms had implemented a "tax controversy leader." Additionally, our textual analysis of tax-related job postings from the LinkUp database shows a steady rise in the demand

[1] Brühne and Schanz (2022, p. 35) define tax risk management as the "entirety of corporate practices implemented by a firm to identify, evaluate, manage, mitigate, monitor, and control corporate tax risk and to establish a beneficial internal information environment," including "specific tools, steps, and sub-processes." We focus on two common and recently promoted tax risk management practices that are particularly relevant in tax disputes.

for these positions, increasing from 38 postings in 2016 to 343 in 2023.[2] Anecdotal evidence further underscores the relevance of controversy managers in firms. For example, a tax manager of a U.S. multinational explains:

> If there are indications of a tax dispute that has global relevance and/or requires coordination with other regions/functions, we often involve our Controversy Managers at our parent company in the U.S.
> —Tax manager, U.S. multinational, responsible for Europe, Middle East, and Africa

Controversy managers provide expertise beyond that of common tax managers (KPMG 2016; 2019). In disputes, they conduct in-depth investigations to identify favorable or unfavorable tax conditions underlying risky tax positions, structuring arguments to resolve disputes favorably with tax authorities (Blaufus, Bob, et al. 2016), which is also reflected in our interviews:

> . . . my job is to evaluate . . . how could a court decide this at the end of the day? How strong are our positions? How strong are the objections that are raised? How certain is the law? How certain is the legal basis?
> —Head of Controversy and Litigation, Partner, Tax, Big4

Unlike other tax professionals, controversy managers are strongly committed to disclosing both favorable and unfavorable conditions to maintain their reputation and credibility as mediators between firms and tax authorities.

> . . . I am and remain an organ of the administration of law and justice and for me, the administration of law and justice is also about representing the interests of my clients . . . and that includes having to say no and . . . being able to catch a client and saying, '. . . we can't continue to take this position, . . . the position is a false position.'
> —Head of Controversy and Litigation, Partner, Tax, Big4

We develop a model incorporating both practices. It involves three strategic players: a tax manager (he), a tax authority (it), and a potentially present controversy manager (she). The tax technology provides the tax manager with private information about the underlying tax condition of a risky tax position. The tax manager has an incentive to decrease the reported tax but also suffers disutility if the tax authority later overturns his reported tax. He can exert tax planning effort, facilitating a low tax report even when the technology indicates a high tax.

[2] From 2016 to 2023, we find 1354 job postings with "tax" and "controversy" in the job title, primarily in the U.S. and Canada. The LinkUp database provides daily job posting data scraped directly from firms' websites. For more details, see Giese et al. (2024).

The tax authority always accepts a high report but challenges a low report, which culminates in a tax dispute.[3] When a tax dispute emerges, the controversy manager can investigate and develop a substantiated tax opinion so as to persuade the tax authority to agree with the tax manager's initial low report. She can choose the properties of the investigation, which we model as the distribution of a tax opinion over the underlying tax condition. For example, a completely informative investigation would correspond to a tax opinion that always reveals the underlying tax conditions.[4] Based on the controversy manager's tax opinion, which either supports or refutes the low report, or the absence of a tax opinion, the net revenue-maximizing tax authority strategically decides to accept a low tax or enforce a high one (i.e., enforce aggressively).

To begin, we illuminate the effect of improving the tax technology for the equilibrium strategies. We find that, *without a controversy manager*, improvements decrease the tax authority's enforcement aggressiveness, and, in turn, increase the tax manager's tax planning effort only if a critical technology quality level is exceeded and the environment is litigation-friendly.[5] Otherwise, improving the tax technology has no impact on equilibrium strategies. *With a controversy manager*, improving the technology similarly decreases the tax authority's incentives to enforce aggressively. Consequently, the controversy manager can design her investigation so that her tax opinion more often supports a low tax, increasing the tax manager's tax planning incentives. However, improving technology increases the tax manager's expected enforcement-related costs after a high technology signal, reducing his planning incentive. We show that this second effect dominates, leading, in equilibrium, to a decrease in tax planning effort.

In subsequent analyses, we show how the quality of the tax technology and the presence of a controversy manager affect three corporate tax metrics: tax dispute probability, the probability of unfavorable dispute outcomes, and the probability of low final tax payments. We find that controversy managers tend to "create their own demand": their presence increases the probability of tax disputes by incentivizing the tax manager to engage in more tax planning. This occurs

[3] We could easily extend our model by allowing the tax authority to challenge only a fraction of low reports. Our results would not change qualitatively.

[4] This aligns with other Bayesian persuasion models, e.g., Kamenica and Gentzkow (2011) and Michaeli (2017).

[5] For example, the environment is litigation-friendly for a taxpayer if it provides easy access to the legal system, an appropriate level of the burden of proof (Rhoades 1997; LeBlanc 1998), or effective arbitration procedures (Markham 2018; Martini et al. 2025). In our model, this is parsimoniously represented by the tax authority suffering high costs after falsely enforcing a high tax liability.

because the probability of losing a tax dispute decreases with a controversy manager, reducing the tax manager's marginal costs of tax planning and increasing his effort. From the firm's perspective, this increase in tax manager effort can be beneficial, as the low tax report—despite triggering tax disputes—is key to ultimately achieving a low final tax payment.

Next we demonstrate that the controversy manager generally reduces the probability of unfavorable dispute outcomes. She has a twofold effect. First, she produces a *tax reassurance* effect, which hinders the tax authority from falsely enforcing a high tax liability. Second, she yields a *tax planning* effect, which can persuade the tax authority to accept a low tax liability more often than would align with the ex ante tax condition. Surprisingly, we also identify conditions under which the controversy manager increases unfavorable dispute outcomes. This result arises because the tax dispute (i.e., the persuasion stage) is endogenously determined through the tax manager's effort. While reducing unfavorable dispute outcomes for a given dispute, the controversy manager's presence can increase the tax dispute probability to an extent that overall unfavorable dispute outcomes occur more often. Conditions with low-quality tax technology and high enforcement-related tax manager costs ultimately result in a negative tax planning effect, which outweighs the still positive tax reassurance effect.

In addition, we find that the controversy manager consistently increases the probability of low final tax payments. Intuitively, the higher tax dispute probability (upside potential) outweighs the risk of unfavorable dispute outcomes (downside potential). Due to complex strategic interactions, tax technology quality can increase or decrease all tax metrics, depending on the presence of the controversy manager, tax manager's planning and enforcement-related costs, and the litigation environment. Our key takeaway is that a firm's preferred tax department design is often characterized by an *imperfect* tax technology and a controversy manager.

Lastly, we extend our analyses to allow for private tax authority information in the tax dispute. This is particularly relevant given recent efforts by tax authorities to collect information from sources beyond tax returns (e.g., Bozanic et al. 2017; OECD 2023). Appending our model in the spirit of Alonso and Câmara (2016), we show that the controversy manager adjusts her investigation in response to private tax authority information. For a given dispute, if the tax authority holds low-quality private information, the investigation still avoids voluntary tax

overpayment, but its tax planning property is diluted. For high-quality private information, the investigation additionally involves some voluntary tax overpayment. Thus, private tax authority information tends to increase the tax manager's expected enforcement-related costs, thereby reducing both the tax planning effort and dispute probability. From a policymaker perspective, this suggests that private tax authority information can be an effective instrument to deal with sophisticated controversy experts. In general, our findings without private information should be viewed as an upper bound of the controversy manager's value to a firm.

Our contribution is threefold. First, we contribute to the literature on strategic tax audits (e.g., Graetz et al. 1986; Sansing 1993; De Simone et al. 2013). Two extensions of this literature relate particularly to our study. First, some studies include (potentially strategic) tax advisors who are *assumed* to resolve taxpayer uncertainty (Melumad et al. 1994; Beck, Davis, and Jung 1996; Phillips and Sansing 1998; Kaçamak 2022) or facilitate (aggressive) tax planning (Lipatov 2012; Elitzur and Yaari 2024). Second, few studies explicitly consider tax disputes after a strategic tax reporting stage (Jung 1995; Franzoni 2004; Martini et al. 2025).[6] Following the call for further research on the role of tax advisors (Niemann and Sailer 2023), we add to this literature by examining the role of controversy experts in corporate tax enforcement and provide an *endogenous* explanation for advisors' tax reassurance and tax planning roles.

Second, we contribute to examining the black box of firms' tax departments (Feller and Schanz 2017; Dyreng and Maydew 2018; X. Chen et al. 2021). In our model, we recognize the upcoming role of tax technologies (Hamilton and Stekelberg 2017; Brühne and Schanz 2022; Krupa and Mullaney 2024) and emphasize that tax planning and tax risk management are intertwined through the interaction of strategic tax and controversy managers. Our work thus relates to empirical studies on tax managers' (Armstrong et al. 2012; Feller and Schanz 2017; Li and Okafor 2024) and tax advisors' (Blaufus, Bob, et al. 2016; Kubick et al. 2020; Acito and Nessa 2021; Belnap et al. 2023; Donohoe et al. 2024) crucial role for firms' tax performance. To the best of our knowledge, we are the first to analytically investigate how tax risk management practices interdependently impact firms' tax outcomes.

[6]Tax disputes are also related to auditor-manager disputes (Kronenberger et al. 2023) and civil disputes (Bebchuk 1984; Reinganum and Wilde 1986; Hay 1995). Unlike these dispute studies, we focus on how controversy experts persuade other dispute parties by providing additional information, and consider litigation parsimoniously in the tax authority's payoffs. For a Bayesian persuasion model in a nontax dispute setting, see Hennigs (2021).

Third, we contribute to the Bayesian persuasion literature by being the first to apply the seminal model of Kamenica and Gentzkow (2011) in a corporate tax setting. Like Alonso and Câmara (2016), we also extend our basic setting to allow for private receiver (i.e., tax authority) information in the persuasion stage. Other model applications in corporate contexts deal with agency problems (Jehiel 2015; Göx and Michaeli 2019), selective disclosure of information to multiple parties (Michaeli 2017), voluntary disclosure (Friedman et al. 2020; Friedman et al. 2022), and corporate governance (Gregor and Michaeli 2024). Unlike these applications, we consider that strategic decisions (i.e., risky tax planning effort) can precede the persuasion stage and influence the (potentially heterogeneous) prior at the persuasion stage.

2 Model

We consider three risk-neutral players: a tax manager (he), a controversy manager (she) and a tax authority (it).[7] The tax manager is responsible for tax planning and reports the firm's tax position to the tax authority. The controversy manager (internal or external expert) gets involved if a material tax dispute emerges (KPMG 2016, 2019). Then she becomes responsible for resolving the dispute with a strategic tax authority.[8] Figure 1 shows the sequence of events.

[Figure 1 about here]

Tax conditions At date 0, there is a significant (and representative) tax position, which is characterized by complexity, uncertainty, or ambiguity.[9] A tax position can exhibit these characteristics because tax law and regulations are often unclear and open to interpretation, yielding different tax liabilities (De Simone et al. 2013; De Waegenaere et al. 2015; Diller, Kortebusch, et al. 2017). We restrict the true tax liability of this tax position to be low with probability $\Pr(L) = p \in (0,1)$ or high with $\Pr(H) = 1 - p$. The true tax liability would only be revealed upon (perfect) adjudication, and is ex ante unknown by all players. The binary

[7] Risk neutrality is a common assumption in studies involving three players (Lipatov 2012; Schantl and Wagenhofer 2020; Blaufus, Schöndube, and Wielenberg 2024). It allows us to keep the model tractable and to focus on strategic interactions between the players.

[8] Subsequently, we do not distinguish between internal and external controversy experts, as both share the objective of resolving a tax dispute in the firm's interest once it arises, as specified below.

[9] The assumption of a representative tax position is made for ease of exposition. Typically, there are several (uncertain) tax positions that have to be filed via the tax return (Rhoades 1999; De Simone et al. 2013; De Waegenaere et al. 2015).

representation of the tax position illustrates, for example, uncertainty about whether R&D expenses qualify for a tax credit (De Waegenaere et al. 2015), a tax expense is tax-deductible (Beck and Jung 1989; Sansing 1993; Mills et al. 2010) or about the application of a specific transfer pricing method in an income shifting context (R. Reineke et al. 2023b).

Tax planning and reporting At date 1, the tax manager obtains a private, imperfect signal from the firm's tax technology. For example, the tax technology could reflect (generative) artificial intelligence (Krupa and Mullaney 2024; EY 2024) or a digitized process support (Brühne and Schanz 2022), which aggregates information about the risky tax position. We make three key assumptions related to this technology. First, the tax manager receives the signal at no cost, implying that the costs of generating information are negligible, once the technology is implemented.[10] Second, the quality of the tax technology is observable to all players. This might be a result of experiences from past interactions in tax audits and disputes or the quality may be inferred from a certified tax risk management system (Blaufus, J. Reineke, and Trenn 2023). Third, the technology is conservative: it never indicates a high tax liability as low, $\Pr(l^{tec}|H) = 0$, but it can indicate a low tax liability as high, $\Pr(h^{tec}|L) = 1-q$. Thus, the conservative default signal is h^{tec}. The quality of the technology q reflects its ability to indicate favorable tax conditions $\Pr(l^{tec}|L) = q \in (0,1)$. This quality definition is consistent with empirical evidence suggesting that internal information quality increases tax avoidance, especially in uncertain environments (Gallemore and Labro 2015), and that firms aim to lower their tax payments. We show in Section 4 that—somewhat surprisingly—setting $q = 1$ is not necessarily preferred by firms even though we assume that improving quality q is costless.

The tax manager must submit a report to the tax authority (date 2). He benefits from reporting the low tax L^{TM}. Reasons for this may include a preference for meeting a targeted low effective tax rate (e.g., Armstrong et al. 2012) or reputational concerns arising from the labor market (e.g., Li and Okafor 2024). For ease of exposition, we normalize the tax manager's utility benefit from reporting L^{TM} to one. In contrast, if a tax dispute emerges and the tax authority ultimately enforces the high tax liability (date 5), the tax manager incurs enforcement-related

[10] Costless, private information in tax settings is a standard assumption (e.g., De Waegenaere et al. 2006; Blaufus, Schöndube, and Wielenberg 2024), with a notable exception being De Waegenaere et al. (2015).

costs $\lambda \in (0,1)$. Two interpretations of these costs are possible. First, the tax manager loses his utility benefit, and λ represents a discount factor, due to time gaps between tax reporting and enforcement (Nessa et al. 2020, Lindsey et al. 2023). Second, λ can include costs from correcting the tax return or unfavorable career outcomes for the tax manager, such as turnover while working in the firm or longer employment gaps after exiting it (Li and Okafor 2024).

Given signal l^{tec}, we assume that the cost of reporting L^{TM} is zero. Thus, independent of the tax authority's subsequent enforcement decision, the tax manager reports L^{TM}. However, upon observing h^{tec}, reporting L^{TM} is privately costly for the tax manager and requires a tax planning effort $\alpha \in (0,1)$, which translates into a low report with probability $\Pr(L^{TM}|h^{tec}) = \alpha$. Tax planning costs, $c\alpha^2/2$ with $c > 0$, include expenses related to preparing documentation, organizing majorities, and convincing stakeholders (Feller and Schanz 2017). Assuming convex tax planning costs is common in the literature (Haufler and Schjelderup 2000; Baumann and Friehe 2013; Koethenbuerger et al. 2019, R. Reineke et al. 2023a). Summing up, these assumptions reflect the tax manager's objective to utilize tax saving opportunities but to avoid surprises and disputes (Armstrong et al. 2012; Graham et al. 2014; Klassen et al. 2017).[11]

Tax dispute At date 3, the tax authority observes the reported tax. The tax authority accepts all high reports H^{TM}, because there is nothing to win in a tax dispute. However, the tax authority (exogenously) challenges all low reports L^{TM}. This reflects recent environments with substantial (perceived) audit aggressiveness and scrutiny (Blaufus, J. Reineke, and Trenn 2023; Brühne and Schanz 2022) as well as that the costs of challenging a tax position's assessment are negligible, because in tax disputes, the onus predominantly falls on the taxpayer (Spier 2007; Tran-Nam and Walpole 2016; Lindsey et al. 2023).[12]

[11] We treat the tax manager's objective as given. This comports with studies highlighting tax actors' personal incentives beyond performance-based contracts (Kohlhase and Wielhouwer 2023; Li and Okafor 2024) and the resulting obstacles of these contracts (Li and Okafor 2024; Gregor and Michaeli 2024). Studies that explicitly analyze the role of incentive contracts in tax planning or minimization include K.-P. Chen and Chu (2005), Crocker and Slemrod (2005), and Jacob, Rohlfing-Bastian, and Sandner (2019). Further, a manager's given compensation is also an assumption used in other accounting contexts (Schantl and Wagenhofer 2020; Gregor and Michaeli 2024).

[12] We could allow the tax authority to challenge only a fraction of reports L^{TM}. Since the controversy manager's and the tax authority's strategic decisions occur after L^{TM}, a lower probability only affects the tax manager's effort decision, which is similarly reflected in a decrease in his enforcement-related cost λ.

At date 4, the controversy manager steps in to resolve the tax dispute. The controversy manager's aims at persuading the tax authority to agree with the tax manager's report. She can do so by performing an investigation, which provides additional information to the tax authority that either supports l or refutes h, the tax manager's report. The choice of the investigation can comprise what tax evaluation methods to choose, which comparable court rulings and precedents to check, or which questions to ask the experts in the R&D or accounting departments. Most importantly, we assume that the controversy manager commits to communicate the outcome of her investigation truthfully to the tax authority. In line with other Bayesian persuasion models (e.g., Michaeli 2017; Kamenica 2019), this commitment to the investigation design enables us to focus on the endogenous choice of information quality and provides an upper bound for the effect of a controversy manager. This commitment assumption is consistent with our anecdotal evidence and particularly descriptive of tax dispute settings for at least two reasons. First, controversy managers are typically lawyers, and their professional ethics or bar rules require them to disclose both favorable and unfavorable information. Second, their commitment can come from reputational concerns. As controversy managers frequently interact with the courts, they are keen to avoid any actions that might be viewed as potentially illegal or unethical.

We formalize the controversy manager's dispute resolution decisions as follows. She chooses the probability Δ of conducting an investigation and the investigation's properties. We formalize these properties as distributions $\delta(\cdot|L)$ and $\delta(\cdot|H)$ that generate a tax opinion l or h. Like most Bayesian persuasion models (e.g., Kamenica 2019; Friedman et al. 2020; Gregor and Michaeli 2024), we assume that the investigation is costless.[13] To start, we assume that the controversy manager and the tax authority share a common prior at the dispute stage μ_P that a low tax manager report originates from a low true tax. Heterogeneous priors are analyzed in section 5. The prior at the dispute stage is

$$\mu_P \equiv \Pr\left(L|L^{TM}\right) = \frac{pq + p(1-q)\alpha}{(1-p)\alpha + pq + p(1-q)\alpha}. \tag{1}$$

[13] Introducing fixed investigation costs would not affect the optimal investigation properties and thus the underlying economics (Alonso and Câmara 2016). However, if different investigations (or messages) impose different costs, the properties of the investigation may change (Gentzkow and Kamenica 2014; Michaeli 2017; Nguyen and Tan 2021).

If the tax opinion (or its absence) persuades the tax authority to enforce L^{TA} instead of H^{TA}, the controversy manager obtains a utility $u^{CM}\left(L^{TA}\right) > u^{CM}\left(H^{TA}\right) = 0$.[14] As we will show later, it then suffices to focus on the controversy manager's investigation property choice $\delta \equiv \delta\left(l|H\right)$, as she is always better off to choose $\delta\left(l|L\right) = 1$ (and respectively, $\delta\left(h|L\right) = 0$).

Finally, at date 5, the tax authority observes the controversy manager's tax opinion (or its absence) and ultimately decides on whether to enforce the low or high tax liability. Formally, it chooses a probability $\beta_j \equiv \Pr\left(H^{TA}|j;L^{TM}\right) = \Pr\left(H^{TA}|j\right)$ with $j \in \{l,h,\varnothing\}$, where we drop L^{TM} for ease of notation wherever possible. If the tax authority chooses L^{TA}, it obtains a utility $u^{TA}(L^{TA}) = 0$, irrespective of the true tax liability. If the tax authority chooses H^{TA} and the true tax liability is high, it obtains the disputed value $u^{TA}(H^{TA}|H) = z > 0$, which comprises the difference in tax liabilities and a penalty proportional to the size of under-reporting.[15] However, if the true tax liability is low, the tax authority incurs a disutility $u^{TA}(H^{TA}|L) = -\theta z$. $\theta > 0$ represents the firm's litigation threat.[16] The tax authority's payoff structure acknowledges the common assumption of a net revenue maximizing tax authority when analyzing strategic interactions in tax audits and disputes (Graetz et al. 1986; Franzoni 2004; Diller, Lorenz, et al. 2024).[17] Figure 2 shows the game tree.

[Figure 2 about here]

[14]This simple payoff structure characterizes the "conventional view" (Phillips and Sansing 1998, p. 4) that the advisor's (i.e., controversy manager's) and taxpayer's (here the tax manager's) incentives are aligned. The results also extend to a more general setting that includes shared enforcement-related costs between the tax and controversy manager. For example, suppose that the controversy manager's incentives arise from avoiding enforcement-related costs if the tax authority chooses L^{TA}, that is $u^{CM}(L^{TA}) = 1-\lambda$ or, if proportional to the disputed value, $(1-\lambda)z$. As can be observed from equation (6), her dispute resolution decisions are independent of these specifications. If the tax manager's enforcement-related costs would increase in the disputed value (λz), we would only require $\lambda z \leq 1$, so that the tax manager always exerts some tax planning effort. Other than that, shared enforcement-related costs are reflected in variations of λ.

[15]If the tax authority incurs nonreimbursable costs when enforcing H^{TA}, z would be the disputed value net of these nonreimbursable costs.

[16]Although we abstain from modeling litigation explicitly, θ captures litigation parsimoniously. Suppose that the firm would litigate the case with an exogenous probability η and that the tax authority's and the firm's (potentially reimbursable) litigation costs are a share of the disputed value ($\kappa^F z$ and $\kappa^{TA} z$). Then, $u^{TA}\left(H^{TA}|L\right) = -z\left(\eta\left(1+\kappa^{TA}+\kappa^F\right)-1\right) = -z\theta^{Eu}$ under the English rule and $u^{TA}\left(H^{TA}|L\right) = -z\left(\eta\left(1+\kappa^{TA}\right)-1\right) = -z\theta^{Am}$ under the American rule. In particular, $\theta^{Eu}, \theta^{Am} > 0$ implicitly requires that the tax authority's expected litigation costs are sufficiently high so that it cares about the true tax liability.

[17]Our results also extent to a setting in which the tax authority only cares about fair taxation, that is, $u^{TA}\left(L^{TA}|L\right) = u^{TA}\left(H^{TA}|H\right) > u^{TA}\left(L^{TA}|H\right) = u^{TA}\left(H^{TA}|L\right) = 0$, or combinations of net revenue maximization and fair taxation.

3 Equilibrium

In this section, we characterize the equilibrium strategies of the tax manager, the potentially involved controversy manager, and the tax authority. We solve the game by backward induction, starting with the tax authority's enforcement decision, then determining the controversy manager's dispute resolution decisions, and finally the tax manager's tax planning effort. All formal proofs are given in the Appendix.

3.1 Tax authority's enforcement decision

The tax authority has no strategic decision to make after the tax manager reports H^{TM}, as this is already its preferred outcome. However, after having observed L^{TM}, the tax authority updates its belief that it would succeed in potential litigation. Thus, conditional on the presence or absence of the controversy manager's tax opinion $j \in \{l, h, \varnothing\}$, the tax authority chooses the probability of enforcing a high tax liability $\beta_j \equiv \Pr\left(H^{TA}|j\right) \in [0,1]$. It solves

$$\max_{\beta_j} \ \beta_j \left[\Pr\left(H|j\right) z - \left(1 - \Pr\left(H|j\right)\right) \theta z\right]. \tag{2}$$

Absent a tax opinion ($j = \varnothing$), enforcing the high tax is beneficial with conditional probability

$$\Pr\left(H|\varnothing\right) \equiv 1 - \mu_P = \frac{(1-p)\alpha}{(1-p)\alpha + pq + p\left(1-q\right)\alpha}. \tag{3}$$

Thus, when $j = \varnothing$, the tax authority's prospects of choosing H^{TA} increase in the tax planning effort α and decrease in the tax technology quality q. Note that, if the enforcement decision absent a tax opinion is $\beta_\varnothing = 0$, independent of the level of tax planning effort, there is no room for the controversy manager to improve the dispute's outcome. In that case, the tax authority already chooses the controversy (and tax) manager's preferred enforcement decision. To rule out this uninteresting case, we make the following assumption.

Assumption 1. *The firm's litigation threat is not too high; that is,* $\theta < \frac{1-p}{p}\frac{1}{c} \equiv \overline{\overline{\theta}}$.

If the tax authority receives a tax opinion l or h, it considers how the controversy manager designs the properties of her investigation $\delta\left(\cdot|L\right)$ and $\delta\left(\cdot|H\right)$. Then enforcing the high tax is

beneficial with conditional probability

$$\Pr(H|j) = \frac{(1-\mu_P)\,\delta(j|H)}{(1-\mu_P)\,\delta(j|H) + \mu_P \delta(j|L)} \text{ with } j \in \{l,h\}. \tag{4}$$

Intuitively, the higher the conditional probability $1-\mu_P$ that enforcing H^{TA} is beneficial *before* receiving a tax opinion, the higher is the conditional probability $\Pr(H|j)$ that enforcing H^{TA} is beneficial *after* tax opinion l or h. As tax planning effort α increases and tax technology quality q decreases $1-\mu_P$, the probability $\Pr(H|j)$ also (weakly) increases in α and decreases in q with a tax opinion. The direct effect of tax technology quality q comports with regulatory proposals encouraging firms to improve their information generation processes as part of their internal controls (De Simone et al. 2013; Blaufus, J. Reineke, and Trenn 2023), which might result in less enforcement scrutiny. However, in this study, we additionally scrutinize the indirect effect of q on the controversy manager's dispute resolution decisions and, in turn, the tax authority's enforcement decision.

3.2 Controversy manager's dispute resolution decisions

The controversy manager's dispute resolution decisions consist of the probability of conducting an investigation and the properties of the investigation. As highlighted above, each tax opinion leads to a posterior belief (equation 4), and thus the properties of the investigation create a distribution over posterior beliefs. The controversy manager designs the properties of the investigation such that it is Bayes-plausible; that is, the expected posterior distribution equals the prior (e.g., Kamenica and Gentzkow 2011; Michaeli 2017).

It is always optimal for the controversy manager to choose the property $\delta(h|L) = 0$ when investigation precision is costless. Then the tax authority can be sure that the tax opinion h stems from a high true tax liability, implying no litigation threat and thus $\beta_h = 1$. Thus, we can restrict our focus to the controversy manager's choice of the property $\delta \equiv \delta(l|H)$. The controversy manager's objective function is given by

$$\max_{\Delta,\delta} \; u^{CM}(L^{TA}) \cdot \left[\Delta\left(\left(\mu_P + (1-\mu_P)\,\delta\right)(1-\beta_l)\right) + (1-\Delta)(1-\beta_\varnothing)\right]. \tag{5}$$

Then the properties of the optimal investigation can be shown to be as follows.

Lemma 1. *The controversy manager chooses* $\delta(l|L) = 1$ *and* $\delta \equiv \delta(l|H) = \theta \frac{\mu_P}{1-\mu_P}$.

The investigation properties in Lemma 1 structurally resemble those obtained in other persuasion models with a binary state (e.g., Friedman et al. 2022). However, in contrast to most other applications, δ depends on the prior $\mu_P(\alpha)$, which endogenously arises in the tax planning and reporting stage. If the tax planning effort and thus $1-\mu_P(\alpha)$ is very high ($\mu_P \to 0$), the investigation becomes perfectly informative ($\delta \to 0$).[18] By contrast, if $1-\mu_P(\alpha)$ is sufficiently low ($\mu_P \to \frac{1}{1+\theta}$), the investigation almost always leads to tax opinion l ($\delta \to 1$). The controversy manager chooses δ such that the tax authority is just willing to choose L^{TA} when observing l (i.e., $\beta_l = 0$).[19] Note that, if $\delta = 1$, the investigation is completely uninformative for the tax authority. Then the controversy manager is indifferent between conducting an investigation or not, and we follow the convention to focus on pure strategies $\Delta \in \{0,1\}$, with $\delta = 1$ implying $\Delta = 0$.[20] Considering Lemma 1, the controversy manager's optimization problem simplifies to

$$\max_{\Delta} \; u^{CM}(L^{TA}) \cdot [\Delta \mu_P (1+\theta)(1-\beta_l) + (1-\Delta)(1-\beta_\varnothing)]. \tag{6}$$

3.3 Tax manager's tax planning effort

The tax manager always reports L^{TM} if the tax technology generates a low signal l^{tec}, as he is always better off to report L^{TM}, independent of the tax authority's enforcement decision. If the tax technology generates a high signal h^{tec}, he has an incentive to engage in tax planning, which succeeds with probability $\Pr\left(L^{TM}|h^{tec}\right) = \alpha$ and involves tax planning costs $c\alpha^2/2$. However, if the tax manager reports L^{TM} and the tax authority enforces the high tax H^{TA}, the tax manager incurs enforcement-related costs $\lambda \in (0,1)$. Without a controversy manager's investigation, the tax manager incurs these costs with probability $(1-\Delta)\beta_\varnothing$. Further, the tax manager considers

[18] The Bayesian persuasion framework implies that a fully informative investigation about the true tax liability is feasible. However, one can reinterpret this liability to be the best estimate *any* expert could generate without requiring the feasibility of an arbitrarily precise investigation (Kamenica and Gentzkow 2011; Kamenica 2019).

[19] Formally, $\beta_l = 0$ would require that the controversy manager chooses $\delta = \theta \frac{\mu_P}{1-\mu_P} - \varepsilon$, with $\varepsilon > 0$ being arbitrarily small. We drop $\varepsilon > 0$, which corresponds to the approach of Kamenica and Gentzkow (2011).

[20] Focusing on "informative signal[s]" (Kamenica and Gentzkow 2011, p. 2591) is common in Bayesian persuasion settings. We thus exclude mixed strategies where the controversy manager arbitrarily conducts uninformative investigations $\Delta \in (0,1]$ and $\delta = 1$, which do not change equilibrium outcomes compared to pure strategy $\Delta = 0$. See also the discussion on (non)genuine mixed strategies in Wagenhofer (1990).

that the controversy manager's tax opinion is tied to the true tax liability (see Lemma 1), and that the tax authority's responses are $\beta_l = 0$ and $\beta_h = 1$. Then the tax manager only needs to worry about situations that occur with probability $\Pr(h^{tec}|H)(1-\delta)$.

Overall, conditional on h^{tec}, the tax manager chooses the tax planning effort solving

$$\max_{\alpha} \ \alpha - \alpha\lambda \left[\Delta \frac{1-p}{1-pq}(1-\delta) + (1-\Delta)\beta_{\varnothing}\right] - c\alpha^2/2. \tag{7}$$

His optimal tax planning effort is thus

$$\alpha = \frac{1 - \lambda \left[\Delta \frac{1-p}{1-pq}(1-\delta) + (1-\Delta)\beta_{\varnothing}\right]}{c}. \tag{8}$$

Let us note that $\lambda < 1$ ensures that the tax manager always engages in *some* tax planning, independent of the tax authority's and controversy manager's decisions. In addition, we require $c \geq 1$ to guarantee an interior tax planning effort $\alpha < 1$ if the tax manager's enforcement-related costs are very small ($\lambda \to 0$).

Absent a controversy manager's investigation ($\Delta = 0$), the tax manager's tax planning effort decreases in the probability $\beta_{\varnothing}$ that the tax authority enforces a high tax liability. This captures the enforcement effect on tax planning. When a controversy manager conducts an investigation ($\Delta = 1$), she affects the enforcement effect in two ways. First, she protects the tax manager from adverse dispute outcomes (and the related costs) that would result from the tax authority falsely enforcing the high tax in a tax dispute. Second, her persuasion also convinces the tax authority to agree with low reports that stem from a high true tax liability with probability δ. While both empirical (e.g., Hoopes et al. 2012; Nessa et al. 2020) and theoretical (R. Reineke et al. 2023a; Blaufus, Schöndube, and Wielenberg 2024) work has scrutinized the enforcement effect on firms' tax outcomes, we emphasize that the enforcement effect depends on the presence of a controversy manager.

3.4 Equilibrium without a controversy manager

In this section, we establish the equilibrium without the controversy manager (i.e., $\Delta = 0$). This equilibrium provides a benchmark for isolating the impact of a controversy manager.

Absent a controversy manager, the tax authority chooses the probability $\beta_{\varnothing}$, which crucially depends on the prior at the dispute stage $1-\mu_P$ that the firm has unfavorable tax conditions. In particular, the tax authority chooses L^{TA} when $1-\mu_P < \frac{\theta}{1+\theta}$ and enforces H^{TA} if $1-\mu_P > \frac{\theta}{1+\theta}$. As $1-\mu_P$ is a function of the tax planning effort α, there is a critical level of tax planning α^*, which determines the tax authority's decision.

Lemma 2. *There exists* $\alpha^* = \frac{pq\theta}{pq\theta+1-p(1+\theta)} \in (0, \frac{1}{c})$*, such that, if* $\alpha > \alpha^*$ *(*$\alpha < \alpha^*$*), the tax authority's best response is* $\beta_{\varnothing} = 1$ *(*$\beta_{\varnothing} = 0$*).* α^* *increases in the tax technology quality* q*.*

The observation in Lemma 2 and the tax manager's optimal tax planning effort (equation 8) allow us to establish the equilibrium without a controversy manager.

Proposition 1. *Without a controversy manager, an equilibrium between the tax manager and the tax authority entails the following strategies.*

i) Suppose $\alpha^* < \frac{1-\lambda}{c}$.

a) Upon observing a high signal from the tax technology h^{tec}*, the tax manager chooses tax planning effort* $\breve{\alpha} = \frac{1-\lambda}{c}$.

b) The tax authority enforces H^{TA} *with probability* $\beta_{\varnothing} = 1$.

ii) Suppose $\alpha^* > \frac{1-\lambda}{c}$.

a) Upon observing a high signal from the tax technology h^{tec}*, the tax manager chooses tax planning effort* $\breve{\alpha} = \alpha^*$.

b) The tax authority enforces H^{TA} *with probability* $\beta_{\varnothing} = \frac{1-c\alpha^*}{\lambda}$.

Proposition 1 shows that equilibria in which the tax authority sometimes or always enforces aggressively exist, depending on the size of α^*. α^* captures the relevant characteristics of the tax dispute environment, including the quality of the firm's tax technology q, the litigation-friendliness of the tax system θ, and the underlying tax facts p. We are particularly interested in how the technology quality q affects the equilibrium behavior. The next observation demonstrates the equilibrium effects.

Corollary 1. *Absent a controversy manager, an increase in the quality of tax technology q affects the tax manager's tax planning effort* $\breve{\alpha}$ *and the tax authority's enforcement aggressiveness* $\beta_\varnothing$ *as follows.*

i) In a litigation-averse environment ($\theta < \overline{\theta}$)*,* $\breve{\alpha}$ *and* $\beta_\varnothing$ *are unaffected.*

ii) In a litigation-friendly environment ($\theta > \overline{\theta}$)*, there exists a unique threshold value* $\underline{q} \in (0,1)$ *such that:*

a) If the tax technology quality is sufficiently low ($q < \underline{q}$)*,* $\breve{\alpha}$ *and* $\beta_\varnothing$ *are unaffected.*

b) If the tax technology quality is sufficiently high ($q > \underline{q}$)*,* $\breve{\alpha}$ *increases and* $\beta_\varnothing$ *decreases.*

Corollary 1 shows that the effect of the tax technology quality q depends on the litigation-friendliness of the tax environment. For example, a litigation-friendly environment is characterized by an easy access to the legal system, an appropriate level of the burden of proof (Rhoades 1997; LeBlanc 1998), and effective arbitration procedures (Markham 2018; Martini et al. 2025). Generally, q directly decreases the prior belief $1 - \mu_P(q)$ that enforcing H^{TA} in a tax dispute is beneficial and does not directly affect the tax manager's incentive to engage in tax planning. However, in a litigation-averse environment, the tax authority's decreasing enforcement incentives never induce a change in the equilibrium enforcement aggressiveness $\beta_\varnothing$. In a litigation-averse environment, the firm's litigation threat is too low to reduce the tax authority's enforcement aggressiveness. Therefore, even when the tax technology quality is perfect ($q = 1$), the tax authority's enforcement aggressiveness, and, in turn, the tax planning effort remain unaffected.

In a litigation-friendly environment, the same economic rationale operates. If the quality of the tax technology quality is low enough, $q < \underline{q}$, the tax authority's enforcement incentives decrease but are insufficient to induce a change in equilibrium behavior. However, if the quality is sufficiently high $q > \underline{q}$, the firm's litigation threat induces the authority to reduce its equilibrium enforcement aggressiveness. Then the tax manager's expected enforcement-related costs decrease, and he increases his tax planning effort in equilibrium.

3.5 Equilibrium with a controversy manager

Next we establish the equilibrium with a controversy manager in Proposition 2.

Proposition 2. *With a controversy manager, an equilibrium between the tax manager, the controversy manager, and the tax authority entails the following strategies.*

i) Suppose $\alpha^* < \frac{1-\lambda\left[\frac{1-p-\theta p(1-q)}{1-pq}\right]}{c}$.

- *a) Upon observing a high signal from the tax technology* h^{tec}*, the tax manager chooses tax planning effort* $\hat{\alpha} = \frac{1-\lambda\left[\frac{1-p-\theta p(1-q)}{1-pq}\right]}{c}$.
- *b) The controversy manager conducts an investigation (*$\Delta = 1$*) with investigation properties* $\delta(l|L) = 0$ *and* $\delta(l|H) = \theta\frac{\mu_P(\hat{\alpha})}{1-\mu_P(\hat{\alpha})}$ *(Lemma 1).*
- *c) The tax authority enforces* H^{TA} *after tax opinion* $\{l,h\}$ *with probabilities* $\beta_h = 1, \beta_l = 0$*, and off-equilibrium path strategy* $\beta_\varnothing = 1$.

ii.) Suppose $\alpha^* > \frac{1-\lambda\left[\frac{1-p-\theta p(1-q)}{1-pq}\right]}{c}$.

- *a) Upon observing a high signal from the tax technology* h^{tec}*, the tax manager chooses tax planning effort* $\hat{\alpha} = \alpha^*$.
- *b) The controversy manager does not conduct an investigation (*$\Delta = 0$*).*
- *c) The tax authority enforces* H^{TA} *after tax opinion* $\varnothing$ *with probability* $\beta_\varnothing = \frac{1-c\alpha^*}{\lambda}$*, and off-equilibrium path strategies* $\beta_l = \frac{1-c\alpha^*}{\lambda}, \beta_h = 1$.

With a controversy manager, we also identify two types of equilibria, depending on the characteristics of the tax dispute environment α^*. When α^* is sufficiently low, the tax authority credibly threatens to enforce a high tax liability $\beta_\varnothing = 1$ if it does not observe an additional tax opinion. This incentivizes the controversy manager to investigate ($\Delta = 1$), which persuades the tax authority to agree with the tax manager's report L^{TM} with positive probability. When α^* is sufficiently high, the tax authority cannot credibly threaten to enforce the high tax. In that case, it only enforces the high tax in a fraction of disputed cases, and the controversy manager does not investigate ($\Delta = 0$), as she cannot affect the dispute's outcome.

Next we show how the tax technology quality q affects the equilibrium behavior when a controversy manager is present.

Corollary 2. *An increase in the quality of tax technology q affects the tax manager's tax planning effort $\hat{\alpha}$, the controversy manager's dispute resolution decisions Δ and δ, and the tax authority's enforcement decision β_j as follows.*

i) In a litigation-averse environment ($\theta < \overline{\theta}$), $\hat{\alpha}$ decreases, δ increases, and Δ and β_j with $j \in \{l, h, \varnothing\}$ are unaffected.

ii) In a litigation-friendly environment ($\theta > \overline{\theta}$), there exists a unique threshold value $\overline{q} \in (0,1)$ such that:

a) If the tax technology quality is sufficiently low ($q < \overline{q}$), $\hat{\alpha}$ decreases, δ increases, and Δ and β_j with $j \in \{l, h, \varnothing\}$ are unaffected.

b) If the tax technology quality is sufficiently high ($q > \overline{q}$), $\hat{\alpha}$ increases, $\beta_\varnothing$ decreases, and Δ, δ, β_l and β_h are unaffected.

Corollary 2 highlights that the impact of tax technology quality q also depends on the litigation environment when a controversy manager is present. In a litigation-averse environment, the controversy manager always submits an informative tax opinion l or h to the tax authority. This makes the tax authority's enforcement decision nonstrategic and thus independent of q. However, the controversy manager internalizes the tax authority's enforcement incentives in her equilibrium choice δ. An increasing quality q decreases the tax authority's expected benefits of enforcing the high tax liability. This creates room for the controversy manager to increase the probability of her favorable dispute outcome L^{TA}. She accomplishes this by increasing the frequency with which a low tax opinion is submitted when the true tax liability is high (δ increases), while leaving the tax authority's enforcement strategies β_j unaffected.

Further, we show that an increase in the quality of tax technology q unambiguously decreases a tax manager's tax planning effort. Although the result seems to be trivial, the underlying economics are more intricate. On the one hand, an increase in q allows the controversy manager to bias her findings toward a low tax (δ increases), incentivizing a higher tax planning effort. On the other, an increase in q weakens the relative importance of the controversy manager's tax reassurance effect, incentivizing less tax planning effort. In equilibrium, we show that the impact on the compliance effect dominates, such that the tax planning effort decreases.

In a litigation-friendly environment, the same economic effects as in a litigation-averse environment are at work if the quality of tax technology is sufficiently low, $q < \overline{q}$. By contrast, if the quality is sufficiently high, $q > \overline{q}$, the controversy manager's presence does not affect the dispute's outcome anymore. Therefore, the effects of q resemble those described absent a controversy manager. Interestingly, this implies that the tax planning effort has a unique minimum at $\overline{q}$ in a litigation-friendly environment. Figure 3 illustrates the effect of the tax technology quality on the tax manager's tax planning effort, depending on the presence of the controversy manager and the litigation environment.

[Figure 3 about here]

4 Preferences over tax department design

In the previous section, we treated the firm's tax technology quality q and the presence of the controversy manager as given. In this section, we think of both tax risk management practices as being determined by the firm.[21] We consider three firm tax metrics that might be considered when designing the tax department: the tax dispute probability (or short-term tax payments), the probability of unfavorable dispute outcomes, and the probability of low final tax payments. For expositional convenience, we will focus on environments in which the controversy manager has an incremental impact and conducts an informative investigation ($\Delta = 1$).

Tax dispute probability To begin, we consider the tax dispute probability with D^{CM} and without a controversy manager D^{NCM}. The difference between these probabilities constitutes the controversy manager's effect on the tax dispute probability DE. In our setting, the tax dispute probability equals the probability that the tax manager submits a low report L^{TM} after the tax planning and reporting stage, because a low report L^{TM} is always challenged by the tax authority and culminates in a tax dispute.

Firms may aim to avoid tax disputes (Klassen et al. 2017) because of the uncertainty they create, which can have undesirable real effects, such as reduced capital investments (Jacob,

[21] We assume that altering tax technology quality or implementing a controversy manager is costless to isolate the strategic effect of these practices. However, our metrics could easily be extended to incorporate such costs.

Wentland, and Wentland 2022). However, strictly avoiding disputes implies a poor tax performance H^{TM}, as also all upside potential is foregone. Therefore, tax disputes might reflect a firm's desire to enhance its (final) tax performance (Klassen et al. 2017). Additionally, a firm may seek to improve its short-term tax performance by reducing cash taxes for liquidity purposes (Law and Mills 2015) or achieving a low effective tax rate to boost capital market performance (Frischmann et al. 2008; Desai and Dharmapala 2009; Flagmeier et al. 2021).

The tax dispute probabilities with and without controversy manager, respectively, are given by

$$D^{CM} = pq + (1 - pq)\,\hat{\alpha}, \tag{9}$$

$$D^{NCM} = pq + (1 - pq)\,\check{\alpha}. \tag{10}$$

Thus, the controversy manager's effect on the tax dispute probability is given by

$$DE = D^{CM} - D^{NCM} = (1 - pq)\,(\hat{\alpha} - \check{\alpha})\,. \tag{11}$$

Both with and without a controversy manager, increasing the quality of tax technology q directly affects the tax dispute probabilities. On the one hand, increased tax technology quality mechanically increases the probability of the technology signal l^{tec} that results in a tax manager report L^{TM} (and dispute) with certainty. On the other, it mechanically decreases the probability of signal h^{tec}, where the report L^{TM} (and dispute) depend on the tax manager's tax planning effort. Since $\check{\alpha} < 1$ and $\hat{\alpha} < 1$, the net direct effect is positive.

An increase in the quality of tax technology q also indirectly affects the tax planning effort and thus the dispute probabilities. *Without* a controversy manager, this indirect effect on D^{NCM} complements the direct positive effect (Corollary 1), making the overall effect on D^{NCM} positive. This implies that the lowest dispute probability occurs for $q = 0$. *With* a controversy manager, an increase in q crowds out the tax planning effort (Corollary 2), making the indirect effect on D^{CM} negative. We show that, if the costs for tax planning are sufficiently low ($c < c^D$), the negative crowding-out effect dominates the positive direct effect, such that D^{CM} unambiguously decreases in q (Lemma 4 ii), Appendix). Intuitively, low tax planning costs make the tax planning effort sensitive to changes in q. This might occur, for example, if anti-tax avoidance rules are lenient

(R. Reineke et al. 2023a). In this case, the lowest dispute probability can be achieved with an intermediate quality $q = \overline{q}$ in a litigation-friendly environment and with the maximum quality $q = 1$ in a litigation-averse environment. Otherwise, the lowest dispute probability is achieved at $q = 0$.

In addition, we show that the tax dispute probability increases with a controversy manager ($DE > 0$). As we have already documented, the controversy manager's investigation serves as an insurance for the tax manager, which shields the tax manager from enforcement-related costs of unfavorable dispute outcomes. Thus, in the presence of a controversy manager, the tax manager increases his tax planning effort, particularly at low technology quality levels.

Figure 4 (top panel) shows tax dispute probabilities with and without a controversy manager (left) as well as the change in the tax dispute probability when employing one (right).

[Figure 4 about here]

Probability of unfavorable dispute outcome There is a common understanding that firms (and managers) consider tax risk in their decision-making (Neuman et al. 2020; Brühne and Schanz 2022).[22] In our context, the probability of an unfavorable dispute outcome reflects the firm's residual tax risk (i.e., after the implementation of tax risk management practices) and is defined as the probability that the tax authority enforces a high tax liability H^{TA} after a low tax report L^{TM}. This definition encompasses most tax risk dimensions identified in the literature. We capture economic risk and tax law ambiguity (Neuman et al. 2020), political risk (Brühne and Schanz 2022) in the uncertainty about the true tax liability, inaccurate information processing (Neuman et al. 2020) and tax process risk (Brühne and Schanz 2022) in our tax planning and reporting stage and financial and enforcement risk (Neuman et al. 2020; Brühne and Schanz 2022) in the tax dispute stage. The probability of an unfavorable dispute outcome with and

[22] Neuman et al. (2020) and Brühne and Schanz (2022) broadly define tax risk as the uncertainty about (future) tax outcomes. According to Neuman et al. (2020), tax risk has three key dimensions: economic risk, tax law ambiguity, and inaccurate information processing. Brühne and Schanz (2022) suggest that tax risk has six dimensions: financial, reputational, political, compliance, tax process, and personal liability risk.

without a controversy manager is given by

$$UD^{CM} = (1-p)\hat{\alpha}(1-\delta(\hat{\alpha})), \tag{12}$$

$$UD^{NCM} = (p(q+(1-q)\check{\alpha})+(1-p)\check{\alpha})\,\beta_{\varnothing} = (pq+(1-pq)\check{\alpha})\,\beta_{\varnothing}. \tag{13}$$

The reduction in unfavorable dispute outcomes achieved by employing a controversy manager is

$$\begin{aligned} UDE &= UD^{NCM} - UD^{CM} \\ &= \underbrace{p(q+(1-q)\check{\alpha})\beta_{\varnothing}}_{\text{tax reassurance effect}} + \underbrace{(1-p)\,(\check{\alpha}\beta_{\varnothing} - \hat{\alpha}\,(1-\delta))}_{\text{tax planning effect}}. \end{aligned} \tag{14}$$

The overall impact of a controversy manager on a firm's unfavorable dispute outcomes can be separated into two components, which we label *tax reassurance effect* and *tax planning effect*. The former effect captures all cases in which the tax authority would falsely enforce a high tax. The controversy manager's tax opinion supports a low tax in all of these cases, and, in equilibrium, the tax authority follows that opinion. The tax planning effect captures all cases with a high true tax that eventually result in a tax dispute. In these cases, the presence of a controversy manager affects the probability of a low tax report and the tax authority's subsequent enforcement decision. We can show that if the tax technology quality is sufficiently low ($q < q^{UDE}$) and the tax manager's enforcement-related costs are sufficiently high ($\lambda > \lambda^{UDE}$), the increase in disputes is so high that unfavorable dispute outcomes increase in total. Then, the negative tax planning effect overcompensates the positive tax reassurance effect.

The quality of tax technology q influences unfavorable dispute outcomes in a nontrivial way (Lemma 5, Appendix). Without a controversy manager, an increase in q has a direct positive effect on unfavorable dispute outcomes. This is because the technology provides the tax manager with a low signal, which he subsequently reports. When faced with a tax authority enforcing the high tax liability, this increases unfavorable dispute outcomes. When the technology quality exceeds $\underline{q}$, the players' equilibrium strategies come to depend on q. Therefore, unfavorable dispute outcomes are also indirectly affected via the equilibrium strategies. We identify conditions in

which the net indirect effects dominate the direct effect, such that unfavorable dispute outcomes decrease when improving intermediate-quality technologies.

With a controversy manager, we show that unfavorable dispute outcomes unambiguously decrease in technology quality q. Then, unfavorable dispute outcomes can be minimized by choosing the maximum feasible quality at which the controversy manager conducts informative investigations. In a litigation-averse environment, unfavorable dispute outcomes are minimized if the technology quality is perfect ($q = 1$), and in a litigation-friendly environment, they are minimized at an intermediate level ($q = \overline{q}$). These results particularly highlight the importance of considering the interdependent effects of tax risk management practices. Absent a controversy manager, an intermediate technology quality can *maximize* unfavorable dispute outcomes, while it can *minimize* them with a controversy manager. Figure 4 (middle panel) illustrates the effects, depending on the quality of the tax technology q.

Probability of low final tax payments Achieving low final tax payments and thus a high final tax performance is obviously of significant interest for the firm (e.g., Armstrong et al. 2012, Klassen et al. 2017). The probabilities of ensuring low final tax payments are given by

$$LT^{CM} = pq + p(1-q)\hat{\alpha} + (1-p)\hat{\alpha}\delta(\hat{\alpha}),$$
$$LT^{NCM} = (pq + p(1-q)\check{\alpha} + (1-p)\check{\alpha})(1-\beta_{\varnothing}).$$

The controversy manager's effect on the probability of low final tax payments is thus given by

$$LTE = LT^{CM} - LT^{NCM} = \left(D^{CM} - UD^{CM}\right) - \left(D^{NCM} - UD^{NCM}\right) = DE + UDE.$$

The probability for low final tax payments is the difference between dispute probability and unfavorable dispute outcomes. Most interestingly, we show that the controversy manager consistently increases the probability for low tax payments ($LTE > 0$), independent of tax technology quality. Intuitively, the downside potential of more unfavorable dispute outcomes is always lower than the upside potential of a dispute in achieving low tax payments.

We also show that, in the absence of a controversy manager, the probability for low tax payments increases in technology quality q (Lemma 6, Appendix). The reason is that the unambiguous positive effect of q on tax dispute probability overcompensates for the (case-dependent) ambiguous effect on an unfavorable dispute outcome, particularly in a litigation-friendly environment. By contrast, in the presence of a controversy manager, an increase in q can decrease the probability for low tax payments due to the potential decreasing dispute probability, which is a prerequisite for low tax payments. Additionally, we find that the controversy manager's value added for low tax payments is often maximized at an intermediate technology quality level. Figure 4 (bottom panels) illustrates the results.

Proposition 3 summarizes the results.

Proposition 3. *The controversy manager has the following effects on a firm's tax metrics:*

i) She increases the tax dispute probability ($DE > 0$), and DE strictly decreases in q.

ii) She affects the probability of unfavorable dispute outcomes (UDE) via a tax reassurance effect and a tax planning effect. The tax reassurance effect always reduces UDE, whereas the tax planning effect can decrease or increase UDE.

Overall, she increases unfavorable dispute outcomes ($UDE < 0$) if the tax technology quality is sufficiently low ($q < q^{UDE}$) and the tax manager's enforcement-related costs are sufficiently high ($\lambda > \lambda^{UDE}$) . Otherwise, she decreases unfavorable dispute outcomes ($UDE > 0$). UDE can increase or decrease in q.

iii) She increases the probability of low final tax payments ($LTE > 0$). LTE can increase or decrease in q.

To sum up, our nuanced findings caution against adopting a one-size-fits-all approach to tax risk management. The optimal design of the tax department depends on a firm's weighting of tax metrics, tax manager characteristics, and the litigation-friendliness of the tax environment.

5 Private tax authority information

Our basic model assumes that the sender (controversy manager) and receiver of information (tax authority) have a common prior μ_P at the start of the tax dispute. This assumption is consistent

with settings in which all material documents have been exchanged through the tax return declaration process (Yoon 2000). In this section, we extend the model and explore a scenario in which the tax authority obtains additional private information about the true tax liability at the outset of the dispute.[23] For example, this information may come from a foreign tax authority via information exchange agreements (e.g., Diller, Lorenz, et al. 2024). We model this additional information as a signal that is correct with probability $\Pr(l^{TAinfo}|L) = \Pr(h^{TAinfo}|H) = \frac{1+\psi}{2}$, where $\psi \in [0,1]$ measures the quality of the signal. $\psi = 0$ corresponds to the case of a completely random signal or one where the tax authority does not receive additional information. $\psi = 1$ captures the case where the tax authority can perfectly observe whether the true tax liability is low or high. Table 1 shows the tax authority's prior beliefs in the tax dispute induced by this signal and their distribution. For expositional convenience, we choose $c = 2$ and, without loss of generality, set the controversy manager's utility from sustaining a final low tax equal to one ($u^{CM}(L^{TA}) = 1$).

[Table 1 about here]

As shown by Alonso and Câmara (2016) the receiver's posterior can be expressed as a function of the sender's and receiver's priors and the sender's posterior.[24] This allows the sender's value function to be formulated solely in terms of the sender's posterior. The value of the optimal signal (and, in turn, the optimal signal) is then given by the value of the concavication[25] of the value function at the (sender's) prior.[26]

The tax authority has two different priors, depending on which signal it receives. Accounting for this, the controversy manager's expected value function is given by

[23] Conversely, the controversy manager may also possess different information than the tax authority. For instance, if the tax technology signal is part of the tax file, it is visible to both the controversy manager and the tax authority. Assume the controversy manager trusts the technology signal, while the tax authority mistrusts it and adheres to its prior, creating heterogeneous priors. These heterogeneous priors, however, yield the same optimal investigation property δ as in our basic model (Lemma 1). Intuitively, this is because the controversy manager's utility does not depend on whether the tax liability *truly* is low or high but only on the tax authority's enforcement decision. Consequently, only the tax authority's prior is relevant to her.

[24] Applied to our setting, the tax authority's posterior is $\mu^{TA} = \mu^{CM} \frac{\frac{\mu_P^{TA}}{\mu_P^{CM}}}{\mu^{CM}\frac{\mu_P^{TA}}{\mu_P^{CM}} + (1-\mu^{CM})\frac{1-\mu_P^{TA}}{1-\mu_P^{CM}}}$.

[25] The concavication of a function f is the smallest concave function that is everywhere weakly greater than f.

[26] C.f. Proposition 2 (ii) in Alonso and Câmara 2016. This method also offers a foundation for analyzing scenarios involving a common prior and costly sender investigation; see Gentzkow and Kamenica (2014).

$$v^{CM} = \Pr(l^{TAinfo})u^{CM}(\mu^{TA}(\mu^{CM};\mu^{TA}_{P,l^{TAinfo}})) + \Pr(h^{TAinfo})u^{CM}(\mu^{TA}(\mu^{CM};\mu^{TA}_{P,h^{TAinfo}})), \quad (15)$$

where $\mu^{TA}_{P,l^{TAinfo}}$ and $\mu^{TA}_{P,h^{TAinfo}}$ denote the tax authority's prior after receiving a low or high tax information signal, respectively. μ^{CM}_P $(= \mu_P)$ is the unchanged controversy manager's prior, and μ^{TA} and μ^{CM} denote the tax authority's and the controversy manager's posteriors, respectively. Inserting the respective priors and posteriors from Table 1 and rearranging equation (15) gives

$$v^{CM} = \begin{cases} 0 & \mu^{CM} < \frac{1-\psi}{1-\psi+\theta(1+\psi)} \\ \frac{1}{2}\left(1 + \frac{\psi(p(1+\alpha-(1-\alpha)(1-q))-\alpha)}{\alpha+(1-\alpha)pq}\right), & \frac{1-\psi}{1-\psi+\theta(1+\psi)} \leq \mu^{CM} < \frac{1+\psi}{1+\psi+\theta(1-\psi)} \\ 1 & \frac{1+\psi}{1+\psi+\theta(1-\psi)} \leq \mu^{CM}. \end{cases} \quad (16)$$

Denote V^{CM} the concavication of v^{CM}. There are two cases, which we refer to as "low-quality information," where ψ is below some threshold (left-hand side in Figure 5), and "high-quality information," with ψ above this threshold (right-hand side in Figure 5).[27] The optimal controversy manager's posteriors, their distribution, and the optimal investigation that they induce are shown in Table 2.

[Figure 5 about here]

[Table 2 about here]

Increasing ψ shifts the second piece of the controversy manager's value function to the left and the third piece to the right. Adjusting ψ until the middle piece meets the concavification provides the condition for the low-quality case:

$$\frac{(1-\psi)(1+\psi+\theta(1-\psi))}{(1+\psi)(1-\psi+\theta(1+\psi))} > \frac{1}{2}\left(1 + \frac{\psi(p(1+\alpha-(1-\alpha)(1-q))-\alpha)}{\alpha+(1-\alpha)pq}\right). \quad (17)$$

[27] For particular parameter constellations—in the high-quality tax authority information case—the controversy manager's prior may be within the first interval of V^{CM}. In this case, we obtain optimal posterior controversy manager beliefs $\mu^{CM}_h = 0, \mu^{CM}_l = \frac{1-\psi}{1-\psi+\theta(1+\psi)}$. This requires a combination of low probability of true low tax L and a high litigation threat θ. A necessary condition that excludes this case is $p > \sqrt{5}-2 \approx 0.24$. We make this assumption to focus on parameter constellations that describe real situations.

If inequality (17) is not fulfilled, the high-quality information case prevails. Then, unlike our basic model, the controversy manager's optimal investigation involves some high tax opinions, although the true tax is low: $\delta(h|L) \equiv \delta_{\uparrow} > 0$. For clarity, we denote $\delta = \delta(l|H) \equiv \delta_{\downarrow}$.

Lemma 3. *With tax authority's private information, the following applies:*

i) The critical tax manager effort level necessary for an informative investigation is given by $\alpha^*_{\psi} = \frac{pq\theta(1-\psi)}{pq\theta(1-\psi)+(1-p)(1+\psi)-p\theta(1-\psi)}$. *Increasing information quality* ψ *increases the parameter range in which an informative investigation is possible.*

ii) There exist $\underline{\psi}$ *and* $\overline{\psi}$ *such that: If* $\psi < \underline{\psi}$ *the low-quality tax authority information case applies over the whole range of feasible effort levels* α*, and if* $\psi > \overline{\psi}$*, the high-quality case applies over the whole range of feasible effort levels* α*. If* $\underline{\psi} < \psi < \overline{\psi}$*, there exists a critical tax manager effort level* α^{crit} *that separates the low-quality and high-quality information cases. If* $\alpha < \alpha^{crit}$*, the low information quality case applies, and vice versa.*

Lemma 3 i) demonstrates how the characteristics of the tax dispute environment change when considering private tax authority information. If the tax authority receives useless private information ($\psi = 0$), we have $\alpha^*_{\psi} = \alpha^*$, as in the base model (Lemma 2). By contrast, if the tax authority receives perfect information ($\psi \to 1$), we have $\alpha^*_{\psi} = 0$, and the controversy manager conducts an (informative) investigation for all tax planning effort levels $\alpha \in [0,1]$, independent of the litigation-friendliness of the dispute environment θ. Thus, when dealing with privately informed tax authorities, her range of influencing tax dispute increases.

Tax manager's tax planning effort Since the controversy manager's investigation sometimes leads to tax opinion *h*, despite a low true tax liability, the tax manager has to additionally account for cases where a high tax technology signal originates from a low true tax. The tax manager's problem is to choose α so as to maximize

$$u^{TM}(\alpha|h^{tec}) = \alpha - \alpha \cdot \left(\frac{1-p}{1-pq} \cdot (1-\delta_{\downarrow}) + \frac{p(1-q)}{1-pq} \cdot \delta_{\uparrow} \right) \cdot \lambda - \alpha^2. \tag{18}$$

Proposition 4 shows the equilibrium tax planning effort with private tax authority information.

Proposition 4.

i) Suppose the tax authority receives low-quality private information $\psi < \underline{\psi}$. Then the tax manager's optimal effort $\hat{\alpha}_{\underline{\psi}}$ is the interior maximum of (18). Increasing information quality ψ decreases the tax manager's tax planning effort.

ii) Suppose the tax authority receives high-quality private information $\psi > \overline{\psi}$. Then the tax manager's optimal effort $\hat{\alpha}_{\overline{\psi}}$ is the unique local maximum of (18).

Moving from the the low-quality information case ($\psi < \underline{\psi}$) to the region where the information environment depends on α ($\underline{\psi} < \psi < \overline{\psi}$), tractability suffers. Using a numerical example, we illustrate in Figure 6 how the tax manager's optimal effort $\hat{\alpha}$ can depend on the tax authority's information quality ψ. From zero to $\underline{\psi}$, $\hat{\alpha}$ decreases, consistent with Proposition 4 i). As ψ continues to increase within the intermediary information quality range, the solution for $\hat{\alpha}$ eventually transitions from being interior to lying on the left boundary of the tax manager's objective function $u^{TM}_{\underline{\psi}}$.Specifically, the tax manager chooses $\hat{\alpha} = \alpha^{crit}$. The critical value α^{crit} increases with ψ, leading to a sharp rise in $\hat{\alpha}$ over a narrow range of ψ—a spike illustrated in Figure 6. As ψ increases further, there comes a point where the maximum value of the tax manager's objective function under the high-quality information environment exceeds the maximum under the low-quality environment ($\max u^{TA}_{\overline{\psi}} > \max u^{TA}_{\underline{\psi}}$). The (interior) arg max of $u^{TA}_{\overline{\psi}}$ is considerably smaller, accounting for the drop depicted in Figure 6. Beyond this point, as the tax authority's information quality continues to improve, $\hat{\alpha}$ increases steadily with ψ.

[Figure 6 about here]

In summary, we demonstrate that increasing the precision of private tax authority information might have a nonmonotonic and nonlinear impact on the tax manager's tax planning effort. As the information precision improves, the tax manager's effort can spike before declining again. This relationship also influences the probability of tax disputes: although additional private information generally reduces disputes by discouraging tax planning, intermediate-quality information can sharply increase the dispute probability.

6 Conclusions

We examine how tax technology and controversy experts affect a firm's probability of tax disputes, unfavorable dispute outcomes, and low final tax payments. In our model, a tax manager exerts tax planning effort given the imperfect signal of the firm's tax technology. If a tax dispute arises, a controversy manager assesses the risky tax position to support the firm's interest and provides a substantiated tax opinion, which the tax authority considers alongside the tax manager's initial report when enforcing the tax liability.

From the firm perspective, we show that the controversy manager has a dual role in tax disputes. First, in a *tax reassurance* role, she reduces the risk of the tax authority falsely enforcing a high tax. Second, in a *tax planning* role, she increases the likelihood that the tax authority accepts a lower tax than the tax conditions otherwise suggest. Both roles weaken the deterrent effect of enforcement on risky tax planning, leading to greater tax planning effort and a higher tax dispute probability. This increase in tax disputes has a potential downside, in terms of more unfavorable outcomes, and an upside, in terms of greater opportunities for the controversy manager to persuade the tax authority and secure low final tax payments.

Surprisingly, we identify conditions under which a controversy manager increases unfavorable dispute outcomes. This effect is particularly evident in firms with low-quality tax technology, where the increase in disputes outweighs her ability to resolve them favorably. However, in most cases, her tax reassurance and tax planning roles reduce unfavorable outcomes. Finally, we show that tax technology quality can either increase or decrease the probability of low final tax payments, depending on tax planning costs and the litigation environment, with intermediate quality often improving the controversy manager's value added.

Our findings have important policy implications for the organization of tax departments. Regulators should be cautious when mandating high-quality tax technologies, as this may unintentionally increase tax disputes. Moreover, our results warrant empirical testing. For example, leveraging the variation in certified and non-certified Tax Control Frameworks as proxies for tax technology quality, future research can assess a controversy manager's impact on firms' effective tax rates, tax dispute propensity and outcomes.

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Appendix

Proof of Lemma 1

The proof follows the notion in Kamenica and Gentzkow (2011). First, an optimal informative investigation implies $\delta(l|L) = 1$ and $\delta(h|L) = 0$. Otherwise, we would have $\delta(l|L) < 1$. Then, the controversy manager would be better off by setting $\delta(l|L) = 1$, because she thereby increases the probability of l, and decreases $\Pr(H|l)$ and thus the tax authority's willingness for β_l. Second, $\delta \equiv \delta(l|H)$ makes the tax authority just indifferent between H^{TA} and L^{TA} after observing l

$$\begin{aligned}\Pr(H|l)\cdot z - \Pr(L|l)\cdot \theta z &= \frac{(1-\mu_P)\,\delta}{(1-\mu_P)\,\delta+\mu_P}\cdot z - \frac{\mu_P}{\mu_P+(1-\mu_P)\delta}\cdot\theta z \stackrel{!}{=} 0\\ \implies \delta &= \theta\frac{\mu_P}{1-\mu_P}.\end{aligned}$$

Proof of Lemma 2

Note that $1-\mu_P(\alpha) = \frac{(1-p)\alpha}{(1-p)\alpha+pq+p(1-q)\alpha}$ increases in α, as $\frac{\partial 1-\mu_P(\alpha)}{\partial\alpha} = \frac{(1-p)pq}{(\alpha+(1-\alpha)pq)^2} > 0$. α^* is the level of tax planning for which the tax authority is indifferent when $j = \varnothing$, that is,

$$(1-\mu_P(\alpha))\cdot z - \mu_P(\alpha)\cdot\theta z \stackrel{!}{=} 0 \implies \alpha^* = \frac{pq\theta}{pq\theta+1-p(1+\theta)}.$$

Then, we have that $\alpha^* \in (0,1)$, because $\alpha^* < 1$ requires $\theta < \frac{1-p}{p}$ and Assumption 1 is even stricter. Next, observe $\frac{\partial\alpha^*}{\partial q} = \frac{1-p(1+\theta)}{(pq\theta+1-p(1+\theta))^2} > 0$. Lastly, $\alpha^* < \frac{1}{c}$ is visible when considering $\frac{\partial\alpha^*}{\partial q} > 0$ and rearranging $\alpha^*(q=1) < \frac{1}{c}$ for θ, which exactly yields the condition stated in Assumption 1. Overall, we have $\alpha^* \in (0, \frac{1}{c})$.

Proof of Proposition 1

Observe that $\alpha^* \in (0, \frac{1}{c})$. Now, suppose $\alpha^* < \frac{1-\lambda}{c}$. Then, from Lemma 2, we have $\beta_\varnothing = 1$, and from equation (8), we see that $\breve{\alpha} = \frac{1-\lambda}{c}$ is a best response absent a controversy manager ($\Delta = 0$).

Next, suppose $\frac{1-\lambda}{c} < \alpha^* < \frac{1}{c}$. Then, there exists no equilibrium in which the tax authority chooses a pure strategy. Thus, given the tax manager's strategy $\breve{\alpha} = \alpha^*$, we know from Lemma 2 that the tax authority is indifferent between L^{TA} and H^{TA}, as the first-order condition yields

$(1-\mu_P(\alpha^*))z-\mu_P(\alpha^*)\theta z=0$. Further, given the tax authority's strategy $\beta_\varnothing=\frac{1-c\alpha^*}{\lambda}$, equation (8) shows that the tax manager optimal response is $\breve{\alpha}=\alpha^*$ when $\Delta=0$.

Lastly, an equilibrium with $\beta_\varnothing=0$ and $\breve{\alpha}=\frac{1}{c}$ does not occur, as it would require $\alpha^*>\frac{1}{c}$.

Proof of Corollary 1

When $\alpha^*<\frac{1-\lambda}{c}$, we have $\frac{\partial\breve{\alpha}}{\partial q}=0$ and $\frac{\partial\beta_\varnothing}{\partial q}=0$. This equilibrium obtains over the whole range of tax technology qualities if $\alpha^*(q=1)<\frac{1-\lambda}{c}$, which makes use of the insight from Lemma 2 that α^* increases in q. Rearranging the inequality for θ yields $\theta<\overline{\theta}\equiv\frac{1-p}{p}\frac{1-\lambda}{c}$. By contrast, if $\theta>\overline{\theta}$, we know that $\alpha^*(q=0)=0<\frac{1-\lambda}{c}<\alpha^*(q=1)$. As $\frac{\partial\alpha^*}{\partial q}>0$ and α^* is continuous, this implies the existence of a unique threshold value $\underline{q}=(\alpha^*)^{-1}\left(\frac{1-\lambda}{c}\right)$, such that if $q<\underline{q}$ ($q>\underline{q}$), we have $\frac{\partial\breve{\alpha}}{\partial q}=0$ and $\frac{\partial\beta_\varnothing}{\partial q}=0$ ($\frac{\partial\breve{\alpha}}{\partial q}>0$ and $\frac{\partial\beta_\varnothing}{\partial q}<0$).

Proof of Proposition 2

Suppose $\alpha^*<\frac{1-\lambda\left[\frac{1-p-\theta p(1-q)}{1-pq}\right]}{c}\equiv\hat{\alpha}_1$. Then, from Lemma 2, the enforcement action absent a tax opinion is $\beta_\varnothing=1$, and we know that this equilibrium exists, because $\alpha^*(q=0)=0<\hat{\alpha}_1(q=0)=\frac{1-\lambda[1-p(1+\theta)]}{c}$. $\beta_\varnothing=1$ implies that the controversy manager conducts an investigation $\Delta>0$. Moreover, the investigation is informative, as $\alpha^*<\hat{\alpha}_1$ implies $\delta(\hat{\alpha}=\hat{\alpha}_1)<1=\delta(\hat{\alpha}=\alpha^*)$. Then, the tax authority weakly prefers $\beta_l=0$,[28] implying $\Delta=1$. Inserting these optimal tax authority and controversy manager responses in equation (8), we see that $\hat{\alpha}=\hat{\alpha}_1$ is the tax manager's best response.

Next, suppose $\hat{\alpha}_1<\alpha^*$. This equilibrium can exist when $\theta>\overline{\theta}$, which can be observed when considering $\frac{\partial\alpha^*}{\partial q}>0$ and the insight in Corollary 2 below showing $\frac{\partial\hat{\alpha}_1}{\partial q}<0$. Then, rearranging $\hat{\alpha}_1(q=1)<\alpha^*(q=1)$ for θ yields $\theta>\overline{\theta}$. When $\hat{\alpha}_1<\alpha^*$, there exists no equilibrium in which the tax authority chooses $\beta_\varnothing=1$. Thus, given the tax manager's strategy $\hat{\alpha}=\alpha^*$, we know from Lemma 2 that the tax authority is indifferent between L^{TA} and H^{TA} if $j=\varnothing$, as the tax authority's first-order condition yields $(1-\mu_P(\alpha^*))z-\mu_P(\alpha^*)\theta z=0$. In addition, when $\hat{\alpha}=\alpha^*$, we would have $\delta=1$. Thus, the signal l would be completely uninformative, implying $\mu_P(\alpha^*)=1/(1+\theta)$ and $\beta_l=\beta_\varnothing$. According to equation (6), these responses make

[28] Note again that we could explicitly express δ as $\delta=\theta\frac{\mu_P}{1-\mu_P}-\varepsilon$, with $\varepsilon>0$ being arbitrarily small. Then, the tax authority strictly prefers $\beta_l=0$. We drop $\varepsilon>0$ for convenience.

the controversy manager indifferent between conducting an investigation or not, and we use the convention that she then chooses $\Delta = 0$. Inserting these optimal responses in equation (8), we see that $\hat{\alpha} = \alpha^*$ is indeed the tax manager's best response. Off-the equilibrium path, Bayes rule does not restrict β_j with $j \in \{l, h\}$. We impose the plausible off-equilibrium strategies $\beta_h = 1$ and $\beta_l = \beta_\varnothing$, such that the controversy manager has no incentive to deviate.

Proof of Corollary 2

Suppose $\alpha^* < \hat{\alpha}_1$. Then, $\frac{\partial \hat{\alpha}_1}{\partial q} = -\frac{\lambda}{c}\frac{p(1-p)}{(1-pq)^2}(1+\theta) < 0$. This equilibrium obtains over the whole range of tax technology qualities if $\alpha^*(q=1) < \hat{\alpha}_1(q=1) = \frac{1-\lambda}{c}$, which yields $\theta < \overline{\theta}$. Next, observe that $\frac{d\delta(q,\alpha(q))}{dq} = \frac{\partial \delta}{\partial q} + \frac{\partial \delta}{\partial \alpha}\frac{\partial \alpha}{\partial q}$. Considering $\frac{\partial \delta}{\partial q} = \theta\frac{p(1-\alpha)}{(1-p)\alpha} > 0$ and $\frac{\partial \delta}{\partial \alpha} = -\frac{p\theta q}{(1-p)\alpha^2} < 0$, as well as $\frac{\partial \hat{\alpha}_1}{\partial q} < 0$, we get $\left.\frac{d\delta(q,\alpha(q))}{dq}\right|_{\alpha=\hat{\alpha}_1} > 0$. The other equilibrium strategies are independent of q.

By contrast, if $\theta > \overline{\theta}$, we know that $\alpha^*(q=0) = 0 < \frac{1-\lambda}{c} = \hat{\alpha}_1(q=1) < \alpha^*(q=1)$. As $\frac{\partial \alpha^*}{\partial q} > 0$ and α^* is continuous, this implies the existence of a unique threshold value $\overline{q} = (\alpha^*)^{-1}(\hat{\alpha}_1)$, such that if $q < \overline{q}$ ($q > \overline{q}$), we have $\frac{\partial \hat{\alpha}}{\partial q} < 0$ and $\frac{\partial \delta}{dq} > 0$ ($\frac{\partial \hat{\alpha}}{\partial q} > 0$ and $\frac{\partial \beta_\varnothing}{\partial q} = \frac{\partial \beta_l}{\partial q} < 0$). The other equilibrium strategies are independent of q.

Proof of Proposition 3 i)

We focus on cases with $DE \neq 0$, excluding trivial effects when $\theta > \overline{\theta}$ and $q > \overline{q}$. To begin, we establish the following lemma.

Lemma 4. *(Tax dispute probability)*

i) D^{NCM} *strictly increases in the tax technology quality q.*

ii) There exists a unique threshold value c^D *such that: If* $c < c^D$, D^{CM} *strictly decreases in q. If* $c > c^D$, D^{CM} *strictly increases in q.*

Note that

$$\frac{dD^{NCM}}{dq} = p(1-\breve{\alpha}) + (1-pq)\frac{\partial \breve{\alpha}}{\partial q} > 0,$$

because we know that $\frac{\partial \check{\alpha}}{\partial q} \geq 0$ from Corollary 1. This shows Lemma 4 i). Next,

$$\frac{dD^{CM}}{dq} = p(1-\hat{\alpha}) + (1-pq)\frac{\partial \hat{\alpha}}{\partial q} = \frac{p}{c}\left(c - (1+\lambda\theta)\right) \propto c - (1+\lambda\theta).$$

Since $c \geq 1$, this implies the existence of a unique threshold value $c^D \in (1,\infty)$, such that if $c > c^D$ ($c < c^D$), we have $\frac{dD^{CM}}{dq} > 0$ ($\frac{dD^{CM}}{dq} < 0$). This completes the proof of Lemma 4 ii).

Further, note that $\hat{\alpha}_1 > \check{\alpha}$, because Assumption 1 guarantees $0 < \frac{1-p-\theta p(1-q)}{1-pq} < 1 \; \forall q \in [0,1)$. Thus, we have $DE > 0$. Lastly, observe that

$$\frac{dDE}{dq} = (1-pq)\left(\frac{\partial \hat{\alpha}}{\partial q} - \frac{\partial \check{\alpha}}{\partial q}\right) - p\left(\hat{\alpha} - \check{\alpha}\right)\Big|_{\hat{\alpha}=\hat{\alpha}_1} < 0,$$

because we have already shown that $\hat{\alpha}_1 > \check{\alpha}$, $\frac{\partial \hat{\alpha}_1}{\partial q} < 0$, and $\frac{\partial \check{\alpha}}{\partial q} \geq 0$. This proves Proposition 3 i).

Proof of Proposition 3 ii)

To begin, we establish the following lemma.

Lemma 5. *(Probability of unfavorable dispute outcomes)*

i) a) In a litigation-averse environment ($\theta < \overline{\theta}$), UD^{NCM} strictly increases in q.

b) There exists a threshold value $\theta^{UD} \in (\overline{\theta}, \overline{\overline{\theta}})$ such that: In a weakly litigation-friendly environment ($\theta < \theta^{UD}$) with $\lambda > 1/2$, UD^{NCM} strictly increases in q. Otherwise, there exists a unique threshold value $q^{UD} \in [\underline{q}, 1)$, such that if $q < q^{UD}$, UD^{NCM} strictly increases in q, and if $q > q^{UD}$, UD^{NCM} strictly decreases in q.

ii) UD^{CM} strictly decreases in q.

Note that

$$\frac{dUD^{NCM}}{dq} = \beta_{\varnothing}\left[p(1-\check{\alpha}) + (1-pq)\frac{\partial \check{\alpha}}{\partial q}\right] + \frac{\partial \beta_{\varnothing}}{\partial q}\left[(1-pq)\check{\alpha} + pq\right].$$

In a litigation-averse environment with $\theta < \overline{\theta}$ and a litigation-friendly environment with $\theta > \overline{\theta}$ and $q < \underline{q}$, we have $\frac{\partial \beta_{\varnothing}}{\partial q} = \frac{\partial \check{\alpha}}{\partial q} = 0$, implying $\frac{dUD^{NCM}}{dq} > 0$. However, if $\theta > \overline{\theta}$ and $q \geq \underline{q}$, we

have $\frac{\partial \beta_{\varnothing}}{\partial q} < 0$ and $\frac{\partial \check{\alpha}}{\partial q} > 0$. Further simplification yields

$$\frac{dUD^{NCM}}{dq}\bigg|_{\check{\alpha}=\alpha^*} = \frac{p(1-p)(1+\theta)(1-p(1+\theta))}{\lambda\left[1-p(1+\theta(1-q))\right]^3}\Omega_q^{UD^{NCM}}, \text{ where}$$
$$\Omega_q^{UD^{NCM}} \equiv 1-p\left(1+\theta+q\theta(2c-1)\right).$$

Due to Assumption 1, we have $1 > p(1+\theta)$, which implies $\frac{dUD^{NCM}}{dq}\big|_{\check{\alpha}=\alpha^*} \propto \Omega_q^{UD^{NCM}}$. Further, observe that $\frac{d\Omega_q^{UD^{NCM}}}{dq} < 0$, and

$$\lim_{q\to\underline{q}} \Omega_q^{UD^{NCM}} = \frac{c(1-p(1+\theta))}{c-1+\lambda}\cdot(2\lambda-1) \propto 2\lambda-1,$$
$$\lim_{q\to 1} \Omega_q^{UD^{NCM}} = 1-p(1+2c\theta).$$

Thus, if $\lambda < 1/2$, we have that $\frac{dUD^{NCM}}{dq} > 0$ if $q < q^{UD} = \underline{q}$ and $\frac{dUD^{NCM}}{dq} < 0$ if $q > q^{UD} = \underline{q}$.

Next, consider the case $\lambda > 1/2$ and thus $\lim_{q\to\underline{q}} \Omega_q^{UD^{NCM}} > 0$. Then, observe that $\lim_{q\to 1} \Omega_q^{UD^{NCM}}$ strictly decreases in θ, and

$$\lim_{\theta\to\overline{\theta}} \left(\lim_{q\to 1} \Omega_q^{UD^{NCM}}\right) > 0, \lim_{\theta\to\overline{\overline{\theta}}} \left(\lim_{q\to 1} \Omega_q^{UD^{NCM}}\right) < 0,$$

with the latter holding due to $\lambda > 1/2$. This implies that there exists a unique threshold value $\theta^{UD} \in (\overline{\theta}, \overline{\overline{\theta}})$, such that if $\theta < \theta^{UD}$, we have $\lim_{q\to 1} \Omega_q^{UD^{NCM}} > 0$, and consequently $\frac{dUD^{NCM}}{dq} > 0 \; \forall \; q$. However, if $\theta > \theta^{UD}$, we know that $\lim_{q\to 1} \Omega_q^{UD^{NCM}} < 0$. This implies that there exists a unique threshold value $q^{UD} \in (\underline{q}, 1)$, such that if $q < q^{UD} (q > q^{UD})$, we have $\frac{dUD^{NCM}}{dq} > 0$ ($\frac{dUD^{NCM}}{dq} < 0$). This establishes Lemma 5 i).

Next, observe that in equilibrium, $UD^{CM} = \hat{\alpha}\left[1-p\left(1+\theta(1-q)\right)\right] - \theta pq$. Then,

$$\frac{dUD^{CM}}{dq} = \frac{\partial \hat{\alpha}}{\partial q}\left[1-p\left(1+\theta(1-q)\right)\right] - \theta p\left(1-\hat{\alpha}\right).$$

Considering $\frac{\partial \hat{\alpha}}{\partial q}\Big|_{\hat{\alpha}=\hat{\alpha}_1} < 0$ proves $\frac{dUD^{CM}}{dq} < 0$ as established in Lemma 5 ii).

We can now finish proving Proposition 3 ii). It is easy to see that the tax reassurance effect is always positive. To see that the tax planning effect TPE can be positive or negative, observe that

$TPE \equiv (1-p)\check{\alpha}\beta_{\varnothing} - UD^{CM}$. Then, it can be easily verified that if $\theta > \overline{\theta}$, we have $\lim_{q \uparrow \overline{q}} TPE > 0$ and if $\theta < \overline{\theta}$, we have $\lim_{q \to 1} TPE > 0$. Thus, $TPE > 0$ can occur for any θ.

Next, we identify conditions for $UDE < 0$, which necessarily imply $TPE < 0$. Considering the insights in Lemma 5, a natural candidate to identify $UDE < 0$ is a situation with low q, as we have $\frac{dUDE}{dq}\big|_{q<\underline{q}} > 0$ independent of θ. With $UDE\big|_{q<\underline{q}} = pq(1+\theta) + (1-pq)\frac{1-\lambda}{c} - (1-p(1+\theta(1-q)))\,\hat{\alpha}_1$, it is further easy to see that $\frac{dUDE}{d\lambda} < 0$. Then, note the following

$$\lim_{\lambda \to 1} UDE\big|_{q<\underline{q}} = p(1+\theta)\left(q - \frac{(1-q)(1-p(1+\theta(1-q)))}{(1-pq)c}\right) \gtreqless 0,$$
$$\lim_{q \to 0}\left(\lim_{\lambda \to 1} UDE\right) < 0, \lim_{\lambda \to 0} UDE\big|_{q<\underline{q}} = pq\left(1+\theta-\frac{1}{c}\right) > 0.$$

This implies that there exist threshold values λ^{UDE} and q^{UDE}, such that if $\lambda > \lambda^{UDE}$ and $q < q^{UDE}$, we have $UDE < 0$. To prove that we otherwise have $UDE > 0$, it suffices to show $\lim_{q \uparrow \overline{q}} UDE > 0$. Since $\lim_{q \uparrow \overline{q}} \hat{\alpha}_1(1-\delta(\hat{\alpha}_1)) = 0$, $UDE > 0$ is obvious from equation (14).

Lastly, observe that $\frac{dUDE}{dq} = \frac{dUD^{NCM}}{dq} - \frac{dUD^{CM}}{dq}$. Because $\frac{dUD^{CM}}{dq} < 0$ is always fulfilled, whenever $\frac{dUD^{NCM}}{dq} > 0$ as identified in Lemma 5, we have $\frac{dUDE}{dq} > 0$. To show that UDE can decrease in q, observe that $\frac{dUDE}{dq}$ strictly decreases in λ if $\frac{dUD^{NCM}}{dq} < 0$. Then, it can easily be verified that $\lim_{\lambda \to 0} \frac{dUDE}{dq}\big|_{q>\underline{q}} < 0$. This proves Proposition 3 ii).

Proof of Proposition 3 iii)

To begin, we establish the following lemma.

Lemma 6. *(Probability of low final tax payments)*

i) If $\theta > \overline{\theta}$ and $q > \underline{q}$, LT^{NCM} strictly increases in q. Otherwise, LT^{NCM} is independent of q.

ii) If $c < c^{LT}$ and $\theta > \theta^{LT}$, LT^{CM} strictly decreases if $q < q^{LT}$, and LT^{CM} strictly increases if $q > q^{LT}$. Otherwise, LT^{CM} strictly increases in q.

Concerning part i), observe that when $\theta < \overline{\theta}$ or when $\theta > \overline{\theta}$ and $q < \underline{q}$, we have $LT^{NCM} = 0$, implying $\frac{\partial LT^{NCM}}{\partial q} = 0$. Next, when $q > \underline{q}$ and $\theta > \overline{\theta}$, we have

$$\frac{dLT^{NCM}}{dq} = (1-\beta_{\varnothing})\left[p(1-\check{\alpha}) + (1-pq)\frac{\partial \check{\alpha}}{\partial q}\right] - \frac{\partial \beta_{\varnothing}}{\partial q}\left[(1-pq)\check{\alpha} + pq\right].$$

Then, from Corollary 1, we know $\frac{\partial \alpha^*}{\partial q} > 0$ and $\frac{\partial \beta_\varnothing}{\partial q} < 0$, implying $\frac{dLT^{NCM}}{dq}\big|_{\breve{\alpha}=\alpha^*} > 0$.

Concerning part ii), simplification yields $LT^{CM} = p(1+\theta)\left[q+(1-q)\hat{\alpha}\right]$. Then, we get

$$\frac{dLT^{CM}}{dq} = p(1+\theta)\left[1-\hat{\alpha}+(1-q)\frac{\partial \hat{\alpha}}{\partial q}\right] \propto 1-\hat{\alpha}+(1-q)\frac{\partial \hat{\alpha}}{\partial q} \equiv \Omega_q^{LT^{CM}}.$$

Further simplification considering $\hat{\alpha} = \hat{\alpha}_1$ yields

$$\Omega_q^{LT^{CM}} = 1 - \frac{1-\lambda\left[\frac{1-p(1+\theta(1-q))}{1-pq}\right]}{c} - (1-q)\frac{\lambda p(1-p)(1+\theta)}{c\,(1-pq)^2}.$$

Note that $\frac{\partial \Omega_q^{LT^{CM}}}{\partial c} > 0 \;\forall\; c \in (1,\infty)$ and $\lim_{c\to\infty} \Omega_q^{LT^{CM}} > 0$. Further, we have

$$\lim_{c\to 1} \Omega_q^{LT^{CM}} = \frac{\lambda}{1-pq}\left[1-p(1+\theta(1-q))-(1-q)\frac{p(1-p)(1+\theta)}{1-pq}\right] = \frac{\lambda}{1-pq}\Omega_{q,c}^{LT^{CM}},$$

with $\frac{\partial \Omega_{q,c}^{LT^{CM}}}{\partial q} > 0$ and $\lim_{c\to 1} \Omega_q^{LT^{CM}} \propto \Omega_{q,c}^{LT^{CM}}$. Further, $\lim_{q\to 0} \Omega_{q,c}^{LT^{CM}} = 1-p(1+\theta)(2-p)$ and $\frac{\partial \lim_{q\to 0} \Omega_{q,c}^{LT^{CM}}}{\partial \theta} < 0$. Lastly, note $\lim_{\theta\to 0}\left(\lim_{q\to 0} \Omega_{q,c}^{LT^{CM}}\right) > 0$ and $\lim_{\theta\to \overline{\overline{\theta}}}\left(\lim_{q\to 0} \Omega_{q,c}^{LT^{CM}}\right) < 0$. This implies that there exists a threshold value $\theta^{LT} \in (0, \overline{\overline{\theta}})$, such that if $\theta < \theta^{LT}$, we have $\Omega_q^{LT^{CM}} > 0$ and consequently $\frac{dLT^{CM}}{dq} > 0$. However, if $\theta > \theta^{LT}$ and $c < c^{LT} \in (1, c^D)$, there exists a threshold value q^{LT}, such that if $q < q^{LT}$, we have $\frac{dLT^{CM}}{dq} < 0$, and if $q > q^{LT}$, we have $\frac{dLT^{CM}}{dq} > 0$. This shows Lemma 6 ii).

We can now finish proving Proposition 3 iii). To begin, note that if $\theta < \overline{\theta}$, we have $LTE = LT^{CM} > 0$. Next, if $\theta > \overline{\theta}$, we similarly have $LTE > 0$ if $0 < q \leq \underline{q}$. If $q > \underline{q}$, we can show that $\lim_{q \uparrow \overline{q}} LTE > 0$. Since LTE can decrease if $\underline{q} < q < \overline{q}$, we need to show $LTE > 0 \;\; \forall\; q \in (\underline{q}, \overline{q})$. Then, note that $\frac{\partial LTE}{\partial c} < 0$ and $\frac{\partial LTE}{\partial \lambda} < 0$. Tedious calculations verify that $\lim_{c\to 1}\left(\lim_{\lambda\to 1} LTE\right) > 0$ if $q \in (\underline{q}, \overline{q})$.

To show that LTE can increase or decrease in q, consider $\theta < \overline{\theta}$. Then, $\frac{dLTE}{dq} \propto \frac{dLT^{CM}}{dq}$. Further, observe that $\theta^{LT} < \overline{\theta}$ if λ is sufficiently small. Then, as established in Lemma 6 ii), $\frac{dLT^{CM}}{dq}$ decreases if $c < c^{LT}$ and $q < q^{LT}$, and increases otherwise. This proves Proposition 3 iii).

Proof of Lemma 3

Concerning part i), note that the controversy manager's investigation is not informative if the value function coincides with its concavication. This is the case if $\frac{1+\psi}{1+\psi+\theta(1-\psi)} = \mu_P(\alpha)$. Solving for α yields $\alpha^*_\psi = \frac{pq\theta(1-\psi)}{pq\theta(1-\psi)+(1-p)(1+\psi)-p\theta(1-\psi)}$. Further, we have $\alpha^*_\psi(\psi=0) = \alpha^*$, $\alpha^*_\psi(\psi=1) = 0$, and $\frac{\partial \alpha^*_\psi}{\partial \psi} = -\frac{2\theta(1-p)pq}{(p(-\psi-\theta(1-\psi)(1-q)-1)+\psi+1)^2} < 0$.

Concerning part ii), note first that the right-hand side of inequality (17) decreases in α. In the *low-quality tax authority information case*, we want to ensure that (17) holds irrespective of α. We have a necessary condition if the inequality holds for $\alpha = 0$. Introducing $\alpha = 0$ into (17), and imposing equality, yields $\frac{8\theta\psi}{(1+\psi)(1+\theta-(1-\theta)\psi)} + \psi = 1$. Solving for ψ gives $\underline{\psi}$.

In the *high-quality tax authority information case*, we want to ensure that (17) is violated irrespective of α. We have a necessary condition if the inequality is violated for $\alpha = 1$. Introducing $\alpha = 1$ into (17), and imposing equality, yields $\frac{8\theta\psi}{(1+\psi)(1+\theta-(1-\theta)\psi)} + 2p\psi - \psi = 1$. Solving for ψ gives $\overline{\psi}$. The above results imply that for $\underline{\psi} < \psi < \overline{\psi}$ there must be α^{crit} as described in the lemma.

Proof of Proposition 4

Inserting the optimal signal for the low-quality case from Table 2, the tax manager's objective function is given by

$$u^{TM}_{\underline{\psi}} = \alpha - \alpha^2 - \alpha \cdot \left(\frac{(1-p)}{p(1-q)+(1-p)} \cdot \left(1 - \frac{\theta(1-\psi)(p(1-(1-\alpha)(1-q)))}{\alpha(1-p)(1+\psi)} \right) \right) \cdot \lambda .$$

The objective function is concave ($\frac{\partial^2 u^{TM}_{\underline{\psi}}}{\partial \alpha^2} = -2$), and the maximum is interior since

$$\lim_{\alpha \to 0} \left(\frac{\partial u^{TM}_{\underline{\psi}}}{\partial \alpha} \right) = \frac{(1-\lambda)(1-p)(1+\psi) + p(1-q)(\theta(\lambda(1-\psi)) + \psi + 1)}{(1+\psi)(1-pq)} > 0,$$
$$\lim_{\alpha \to 1} \left(\frac{\partial u^{TM}_{\underline{\psi}}}{\partial \alpha} \right) = -\frac{(\lambda+1)(1-p)(\psi+1) + p(1-q)(-\theta\lambda(1-\psi) + \psi + 1)}{(\psi+1)(1-pq)} < 0.$$

The maximum is given by $\hat{\alpha}_{\underline{\psi}} = \frac{(1-\lambda)(1-p)(1+\psi)+p(1-q)(\theta(\lambda(1-\psi))+\psi+1)}{2(1+\psi)(1-pq)}$.

Further, $\frac{\partial \hat{\alpha}_{\underline{\psi}}}{\partial \psi} = -\frac{p(1-q)\theta\lambda}{(1-pq)(1+\psi)^2} < 0$. This shows part i).

Next, the tax manager's objective function $u_{\overline{\psi}}^{TM}$ is given by introducing the optimal signal for the high-quality case from Table 2 into (18). The objective function is concave:

$$\frac{\partial^2 u_{\overline{\psi}}^{TM}}{\partial \alpha^2} = -\frac{\lambda(1-p)(1-q)q^2\left(1-\psi^2\right)+4\theta\psi(1-pq)(\alpha(1-q)+q)^3}{2\theta\psi(1-pq)(\alpha+(1-\alpha)q)^3} < 0.$$

Thus, $\hat{\alpha}$ is either 0, 1, or the solution to the first-order condition $\frac{\partial u_{\overline{\psi}}^{TM}}{\partial \alpha} = 0$. This shows part ii).

Figures and Tables

Figure 1: Timeline

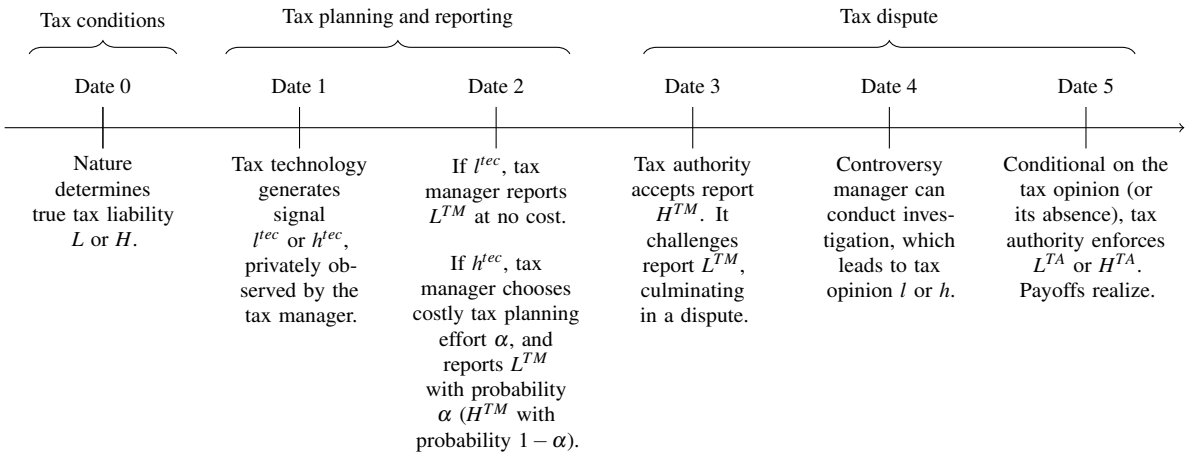
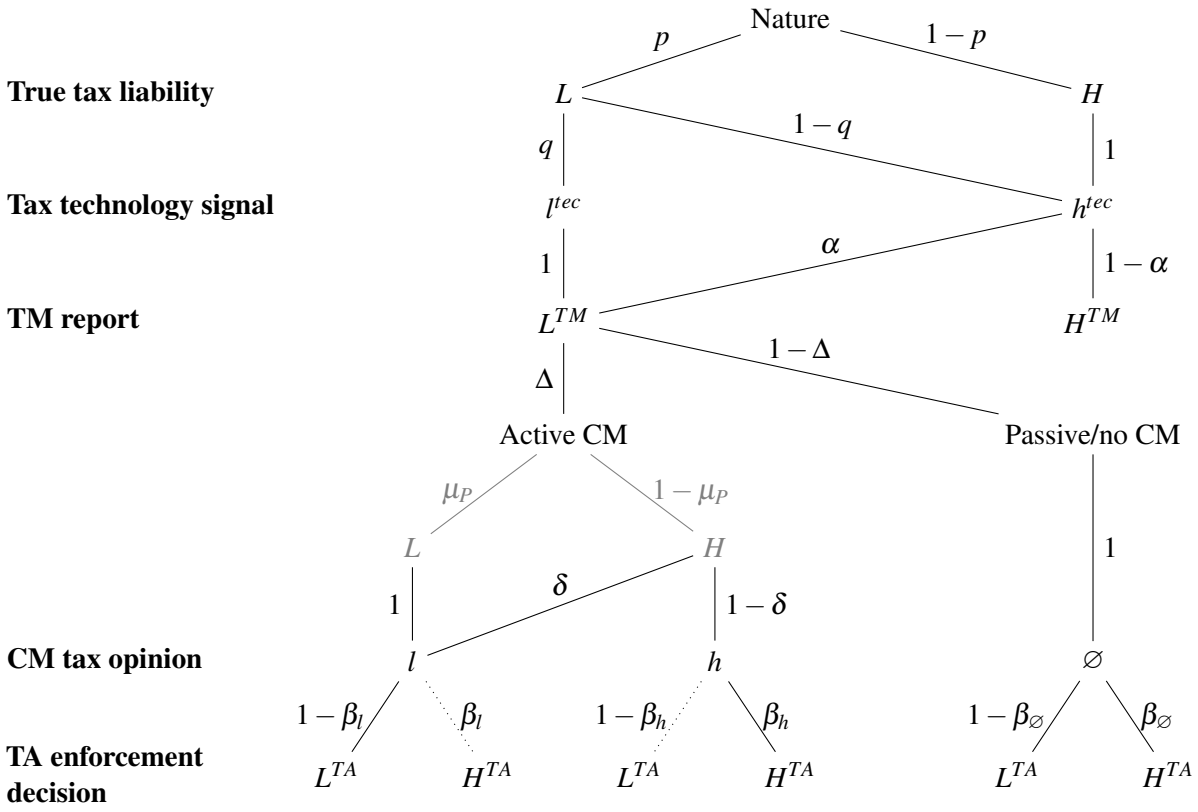
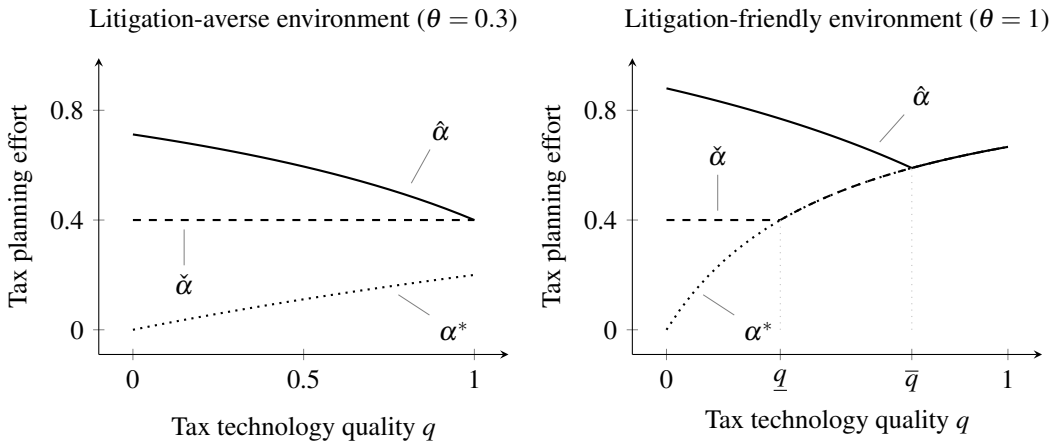


Figure 2: Game Tree.



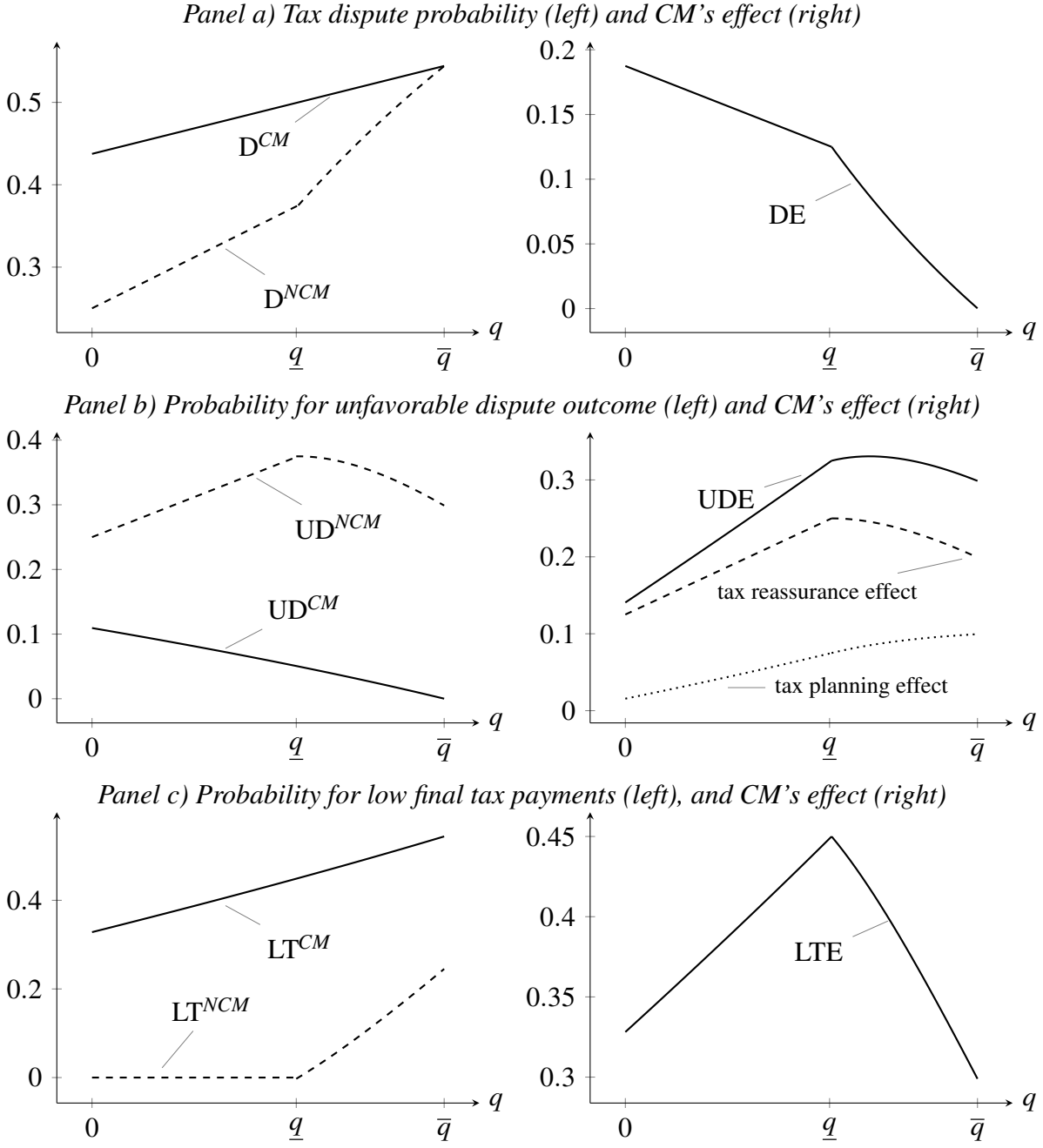
Note: Nature and tax technology are exogenous; tax manager (TM), controversy manager (CM), and tax authority (TA) are players. TM chooses α, CM chooses Δ and δ, and TA chooses β_j with $j \in \{l, h, \varnothing\}$. In addition, for $\Delta = 0$, the game tree depicts the game without a CM. The gray lines indicate that the CM's investigation provides a signal about the true tax liability, which is truthfully submitted. The dotted lines are off-equilibrium path.

Figure 3: Effect of tax technology quality on the tax manager's tax planning effort



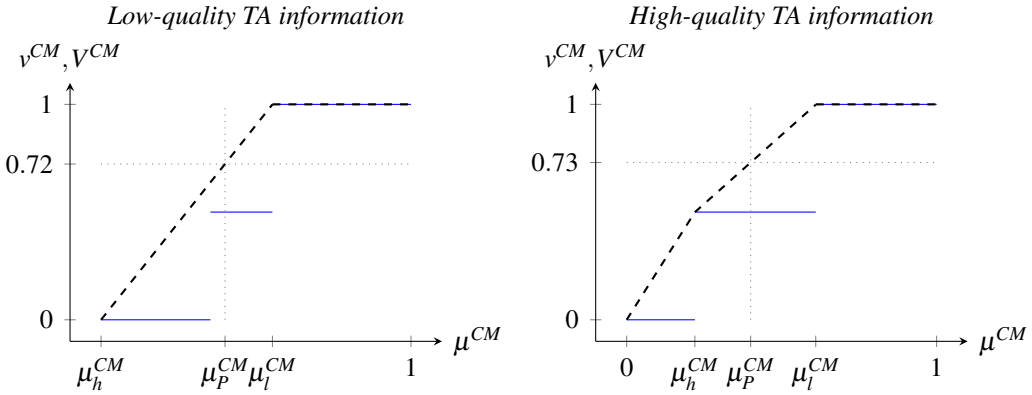
Note: This figure illustrates Corollary 1 and 2. The results are shown for a litigation-averse (left, $\theta = 0.3$) and litigation-friendly (right, $\theta = 1$) environment. The dashed (solid) lines constitute the effort, absent a controversy manager $\check{\alpha}$ (with a controversy manager $\hat{\alpha}$). The dotted lines depict the critical value α^*, which determines the obtained equilibrium (Propositions 1 and 2). The other parameters are chosen as $\lambda = 0.6, c = 1, p = 0.4$.

Figure 4: Corporate tax metrics and controversy manager's effect depending on tax technology quality



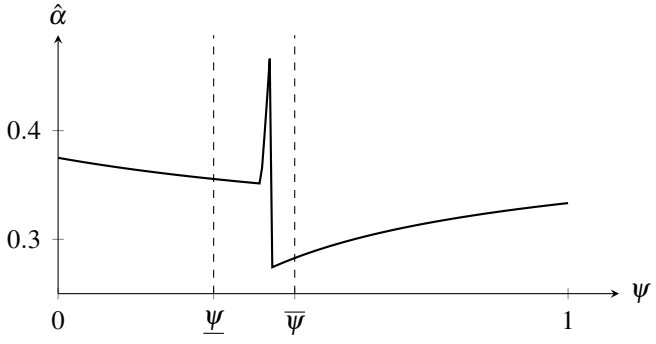
Note: This figure illustrates Proposition 3, and Lemmas 5, and 6. Panel a): tax dispute probability. Panel b): probability of unfavorable dispute outcome. Panel c): probability of low final tax payments. On the left, we plot the corporate metrics with (solid lines) and without a controversy manager (dashed lines). On the right, we plot the (absolute) difference, that is, the effect of the controversy manager. Parameters are $\theta = \lambda = p = 0.5, c = 2$, which constitute a litigation-friendly environment. We have $\underline{q} = 0.33, \overline{q} = 0.57$.

Figure 5: Controversy manager's value function with private tax authority information



Note: The blue lines show the controversy manager's value function and the black dashed lines its concavication. We choose exogenous priors (independent from α) for expositional purposes. The tax authority's priors are assumed equally distributed for the same reason. Parameters are $\theta = 1, \mu_P^{CM} = 0.4$ as well as $\mu_{P,l}^{TA} = 0.55, \mu_{P,h}^{TA} = 0.35$ (left-hand side) and $\mu_{P,l}^{TA} = 0.7, \mu_{P,h}^{TA} = 0.3$ (right-hand side). When the middle piece of the value function touches the concavication (right-hand side), a qualitatively new set of optimal posteriors of the controversy manager is induced, especially, $\mu_h^{CM} > 0$. This requires that the controversy manager's prior lies within the second piece of the value function; see footnote 27.

Figure 6: Effect of the tax authority's private information quality on tax planning effort



Note: This figure illustrates Proposition 4. Parameters are $p = \theta = \lambda = q = \frac{1}{2}$.

Table 1: Tax authority's prior beliefs, distribution of priors, and posterior beliefs.

TA information quality	$\psi = 0$	$0 < \psi < 1$	$\psi = 1$
$\Pr(l^{TAinfo})$, $\Pr(h^{TAinfo})$	$\frac{1}{2}, \frac{1}{2}$	$\mu_P \frac{1+\psi}{2} + (1-\mu_P)\frac{1-\psi}{2}$, $\mu_P \frac{1-\psi}{2} + (1-\mu_P)\frac{1+\psi}{2}$	$\mu_P, 1-\mu_P$
$\Pr(L\|l^{TAinfo})$, $\Pr(L\|h^{TAinfo})$	μ_P, μ_P	$\frac{p(\psi+1)((\alpha-1)(1-q)+1)}{-\alpha\psi+\alpha+\alpha p(\psi+\psi(1-q)-q)+p(1+\psi)q}$, $\frac{p(\psi-1)((\alpha-1)(1-q)+1)}{p(\alpha(\psi-(1-\psi)(1-q)+1)+\psi-\psi(1-q)-q)-\alpha(\psi+1)}$	$1, 0$
TA's posterior given priors, depending on CM's posterior	μ^{CM}, μ^{CM}	$\frac{(1+\psi)\mu^{CM}}{1-\psi+2\psi\mu^{CM}}, \frac{(1-\psi)\mu^{\mathrm{CM}}}{1+\psi-2\psi\mu^{CM}}$	$1, 0$

Note: The distribution of the tax authority's prior beliefs (first row) is given by the probability that the tax authority observes the low (l^{TAinfo}) or high (h^{TAinfo}) signal realization. The second row shows the tax authority's prior belief that the true tax liability is low *after* observing the signal realization (l^{TAinfo} or h^{TAinfo}). The third row shows the tax authority's posterior as a function of its prior and the controversy manager's prior and posterior (see also Footnote 24, Alonso and Câmara 2016, Proposition 1, and Gentzkow and Kamenica 2014, p. 460).

Table 2: Optimal controversy manager's posterior belief, distribution of controversy manager's posterior beliefs, and optimal signal.

	Low-quality TA information	High-quality TA information
Optimal CM belief	$\mu_h^{CM}=0,\ \mu_l^{CM}=\frac{1+\psi}{\theta(1-\psi)+\psi+1}$	$\mu_h^{CM}=\frac{1-\psi}{\theta(\psi+1)-\psi+1}$, $\mu_l^{CM}=\frac{1+\psi}{\theta(1-\psi)+\psi+1}$
CM belief dist.	$\Pr(\mu_l^{CM})=\mu_P\frac{\theta(1-\psi)+\psi+1}{1+\psi}$, $\Pr(\mu_h^{CM})=1-\Pr(\mu_l^{CM})$	$\Pr(\mu_l^{CM})=\frac{\mu_h^{CM}-\mu_P}{\mu_h^{CM}-\mu_l^{CM}}$, $\Pr(\mu_h^{CM})=1-\Pr(\mu_l^{CM})$
Optimal signal	$\delta_\downarrow\equiv\Pr(l\|H)=\frac{1-\psi}{1+\psi}\theta\frac{p(\alpha+(1-\alpha)q)}{\alpha(1-p)}$, $\delta_\uparrow\equiv\Pr(h\|L)=0$	$\delta_\downarrow=\frac{\theta p(1-\psi)(1+\psi)q}{4\alpha(1-p)\psi}-\frac{\alpha(1-\psi)(1-p(1-\psi)-\theta p(\psi+1)(1-q)-\psi)}{4\alpha(1-p)\psi}$, $\delta_\uparrow=-\frac{(1-\psi)^2q}{4(\psi-(1-\alpha)\psi(1-q))}+\frac{\alpha(1-\psi)(1-p(\psi+\theta(1-\psi)(1-q)+1)+\psi)}{4\theta p\psi(1-(1-\alpha)(1-q))}$

Note: The first row shows the optimal posterior belief of the controversy manager (that the true tax is low) after her investigation leads to a high (μ_h^{CM}) or low (μ_l^{CM}) signal realization. These optimal posterior beliefs are induced by the concavication V^{CM}. The second row shows the corresponding distribution, as determined by Bayes plausibility, $\mu_P=\mu_h^{CM}\Pr(\mu_h^{CM})+\mu_l^{CM}\Pr(\mu_l^{CM})$. Finally, the third row depicts the controversy manager's optimal investigation/the signal implied by her posterior beliefs and belief distribution.