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An economic analysis of joint tax audits*

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Abstract

We investigate how tax authorities use joint tax audits in cross-border transactions of a multinational firm. Joint tax audits aim to resolve potential tax disputes early, before such disputes escalate into costly and time-consuming resolution procedures that may not fully eliminate double taxation. Employing a game-theoretic model, we identify settings in which we expect joint audits to occur and investigate their effect on the firm's expected tax payments and tax audit efficiency. We find that the occurrence of joint audits depends on the double taxation risk absent such audits. This risk critically shapes the firm's income-shifting strategy, and the firm prefers to change its strategy to induce joint tax audits when this risk is high. Thereby, the firm enables tax authorities to better target tax disputes via joint audits that otherwise escalate. While joint audits then reduce the firm's expected tax payments, we surprisingly identify conditions under which tax audit efficiency also decreases, despite both tax authorities' consent to coordinate on a joint audit. Our results imply that the resulting coordination costs should be allocated between tax authorities and the firm according to the level of double taxation risk. This implication is particularly relevant for policymakers designing joint audit frameworks.

Keywords: joint tax audits, double taxation, dispute prevention, income shifting
JEL classification: H26, H87, F23, M42, C72

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TWO audit teams – ONE common solution – ZERO double or non-taxation.
That is what joint audits are about![1]

— Eva Oertel

1 Introduction

Joint tax audits have emerged as a critical tool in international tax enforcement. They involve two or more tax authorities collaboratively reviewing taxpayer records, thereby ensuring consistent tax assessments across jurisdictions and preventing double taxation (Burgers & Criclivaia, 2016; Čičin-Šain & Englisch, 2022). Double taxation arises when two or more tax authorities assert the right to tax the same income, and is a result of inconsistent applications of tax rules across jurisdictions. Anecdotal and empirical evidence suggests that inconsistent applications of tax rules, for example of transfer pricing rules, are widespread (Diller et al., 2025; Rathke et al., 2020). Theoretical models similarly predict inconsistent applications of tax rules as a result of tax competition (Mansori & Weichenrieder, 2001; Raimondos-Møller & Scharf, 2002), and this problem is further aggravated by the widespread fiscal constraints currently faced by many countries (e.g., PwC, 2025). Due to the economic distortions for firms, instruments to prevent double taxation ex ante, such as Advance Pricing Agreements (APAs) or Advance Tax Rulings (De Waegenaere et al., 2007; Diller et al., 2017), and to resolve double taxation of escalated disputes ex post, such as Mutual Agreement Procedures (MAPs) or arbitration (Martini et al., 2025), exist. However, these instruments are costly and time-consuming for all stakeholders (OECD, 2019).

Given this context, joint tax audits have been introduced as a policy response to reduce international tax disputes through coordinated enforcement. Joint audits can be conducted across various cross-border transactions, including transfer pricing cases, profit attribution to permanent establishments, and complex business restructurings. First pilot projects indicate that joint tax audits can be an efficient and timely alternative to traditional dispute prevention and resolution instruments (Braun et al., 2020). Most recently, the Directive on Administrative Cooperation (DAC7) provides the first legally binding framework for conducting joint tax audits

[1] The quote is cited in OECD (2019, p. 13). At that time, Eva Oertel was a Legal Counsel for International Tax Policy at the Federal Ministry of Finance in Berlin.

in the European Union (Čičin-Šain & Englisch, 2022; Form & Oestreicher, 2021). Despite the growing interest of policymakers and practitioners, we lack a theoretical understanding of when tax authorities are willing to engage in joint audits and what their economic implications are. This question is particularly pertinent because, although joint tax audits are expected to prevent disputes, they typically require greater administrative resources than national audits (Burgers & Criclivaia, 2016; OECD, 2019).

To address this gap, we develop a game-theoretic model that analyses the strategic interactions between a multinational firm, two tax authorities, and their respective national tax auditors. In particular, we study the conditions under which we expect joint tax audits to arise and their effects on the firm's expected tax payments and tax audit efficiency.

The model features a multinational firm operating in a high-tax and a low-tax country. Part of the firm's income is disputed with regard to its allocation between the two countries. The true allocation is determined by the state of the world. In 'consistent' states, tax rules are consistently applied across countries even in a national audit. In the 'inconsistent' state, tax rules are inconsistently applied if no joint tax audit is established and a national audit is conducted, leading to double taxation. The firm privately observes the state and reports the disputed income to one of the tax authorities. Reporting disputed income to the low-tax authority can constitute income shifting. In particular, the firm can engage in 'aggressive' income shifting when both countries would agree the income should be taxed in the high-tax country (consistent state), in 'moderate' income shifting when both countries would disagree on the income allocation (inconsistent state), or abstain from income shifting altogether.[2] For example, the firm can shift income by varying a royalty payment from a subsidiary located in the low-tax country to the parent company located in the high-tax country. Following the firm's report, both tax authorities independently decide whether to opt for a joint tax audit, which is established only if both give their consent. If no joint audit occurs, the decisions to conduct (in-depth) national audits are delegated to strategic tax auditors.[3] While joint audits involve additional coordination costs for

[2]We refer to income shifting in this consistent state as aggressive, since the firm deliberately misreports against a shared understanding of where income should be taxed. In the inconsistent state, shifting is termed moderate, as any interpretation is reasonable and both countries can plausibly claim taxing rights.

[3]We focus on permanently audited multinational firms, and thus the national audit decisions reflect auditors' decisions to conduct in-depth national audits of the underlying transaction.

both net-revenue maximising authorities, joint audits prevent double taxation and avoid the costs associated with dispute resolution procedures (e.g., MAPs) when national audits would lead to double taxation. We label the latter as 'inconsistency costs'.

Three key institutional characteristics that depend on the specific country pair shape the players' behaviour in the model. *Tax rule inconsistency* reflects how likely it is that diverging interpretations are practically applied under national audits, which varies even within OECD countries (Diller et al., 2025). This institutional friction directly affects the behaviour of national tax auditors. These auditors typically have implicit incentives to increase revenues by uncovering income shifting (Blaufus et al., 2025), but also face personal audit costs. As tax rule inconsistency increases, so does the likelihood that (at least moderate) income shifting occurs, making their decisions to conduct national audits more attractive. The tax authorities base their preceding joint audit decisions on the anticipated behaviour of the national auditors. While national audits increase revenues if they uncover income shifting, they may trigger *inconsistency costs* in the case of double taxation. These costs capture the administrative and procedural burden of resolving disputes through mechanisms such as MAPs. The costs can vary across countries, as, for example, reflected in different MAP durations (Martini et al., 2025). Higher inconsistency costs make joint audits more attractive to the tax authorities as a means to prevent disputes ex ante. A third institutional factor is the *residual risk of double taxation* for the firm, which captures the effectiveness of dispute resolution mechanisms in eliminating double taxation after national audits. The higher this risk, the less likely the firm is to engage in moderate income shifting, and the more likely conflicting preferences become between the firm and the authorities regarding joint versus national audits. This risk is low in country pairs with mandatory binding arbitration and can be high otherwise, particularly when the countries' tax rates are similar.

Our equilibrium analysis reveals how the firm's income shifting decisions, the tax authorities' decisions to opt for a joint audit, and the auditors' decisions to conduct national audits depend on these institutional characteristics. We find that the economic implications of joint tax audits critically depend on the firm's residual double taxation risk *absent* joint audits. When this risk is low, joint audits only occur when the tax authorities' expected inconsistency costs under national audits are higher than the additional coordination burdens under a joint tax audit. Therefore,

a necessary condition for joint audits to occur is that the tax authorities' expected deadweight losses are lower than under national audits. Since these deadweight losses serve as our measure for tax audit efficiency, this reveals that when the residual risk is low, joint audits are always efficient if established. However, the converse is not true, as not all efficiency-enhancing joint audits are established. A joint audit requires mutual consent by both authorities, and the tax authority in the low-tax country blocks some efficiency-enhancing joint tax audits because the low-tax authority does not internalise the inconsistency cost savings that could be realised by the high-tax authority. This reveals a fundamental coordination problem in decentralised enforcement settings that efficiency can be necessary but not sufficient for implementation.

When tax rule inconsistency is sufficiently low but the risk of residual double taxation is high—that is, disputes are rare but in case of occurrence hard to resolve through traditional dispute resolution—we find that joint tax audits are unlikely to be initiated. However, as soon as tax rule inconsistency exceeds a threshold, we show that a national audit and a joint audit equilibrium may coexist. In the national audit equilibrium, the auditors of both countries conduct some national audits, and the firm engages in some moderate and aggressive income shifting. In the joint audit equilibrium, the firm engages in no moderate income shifting and more aggressive income shifting compared to the national audit equilibrium. On the one hand, the different income shifting behaviour enables the tax authorities' to more effectively use joint audits to target genuine tax disputes that emerge in the inconsistent state, as the required inconsistency costs for joint audits decrease. On the other hand, the changed income shifting behaviour triggers the possibility that joint audits get inefficient, because these can occur even for low levels of inconsistency costs. Summing up, we generally find that the existence of joint audits can decrease tax audit efficiency. This result is striking given that our tax audit efficiency definition incorporates both tax authorities' expected deadweight losses and their mutual consent is required for joint audits to occur. Further, we also show that efficient joint audits can be blocked by either tax authority, which contrast the findings from the low risk case.

We also examine how the presence of joint tax audits affects the firm's expected tax payments compared to a setting with only national audits. Across all equilibria, our findings suggest that the expected tax payments in the consistent states are identical, and hence any differences

originate from the inconsistent state. When the residual double taxation risk is low, joint audits can increase expected tax payments because they can prevent the firm from fully leveraging the tax rate differential through moderate income shifting. Once the residual risk of double taxation is sufficiently high, joint tax audits always reduce the firm's expected tax payments. Because joint tax audits require both authorities to agree on a common report that eliminates double taxation, a high residual risk undermines the prospects of reaching such an agreement due to negative revenue implications for at least one authority. Notably, the cases where joint audits reduce expected tax payments coincide with those in which joint audits may be inefficient.

Concerning regulatory implications, our findings suggest that when the residual double taxation probability is low, a regulatory cost-sharing mechanism that reallocates coordination costs from the low-tax to the high-tax authority could enable more coordinated enforcement and efficient outcomes. By contrast, when the residual double taxation risk is high, a third-party cost-sharing approach involving the firm is more suitable. If the firm shares part of the coordination burden, such cost-sharing approach could better align the firm's preferences with overall efficiency goals.

We contribute to the literature in two ways. First, we contribute to the literature on strategic individual and corporate taxpayer audits (e.g., Graetz et al., 1986; Mills et al., 2010; Sansing, 1993). Within this literature, De Waegenaere et al. (2006) employ an international tax compliance model with potential inconsistent applications of transfer prices and investigate the economic effects of harmonising transfer pricing rules on income shifting and audit strategies. Diller et al. (2025) examine the effects of enhancing standards consistency on a firm's reporting and tax authorities' audit strategies, additionally including real effects. Unlike these studies, we analyse joint tax audits as an institutional mechanism that can be used by tax authorities to overcome inconsistency when harmonisation is difficult or practically impossible.

Similarly, other studies consider institutional mechanisms to resolve or prevent inconsistencies and disputes. Kourouxous et al. (2024) study how the presence of a court of appeals affects taxpayer reporting and the tax authority's audit process. In an international setting, Martini et al. (2025) analyse how different arbitration mechanisms to resolve double taxation affect tax audit qualities. Unlike these resolution mechanisms, preventive mechanisms, such as joint tax audits,

are voluntarily established by some of the players. De Simone et al. (2013) examine when firms and tax authorities voluntarily enter into Enhanced Relationship Programs and how the benefits of the program are shared. Diller et al. (2017) analyse the circumstances under which investors request Advance Tax Rulings. Unlike these studies, we focus on dispute prevention in an international setting. Similar to our international setting, De Waegenaere et al. (2007) examine when bilateral APAs arise and how they affect tax audit efficiency. They find that the absence of bilateral APAs can reveal private information which can decrease tax audit efficiency. Our study differs from De Waegenaere et al. (2007) because joint tax audits do not require the firm's consent and the authorities' joint audit decisions are based on the firm's report. We find that the existence of joint tax audits can decrease tax audit efficiency because the firm alters its income-shifting strategy, while the information-revealing channel of De Waegenaere et al. (2007) is muted in our setting.

Second, we contribute to the literature on joint audits in non-tax settings. Deng et al. (2014) analyse joint audits in which two audit firms simultaneously but yet separately audit a firm's financial statement, considering two joint audit and one single audit regime. They find that joint audits can impair audit quality due to free-riding incentives. Biehl et al. (2022) propose an extension of this model and additionally consider joint audit synergies. Blaufus et al. (2024) examine whether tax audits become more efficient if tax auditors have access to information about statutory audit adjustments. Their setting can be interpreted as a sequential joint audit of two auditors with distinct but related audit fields. While these joint audit models also result in a common report, our tax setting differs because participation is voluntary and endogenous, the relationship absent a joint tax audit is more adversarial, and free-riding incentives are muted. Taken together, we are the first to theoretically examine the distinct characteristics and economic effects of joint tax audits compared to other tax dispute prevention tools and non-tax joint audits.

The paper proceeds as follows. Section 2 describes the relevant elements of the institutional setting. Section 3 introduces the analytical model and its main assumptions. Section 4 presents the equilibria depending on the low or high residual double taxation risk. Section 5 identifies the economic effects of joint audits. Finally, section 6 concludes.

2 Institutional framework

The OECD's Base Erosion and Profit Shifting project marked a turning point in international tax cooperation. In particular, action 14 of the project emphasised improving tax dispute resolution mechanisms between member states to address double taxation and income shifting by multinational firms (OECD, 2015). Against this backdrop, joint tax audits emerged as a critical tool in international tax enforcement in a short period of time. In contrast to national or simultaneous audits, joint tax audits involve two or more tax authorities collaboratively reviewing taxpayer records, ensuring consistent tax assessments across jurisdictions and thereby avoiding double taxation (Burgers & Criclivaia, 2016; Form & Oestreicher, 2021). While information exchange is a key component of a joint tax audit, this exchange also exists outside joint tax audits. Thus, what sets the different audit types apart is the ability to reach a common assessment through mutual understanding (OECD, 2019).

A joint tax audit typically replaces a national audit and renders subsequent MAPs, which are used to resolve double taxation arising from escalated disputes, unnecessary. An alternative for resolving double taxation issues related to transfer prices are APAs, which are based on the same legal provision as MAPs, namely Article 25 of the OECD Model Convention for Double Taxation Agreements. Even though both MAPs and APAs can provide solutions to double taxation issues, both exhibit similar weaknesses as they are time consuming and are mostly unable to resolve issues in advance of an audit (Zimmerl, 2022).

Important milestones in institutionalising joint tax audits within the European Union include the EU directive on Tax Dispute Resolution Mechanisms and DAC7. While the former introduced mandatory binding arbitration and encouraged member states to conduct joint audits (EU Council, 2017), the latter establishes a legal and administrative framework by providing a structured approach to collaboration and information sharing mechanism aimed at standardising joint audit procedures within the European Union (Čičin-Šain & Englisch, 2022; Form & Oestreicher, 2021). The 2008 revision of Article 26 of the UN Model Tax Convention also played a key role in facilitating joint tax audits. It influenced agreements at both the European and OECD levels and supported the establishment of joint audits through bilateral treaties by promoting information exchange between contracting states. Its provisions regarding the scope

of information, confidentiality, and conditions for exchange were a contributing factor that led to the facilitation of joint audits globally. However, to this point, there is no institutional framework that mandates joint tax audits. In all cases, joint tax audits have to be initiated by one party and subsequently mutually agreed upon by the other participating parties (OECD, 2019). In addition, under the current European and global provisions, taxpayers do not have a legally standardised right to request or reject a joint audit (Čičin-Šain & Englisch, 2022; Form & Oestreicher, 2021).

Globally, by 2020, we observe 232 joint audit cases (Braun et al., 2020). Although administrative barriers with regard to aligning the various tax audit procedures of participating jurisdictions were not yet fully resolved, first pilot projects between Germany, France, and the Netherlands in the early 2010s demonstrated that joint tax audits have the potential to prevent international tax disputes (Criclivaia, 2020; OECD, 2019). The majority of the pilot projects were initiated by member states of the European Union with Germany in the lead having initiated 113 of those 232 joint audits (Braun et al., 2020; Criclivaia, 2020).[4] Recently, we also observe joint tax audits with a number of non-European countries. Initial reports indicate that joint tax audits can be a time-saving tool as compared to other traditional resolution procedures, as most cases have been resolved and double taxation has been avoided. However, joint tax audits still lack mass suitability (Form & Oestreicher, 2021). Also, joint audits are conducted by a limited pool of specialised auditors, and impose additional coordination burdens on tax authorities due to differences in procedures, legal frameworks, and audit standards, as well as practical challenges such as language barriers (Burgers & Criclivaia, 2016). This calls for a theoretical foundation of joint tax audits.

3 Model

3.1 *Model setup*

We now present the model setup, which is a variation of the international tax compliance model of De Waegenaere et al. (2006) that additionally incorporates joint tax audits.

[4] Joint tax audits exhibit a close resemblance to the interstate tax audits conducted by the Multistate Tax Commission in the United States (Burgers & Criclivaia, 2016). Within the United States, first pilot projects regarding state-level sales and income tax were completed as early as 1969 (Multistate Tax Comission, 1970).

Basic assumptions We assume that a firm with worldwide income W operates in two countries, a low-tax country L and a high-tax country H. The firm's income must be taxed in either of these countries. Income is subject to tax rate τ_L in the low-tax country or tax rate τ_H in the high-tax country with $\tau_H > \tau_L \geq 0$. Part of this income is disputed, where the disputed income is normalised to one. There are three possible states of nature: y_L, y_H and y_B. In state y_L (y_H), both tax authorities agree that the firm's disputed income should be taxed in country L (H). In state y_B, a tax dispute arises as both tax authorities claim the right to tax the firm's income following national audits, resulting in double taxation. The probabilities of the states are $\Pr(y_L) = \Pr(y_H) = (1-p)/2$ and $\Pr(y_B) = p$, where $p \in [0,1]$ reflects the probability that the tax rules are inconsistently applied by the tax authorities. For example, a high p may reflect transactions between countries with fundamentally different transfer pricing systems (Rathke et al., 2020). However, even among countries aligned with OECD guidelines, inconsistent applications of rules are prevalent, as shown by anecdotal evidence (Diller et al., 2021, 2025) and the high concentration of arbitration cases within this group (Martini et al., 2025).

The firm privately observes the state of nature, which captures the informational asymmetry typically assumed between the firm and the tax authorities or auditors before any audit. After observing the state, the firm reports its aggregate taxable income W to country L and H. We restrict our focus to income shifting, which requires that aggregate income reported must equal W. For example, the firm can vary a royalty payment from a subsidiary located in L to the parent company located in H owning the intangible property. Therefore, we implicitly assume that cross-border information exchange, disclosure requirements, and substantial penalties for misreporting deter tax evasion (i.e., reported aggregate income smaller than W). The critical decision concerns the country to which the firm shifts the disputed income, either to L or H, as reflected in the respective reports x_L and x_H.

Next, both tax authorities observe the firm's report x_L or x_H and simultaneously decide whether they want to opt for a joint tax audit. Only when both tax authorities independently opt for the joint audit, it is established. Otherwise, the audit decision is delegated to strategic tax auditors who can audit nationally.[5] Joint tax audits involve additional coordination burdens

[5]The simultaneous joint audit decisions avoid introducing strategic timing frictions unrelated to the core question of coordinated enforcement and reflect the institutional reality that the momentum for coordination is typically

relative to national audits (Burgers & Criclivaia, 2016; OECD, 2019). We model this by a cost $K > 0$ each tax authority incurs in case of a joint tax audit. Ultimately, the tax authorities' joint audit decisions are a trade-off between the additional coordination cost and the potential to avoid inconsistency costs associated with costly MAPs or arbitration, while accounting for the expected tax revenue consequences of the different types of audits. The payoffs are described in the following. Figure 1 depicts the game tree.

[Figure 1 about here]

National tax audits If no joint tax audit is established, the tax authorities delegate the audit decisions to their respective national auditors, who also observe the report x_i with $i \in \{L,H\}$. If conducted, national audits reveal the state. The tax auditors in both countries receive a fixed benefit $b > 0$ if they uncover income shifting. For example, tax auditor H receives the benefit when x_L is reported and he uncovers state y_H ('aggressive' income shifting) or y_B ('moderate' income shifting). Conversely, auditor L receives the benefit when x_H is reported and states y_L or y_B are uncovered. However, auditing is personally costly to the auditors at cost $c_i > 0$ with $c_i < b$. These assumptions reflect that tax auditors typically have implicit incentives to generate additional revenues through tax audits (Blaufus et al., 2024, 2025). The benefit in state y_B reflects the current environment of intensified competition for tax revenues across countries (e.g., Blaufus et al., 2023). In addition, we require that $b > 2c_H$, which guarantees that auditor H's audit threat is credible even if there is no inconsistency ($p = 0$).

The auditors' decisions affect the tax authorities' collected revenues. If the firm shifts income aggressively (report x_L in state y_H) and auditor H conducts an audit, the tax authority collects the tax and an additional penalty $\tau_H(1+\pi)$. This is similarly true in the opposite case when the state is y_L, the firm reports x_H, and auditor L audits, but this case never occurs in equilibrium. Thus, only the penalty π imposed by country H is relevant. In either case, the other authority collects no revenues because the allocation of income is undisputed in the consistent states.

lost once in-depth national audits have commenced (OECD, 2019). In addition, the setup reflects that national audits are typically delegated to national tax auditors, whereas joint audits require higher-level coordination between authorities that are conducted by other auditors (Braun et al., 2020; Federal Central Tax Office, 2025).

If an audit is conducted in the inconsistent state y_B by auditor i after a report x_{-i}, both tax authorities claim the right to tax the disputed income, resulting in double taxation. Authority i, however, does not claim a penalty as any interpretation is reasonable in state y_B. To resolve double taxation, we assume that the firm initiates a MAP (potentially followed by arbitration) or litigates nationally.[6] The outcome of the dispute resolution procedure is that tax authority i (auditor i has audited x_{-i}) collects $\varepsilon\tau_i$ with $0 \leq \varepsilon \leq 1$, and tax authority $-i$ taxes the full income. In the following, we refer to ε as the residual double taxation risk, where 'residual' refers to double taxation after the dispute resolution procedure. For example, if $\varepsilon = 0$, there would be mandatory binding arbitration in both countries, completely resolving double taxation. If $\varepsilon = 1$, both countries claim to tax the disputed income even after MAP. This modelling choice captures the assumption that the MAP procedure or arbitration panel favours the initial report x_i of the firm.[7]

Dispute resolution procedures aimed at eliminating double taxation have implications beyond the mere allocation of tax payments. These procedures are often lengthy and resource-intensive for tax authorities (Martini et al., 2025) and may erode taxpayers' trust in the fairness and efficiency of the system (Braun et al., 2020). Therefore, we additionally consider these *inconsistency costs*, and model them as an amount $k\tau_i$ with $k > 0$ incurred by each tax authority when national audits lead to double taxation. Countries with a higher tax rate thus have a larger share of revenue at stake, triggering more complex and costly resolution processes (Martini et al., 2025). High levels of k can occur when countries, such as the United States or India with a long average duration for arbitration cases, are part of the firm's business activity. Avoiding these inconsistency costs is among the determining factors for tax authorities to initiate joint tax audits.

Table 1 summarises the players' payoffs for every possible state y_i and action choice in the national audit. Given that auditing x_i is a dominated strategy for tax auditor i, these choices are not included in the table.

[6] Our model captures both dispute resolution procedures. However, since national litigation is less common than resolution through MAP or arbitration, we concentrate on the international mechanisms in the main text.

[7] The assumption is consistent with our interpretation of state y_B, in which any outcome supported by robust documentation is considered reasonable. Given the cooperative nature of joint tax audits, we expect a more balanced allocation of income between countries compared to the typically adversarial nature of ex post dispute resolution procedures such as MAP or arbitration. We specify this balanced allocation below.

[Table 1 about here]

Joint tax audit Once both tax authorities opt for a joint tax audit, involving coordination cost $K > 0$ for each authority, we assume that no further strategic decisions are made. National auditors no longer play an active role, and the authorities are assumed to reach a common agreement, as there is a strong commitment to reach an agreement once joint tax audits are in place.[8] As in national tax audits, we assume that joint tax audits reveal the state. In the consistent states, the revenue consequences are equivalent to those under national audits. In state y_B, however, the authorities agree on an income allocation that prevents double taxation. We model the joint audit outcome parsimoniously by assuming that, at the time of the joint audit decision, the share κ allocated to tax authority H is unknown. κ is drawn from a probability distribution with full support on [0,1], and independent of x_i. We consider symmetric distributions, for example, $\kappa \sim U(0,1)$, with all players anticipating the expected share $\mathbb{E}(\kappa) = \mathbb{E}(1-\kappa) = 1/2$. Table 2 summarises the players' payoffs for every possible state y_i and report x_i.

[Table 2 about here]

3.2 *Strategies and objective functions*

We now turn to the players' strategies and their objective functions. Since the firm observes the state, it conditions its strategy on this private information. In state y_L, the firm has a dominant strategy of reporting x_L, as it can be sure that this report will be accepted regardless of the subsequent decisions by other players. In state y_H, the firm chooses a mixed strategy reporting x_H with probability α and x_L with probability $1-\alpha$, maximising $\mathbb{E}[u_F(\alpha|y_H)]$. In state y_B, it chooses a mixed strategy reporting x_H with probability β and x_L with probability $1-\beta$, maximising $\mathbb{E}[u_F(\beta|y_B)]$.

Both tax authorities observe the report x_i. Tax authority H chooses probability $\mu_H(x_i)$ to conduct a joint tax audit, considering expected payoffs in a joint audit $\mathbb{E}[v_H(JA|x_i)]$ and national audit $\mathbb{E}[v_H(NA|x_i)]$. Similarly, tax authority L chooses probability $\mu_L(x_i)$ considering

[8] As Braun et al. (2020, p. 24) note: 'So far, almost all [joint tax audit] cases have been resolved and double taxation avoided'. Also, the assumption aligns with those made for Bilateral Advance Pricing Agreements (De Waegenaere et al., 2007) and Cooperative Compliance Programs (De Simone et al., 2013).

$\mathbb{E}[v_L(JA|x_i)]$ and $\mathbb{E}[v_L(NA|x_i)]$. If no joint tax audit is established, the tax auditors come into play. Tax auditor H never audits x_H, since the auditor can only benefit from an audit of x_L. However, conditional on x_L, he chooses an audit probability γ by maximising $\mathbb{E}[u_H(\gamma|x_L)]$. Analogously, tax auditor L never audits x_L and chooses an audit probability δ by maximising $\mathbb{E}[u_L(\delta|x_H)]$. We next show the players' objective functions given their available information when making their strategic decisions. We start with the tax auditors' audit decisions.

Tax auditors' audit decisions Conjecturing the firm's strategies α and β, tax auditor H's expected utility given report x_L is

$$\mathbb{E}[u_H(\gamma|x_L)] = \gamma[(\Pr(y_H|x_L) + \Pr(y_B|x_L))\, b - c_H], \tag{1}$$

with

$$\Pr(y_H|x_L) = \frac{\frac{1-p}{2}(1-\alpha)}{\frac{1-p}{2}(1-\alpha) + \frac{1-p}{2} + p(1-\beta)}, \tag{2}$$

$$\Pr(y_B|x_L) = \frac{p(1-\beta)}{\frac{1-p}{2}(1-\alpha) + \frac{1-p}{2} + p(1-\beta)}. \tag{3}$$

Thus, tax auditor H trades off the expected benefit of uncovering income shifting against the audit costs. Similarly, tax auditor L's expected utility given report x_H is given by

$$\mathbb{E}[u_L(\delta|x_H)] = \delta[\Pr(y_B|x_H)\, b - c_L] = \delta\left[\frac{p\beta}{p\beta + \frac{1-p}{2}\alpha} b - c_L\right]. \tag{4}$$

Notably, the expected benefit to conduct an audit increases for both tax auditors when tax rule inconsistency p is higher.

Tax authorities' joint audit decisions The tax authorities simultaneously decide on whether they opt for a joint audit. They conjecture the firm's reporting strategy, the other tax authority's joint audit strategy, and the auditors' audit strategies if no joint tax audit is established. Given a

report x_L, tax authority H's expected payoff from a joint and national audit is

$$\mathbb{E}\left[v_H(JA|x_L)\right] = \Pr\left(y_H|x_L\right)\tau_H(1+\pi) + \Pr\left(y_B|x_L\right)\frac{\tau_H}{2} - K, \tag{5}$$

$$\mathbb{E}\left[v_H(NA|x_L)\right] = \gamma[\Pr\left(y_H|x_L\right)\tau_H\left(1+\pi\right) + \Pr\left(y_B|x_L\right)\left(\varepsilon - k\right)\tau_H]. \tag{6}$$

Thus, upon observing report x_L, tax authority H prefers a joint audit if

$$\tau_H\left[\Pr(y_H|x_L)(1-\gamma)(1+\pi) + \Pr(y_B|x_L)\left(\frac{1}{2} - \gamma(\varepsilon - k)\right)\right] \geq K. \tag{7}$$

Tax authority H's trade-off conditional on x_L is as follows. On the cost side, joint audits incur additional coordination costs and the authority loses expected tax revenues from double taxation. On the benefit side, it taxes the income and imposes an additional penalty if no national audit occurs in y_H, it taxes half of the income in y_B, and, most importantly, it saves the inconsistency costs when double taxation would occur in a national audit.

Conditional on x_L, tax authority L's expected payoffs from a joint and national audit is

$$\mathbb{E}\left[v_L(JA|x_L)\right] = \Pr\left(y_L|x_L\right)\tau_L + \Pr\left(y_B|x_L\right)\frac{\tau_L}{2} - K, \tag{8}$$

$$\mathbb{E}\left[v_L\left(NA|x_L\right)\right] = \tau_L - \gamma[\Pr\left(y_H|x_L\right)\tau_L + \Pr\left(y_B|x_L\right)\tau_L k]. \tag{9}$$

Thus, tax authority L prefers a joint audit if

$$\tau_L\left[\Pr\left(y_B|x_L\right)\left(\gamma k - \frac{1}{2}\right) - \Pr\left(y_H|x_L\right)(1-\gamma)\right] \geq K. \tag{10}$$

Intuitively, preventing the inconsistency costs arising from double taxation is the only advantage for authority L in this case. Other than that, a joint tax audit has negative revenue implications and induces the coordination cost K. Overall, tax authority L and H choose $\mu_i(x_L)$ so as to maximise

$$\mathbb{E}\left[v_i\left(\mu_i(x_L)\right)\right] = \mu_i(x_L)\mu_{-i}(x_L)\mathbb{E}\left[v_i\left(JA|x_L\right)\right] + \left(1 - \mu_i(x_L)\mu_{-i}(x_L)\right)\mathbb{E}\left[v_i\left(NA|x_L\right)\right]. \tag{11}$$

The following lemma simplifies the equilibrium analysis. The proof is in the Appendix B.

Lemma 1. *If the firm reports x_L, the joint audit incentive for tax authority H is always higher than for tax authority L. Thus, the binding constraint to consider is* (10).

Lemma 1 establishes that in the equilibrium analysis, it suffices to focus on tax authority L's joint audit decision when the firm reports x_L. If (10) does not hold, no joint tax audit can occur.

Next, we turn to the decisions when the firm reports x_H. As this report cannot stem from state y_L, tax authority H's expected payoffs in a joint and national audit are

$$\mathbb{E}\left[v_H\left(JA|x_H\right)\right] = \Pr\left(y_H|x_H\right)\tau_H + \Pr\left(y_B|x_H\right)\frac{\tau_H}{2} - K, \tag{12}$$

$$\mathbb{E}\left[v_H\left(NA|x_H\right)\right] = \Pr\left(y_H|x_H\right)\tau_H + \Pr\left(y_B|x_H\right)\tau_H - \delta\Pr\left(y_B|x_H\right)k\tau_H. \tag{13}$$

Thus, tax authority H prefers a joint audit if

$$\tau_H \Pr(y_B|x_H)\left(\delta k - \frac{1}{2}\right) \geq K. \tag{14}$$

In this case, tax authority H trades-off the benefit of preventing inconsistency costs against the negative revenue effect of splitting the tax base and the coordination cost. Similarly, we obtain tax authority L's expected payoffs

$$\mathbb{E}\left[v_L\left(JA|x_H\right)\right] = \Pr\left(y_B|x_H\right)\frac{\tau_L}{2} - K, \tag{15}$$

$$\mathbb{E}\left[v_L\left(NA|x_H\right)\right] = \delta\left[\Pr\left(y_B|x_H\right)\left(\varepsilon - k\right)\tau_L\right]. \tag{16}$$

Thus, tax authority L prefers a joint audit if

$$\tau_L \Pr(y_B|x_H)\left(\delta(k-\varepsilon) + \frac{1}{2}\right) \geq K. \tag{17}$$

The trade-off resembles the one for tax authority H after a report x_L. Notably, we cannot establish a similar result as in Lemma 1 when the report is x_H. While the joint audit incentive for tax authority L is higher when $K = 0$ due to $\delta(k-\varepsilon) + \frac{1}{2} > \delta k - \frac{1}{2}$, this need not be the case

when the coordination costs K are high.[9] Overall, tax authority L and H choose $\mu_i(x_H)$ so as to maximise

$$\mathbb{E}\left[v_i\left(\mu_i(x_H)\right)\right] = \mu_i(x_H)\mu_{-i}(x_H)\mathbb{E}\left[v_i\left(JA|x_H\right)\right] + \left(1-\mu_i(x_H)\mu_{-i}(x_H)\right)\mathbb{E}\left[v_i\left(NA|x_H\right)\right]. \quad (18)$$

Firm decisions The firm conjectures the auditors' audit decisions and the probabilities that a joint audit is established $\mu_L(x_i)\mu_H(x_i)$. As explained above, the firm always reports x_L in state y_L. In state y_H, the firm trades-off the costs and benefits of aggressive income shifting $1-\alpha$. Then, the firm's expected utility is given by

$$\begin{aligned}\mathbb{E}\left[u_F\left(\alpha|y_H\right)\right] = &-\alpha\tau_H - (1-\alpha)\left[\mu_H(x_L)\mu_L(x_L)\tau_H(1+\pi)+\right.\\ &\left.\left(1-\mu_H(x_L)\mu_L(x_L)\right)\left(\gamma\tau_H(1+\pi)+(1-\gamma)\tau_L\right)\right]. \quad (19)\end{aligned}$$

From the perspective of the firm, joint tax audits and a national audit by auditor H are equally threatening, as both lead to a repayment of the tax and a penalty when it reports x_L in y_H.

In state y_B, the firm trades off the costs and benefits of moderate income shifting with probability $1-\beta$. The firm's expected utility is given by

$$\begin{aligned}\mathbb{E}\left[u_F\left(\beta|y_B\right)\right] = &-\left[\frac{\tau_L+\tau_H}{2}\right]\left[\beta\,\mu_H(x_H)\mu_L(x_H)+(1-\beta)\,\mu_H(x_L)\mu_L(x_L)\right]\\ &-\beta\left(1-\mu_H(x_H)\mu_L(x_H)\right)\left[\delta\left(\tau_H+\varepsilon\tau_L\right)+(1-\delta)\tau_H\right]\\ &-(1-\beta)\left(1-\mu_H(x_L)\mu_L(x_L)\right)\left[\gamma(\tau_L+\varepsilon\tau_H)+(1-\gamma)\tau_L\right]. \quad (20)\end{aligned}$$

When no joint audit is established, the firm's objective functions are fully in line with our benchmark model. Further, when tax authorities agree on a joint audit, for example after report x_L, the firm can prevent double taxation by choosing $\beta = 0$. Since the same outcome can also be achieved when joint audits are conducted after x_H and the firm chooses $\beta = 1$, this gives rise to multiple equilibria. We discuss this in more detail in the next section.

[9] Lemma 1 is driven by our modelling choice for the inconsistency costs, that is, $k\tau_i$. If we model fixed inconsistency costs k independent of τ_i, Lemma 1 would not hold and the implications are similar to those in our setup when the report is x_H. By contrast, with fixed inconsistency costs, we could establish a similar lemma where (14) is the binding constraint when the report is x_H. Our results remain qualitatively unchanged for fixed inconsistency costs.

4 Equilibria

4.1 *General remarks*

In this section, we characterise the equilibria. Our equilibrium concept is Perfect Bayesian Equilibrium as defined in Gibbons (1992). When multiple equilibria arise for the same parameter values, we focus on those that are weakly payoff dominant (i.e., all players are weakly better off and at least one is strictly better off). For example, we exclude equilibria in which the firm's expected tax payments and the auditors' expected payoffs are identical to that in another equilibrium, but tax authorities incur higher deadweight losses (inconsistency and coordination costs).[10] We also rule out equilibria that rely on firm randomisation in state y_B to induce a joint tax audit, as these only occur for extremely high inconsistency costs. Overall, we obtain equilibria that are institutionally plausible.[11]

The following observation underscores the role of De Waegenaere et al. (2006) as our benchmark model.

Observation. *Suppose there are no inconsistency costs ($k = 0$). Then, only national audits will be conducted, and we obtain equilibria I^{NA} to VI^{NA} with strategic tax auditors.*

The observation can be directly seen from the tax authorities' expected utilities. If we neglect inconsistency costs, tax authority L never prefers a joint audit when observing x_L (see equation 10) and tax authority H never prefers a joint audit when observing x_H (see equation 14). Since a joint audit requires consent of both authorities, this implies that only national audits are conducted. We postpone the proof that equilibria I^{NA} to $\mathrm{VI}^{\mathrm{NA}}$ exist to Proposition 1 to 5.

The various national audit equilibria crucially depend on the residual double taxation risk ε and the tax rule inconsistency p. The intuition behind the national audit equilibria is as follows. For a given level of ε, an increase in inconsistency generally induces auditors to adopt more rigorous audit strategies. This, in turn, reduces aggressive income shifting by the firm, but may generally increase or decrease moderate income shifting. The increase in audit aggressiveness

[10] Harsanyi and Selten (1988) develop strict payoff dominance as a criterion for equilibrium selection, noting that weak payoff dominance is a possible refinement.

[11] As Korn and Schiller (2003) point out, equilibrium refinements should identify those equilibria that are (likely to be) observed in reality.

also increases tax authorities' expected inconsistency costs. If the authorities want to conduct a joint tax audit, a sufficiently high inconsistency p ensures credible off the equilibrium path (national audit) threats. Moreover, for a given level of p, an increase in ε generally discourages moderate income shifting. While this does not discourage joint tax audits per sé, it increases the range where national audit equilibria are feasible.

More specifically, the national audit equilibria depend on threshold values for the probability of double taxation, namely $\varepsilon_1^* = (\tau_H - \tau_L)/\tau_H$ and $\varepsilon_2^* = \pi + (\tau_H - \tau_L)/\tau_H$, as well as threshold values for tax rule inconsistency, namely p_1^*, p_2^* and p_3^*.[12] We will show that the thresholds are defined as

$$p_1^* = \frac{c_H}{2(b-c_H)+c_H}, \quad p_2^* = \frac{(b-c_H)c_L + (b-c_L)c_H}{(b-c_H)c_L + (b-c_L)c_H + 2(b-c_H)(b-c_L)}, \text{ and}$$

$$p_3^* = \frac{(b-2c_H)c_L}{(b-2c_H)c_L + 2(b-c_L)(b-c_H)}.$$

The value p_1^* reflects the value of p for which auditor H would be indifferent between auditing and not auditing reports x_L if the firm would never engage in aggressive income shifting but always engages in moderate income shifting. The value p_2^* (p_3^*) is the value of p for which auditor H would always audit (auditor L audits with positive probability) when the residual double taxation risk is high, that is, $\varepsilon > \varepsilon_2^*$. Similar to the benchmark model, our assumptions guarantee that $0 \leq p_1^* \leq p_2^* \leq 1$ and $0 \leq p_3^* \leq p_2^* \leq 1$.

Tax authorities' joint tax audit decisions will also depend on threshold values for inconsistency costs. Therefore, we will only discuss two ε-cases, namely $\varepsilon < \underline{\varepsilon}$ and $\varepsilon > \overline{\varepsilon}$, where

$$\underline{\varepsilon} = \min\left\{\frac{\tau_H - \tau_L}{\tau_H}, \frac{\tau_H(1+\pi) - \tau_L}{2\tau_H}\right\} \quad \text{and} \quad \overline{\varepsilon} = \varepsilon_2^* = \frac{\tau_H(1+\pi) - \tau_L}{\tau_H}.$$

Intuitively, the case when the residual double taxation risk is low ($\varepsilon < \underline{\varepsilon}$) occurs when the countries participate in mandatory binding arbitration or when their tax rate differential is

[12] Compared to our model, De Waegenaere et al. (2006) differ on one key dimension. In our model, tax auditors conduct national audits, while in their model, these are conducted by the tax authorities themselves. Tax authorities directly consider the revenue implications of the audit, particularly $\varepsilon\tau_i$ in state y_B, while auditors receive a fixed benefit b. Therefore, while ε_1^* and ε_2^* remain identical, the threshold values for tax rule inconsistency become independent of ε in our model.

high. By contrast, the case when this double taxation risk is high ($\varepsilon > \overline{\varepsilon}$) occurs if the tax rate differential is low and no binding arbitration exists.

To keep the following Propositions concise, we report only the outcomes of the joint audit decisions $\mu_L^*(x_L)\mu_H^*(x_L)$ and $\mu_L^*(x_H)\mu_H^*(x_H)$ in the main text. The individual decisions $\mu_i^*(x_L)$ and $\mu_i^*(x_H)$, as well as the specific values of mixed strategies (where applicable) and the proofs, are provided in the Appendix B.

4.2 *Low residual double taxation risk*

To begin, let us preview the different equilibria regions when the residual double taxation risk is low $\varepsilon < \underline{\varepsilon}$ in Figure 2, depending on the probability of tax rule inconsistency p and inconsistency cost k. Importantly, the equilibrium that is played crucially depends on the specific country-pair combination in which the firm's business activity takes place. The intuition for all equilibria regions is illustrated in Figure 4 in the Appendix A. There, we provide a parsimonious classification for potentially observed equilibria, taking Germany as a fixed part of the country-pair combination.[13]

[Figure 2 about here]

When the residual double taxation risk is low, the following equilibria arise when p is smaller than p_1^*.

Proposition 1. *If $p < p_1^*$ and*

(i) if $k < k_I^*$, we obtain equilibrium I^{NA}.

The firm chooses a mixed reporting strategy α^* in y_H and always reports x_L in y_B ($\beta^* = 0$). The tax authorities do not conduct joint tax audits. Auditor H chooses a mixed auditing strategy γ^* of reports x_L, and auditor L never audits reports x_H ($\delta^* = 0$).

(ii) if $k > k_I^*$, we obtain equilibrium I^{JA}.

The firm chooses a mixed reporting strategy α^* in y_H and always reports x_L in y_B ($\beta^* = 0$). The tax authorities conduct joint tax audits of reports x_L with probability $\mu_L^*(x_L)$, and no

[13] Germany is a global pioneer with regard to joint tax audits (Braun et al., 2020; Criclivaia, 2020), making it a particularly fitting example.

joint tax audits of reports x_H. Auditor H chooses a mixed auditing strategy γ^* of reports x_L, and auditor L never audits reports x_H ($\delta^* = 0$).

In equilibrium I^{NA}, no joint tax audits are established because the (expected) inconsistency costs are too low ($k < k_I^*$), particularly for tax authority L. Further, there is no pure strategy with regard to auditor H's national audit strategy γ^* and aggressive income shifting α^*. Intuitively, when auditor H always audits ($\gamma = 1$), the firm will never engage in aggressive income shifting ($\alpha = 1$); but then the relatively low inconsistency $p < p_1^*$ implies that auditor H would not audit anymore ($\gamma = 0$). However, if auditor H does not audit, the firm would prefer to always engage in aggressive income shifting ($\alpha = 0$), which incentivises auditor H to always audit. Thus, the only equilibrium is in mixed strategies γ^* and α^*. Also, as the residual double taxation risk is low, the firm prefers to always engage in moderate income shifting $\beta^* = 0$. Consequently, auditor L never audits $\delta^* = 0$.

In equilibrium I^{JA}, some joint tax audits of reports x_L are conducted when the (expected) inconsistency costs are sufficiently high ($k > k_I^*$). In addition, the same notion for auditor H's audit strategy and aggressive income shifting as in equilibrium I^{NA} applies, requiring randomisation γ^* and α^*. The reason that only *some* reports x_L are jointly audited is as follows. If tax authority L always opted for a joint audit ($\mu_L(x_L) = 1$), the joint audit would always be established (see Lemma 1). Then, aggressive income shifting would be deterred ($\alpha = 1$), and the relatively low inconsistency $p < p_1^*$ implies that auditor H would not audit ($\gamma = 0$). This, however, mutes the off the equilibrium path audit threat of auditor H, leading to expected inconsistency costs of zero. Then, tax authority L would prefer a national audit ($\mu_L(x_L) = 0$) to avoid the joint audit coordination cost $K > 0$. By contrast, due to $k > k_I^*$, the (expected) inconsistency costs in the national audit equilibrium I^{NA} are so high that tax authority L wants to conduct some joint tax audits. Thus, the equilibrium requires mixed strategy $\mu_L^*(x_L)$.

Equilibria I^{NA} and I^{JA} correspond to settings with limited disputes over the application of tax rules and country pairs with binding arbitration or sufficiently different tax rates. Equilibrium I^{NA} is likely when both countries consistently apply the OECD Transfer Pricing Guidelines and exhibit relatively moderate MAP durations. Many transaction within the European Union, for example, among Germany (high-tax) and Ireland (low-tax) could fall into this category. By

contrast, equilibrium I^{JA} would require a country pair characterised by significantly prolonged MAP or arbitration procedures.

Next, we turn to the equilibria that arise when p is larger than p_1^*.

Proposition 2. *If $p > p_1^*$ and*

(i) if $k < k_{II}^*$, we obtain equilibrium II^{NA}.

The firm always reports x_H in y_H ($\alpha^* = 1$) and x_L in y_B ($\beta^* = 0$). The tax authorities do not conduct joint tax audits. Auditor H always audits reports x_L ($\gamma^* = 1$), and auditor L never audits reports x_H ($\delta^* = 0$).

(ii) if $k > k_{II}^*$, we obtain equilibrium II^{JA}.

The firm always reports x_H in y_H ($\alpha^* = 1$) and x_L in y_B ($\beta^* = 0$). The tax authorities always conduct joint tax audits of reports x_L, and never of reports x_H. Auditor H would always audit reports x_L ($\gamma^* = 1$), and auditor L never audits reports x_H ($\delta^* = 0$).

In equilibrium II^{NA}, no joint tax audit is established because the (expected) inconsistency costs are too low for tax authority L to initiate one ($k < k_{II}^*$). Compared to equilibrium I^{NA}, auditor H has now sufficient incentives to always audit report x_L due to $p > p_1^*$, although the report solely stems from moderate income shifting. Thus, $\alpha^* = \gamma^* = 1$ arise simultaneously, and, together with $\beta^* = \delta^* = 0$, constitute this pure strategy equilibrium.

In equilibrium II^{JA}, the inconsistency costs are sufficiently high ($k > k_{II}^*$) that both tax authorities always initiate joint tax audits after a report x_L. Compared to equilibrium II^{NA}, the authorities' joint audit decision neither changes the firm's income shifting decisions nor the auditors' audit strategies. The reason is that, from the firm's perspective, both the joint and national audit are qualitatively identical in uncovering aggressive income shifting. Also, the firm still prefers to always engage in moderate income shifting, as the resulting joint audit eliminates double taxation and yields a higher payoff than the otherwise certain tax payment of τ_H. Importantly, our equilibrium concept requires auditor H to act optimally off the equilibrium path. The resulting audit threat ($\gamma^* = 1$) ensures that authority L opts for the joint audit to avoid the inconsistency costs that would otherwise arise in a national audit.

Equilibria II^{NA} and II^{JA} reflect situations with substantial disputes over the application of tax rules, but where dispute resolution mechanisms to eliminate double taxation are in place. Transactions involving many European countries and Italy are likely to fall under equilibrium II^{JA}, as Italy is known for unilateral transfer pricing adjustments (Diller et al., 2021).

Corollary 1 emphasises two additional implications of the equilibria.

Corollary 1. *The required inconsistency costs for joint tax audits approach to infinity when* $\tau_L = 0$*, and are (significantly) higher when tax rules are consistently applied (*$p < p_1^*$*).*

First, we find that joint tax audits do not occur with tax haven countries ($\tau_L = 0$), as the required inconsistency costs k_I^* and k_{II}^* get extremely high. Second, we find that when tax rule inconsistency is low, joint tax audits require significantly higher inconsistency costs ($k_I^* \gg k_{II}^*$) to be worthwhile for the authorities. Put differently, joint audits are less likely in low-p environments unless the (expected) inconsistency costs stemming from MAPs or arbitration are very high. The requirement $k > k_I^*$ could reflect extremely long and resource-intensive MAPs, as, on average, in cases involving the United States (Martini et al., 2025). By contrast, if $k > k_{II}^*$, joint audits may become attractive even under average MAP or arbitration durations. Notably, marginal increases in p, especially around the threshold p_1^*, can substantially expand the joint audit equilibrium range, as auditor H's strategy changes discontinuously.

The strategies of the players are summarised in Table 3 when the residual double taxation risk is low.

[Table 3 about here]

4.3 *High residual double taxation risk*

Now, we turn to the different equilibria regions when the residual double taxation risk is high ($\varepsilon > \overline{\varepsilon}$). We preview the different equilibria in Figure 3.

[Figure 3 about here]

The following equilibria arise when p is smaller than p_3^*.

Proposition 3. *If $p < p_3^*$,*

(i) we obtain equilibrium V^{NA}.

The firm chooses a mixed reporting strategy α^* in y_H and always reports x_H in y_B ($\beta^* = 1$). The tax authorities do not conduct joint tax audits. Auditor H chooses a mixed auditing strategy γ^* of reports x_L, and auditor L never audits reports x_H ($\delta^* = 0$).

(ii) $p_1^* < p < p_3^*$ and $k > k_{II}^*$, we obtain equilibrium II^{JA} (see Proposition 2 (ii)).

(iii) $p_3^* < p_1^*$ and $k > k_V^*$, we obtain equilibrium I^{JA} (see Proposition 1 (ii)).

In equilibrium $\mathrm{V^{NA}}$, the tax authorities prefer national audits over joint audits. Further, the firm engages in some aggressive income shifting α^* but no moderate income shifting ($\beta^* = 1$). The relatively low inconsistency implies that auditor H does not want to always audit. However, the national audit probability γ^* together with the high double taxation probability ε deter moderate income shifting. Although $\beta^* = 1$ creates audit incentives for auditor L, the level of inconsistency is yet too low for auditing reports x_H ($\delta^* = 0$). Interestingly, this national audit equilibrium exists independent of the size of inconsistency costs k. The reason is that in this national audit equilibrium, the tax authorities do not incur any inconsistency costs in expectation. Hence, they have no incentive to conduct joint audits. Notably, this is the *only* national audit equilibrium with this characteristic.

The mere fact that tax authorities would always prefer a national tax audit when $p < p_3^*$ does not imply that this equilibrium is actually played. As we show in Proposition 3 (ii) and (iii), joint audit equilibria do exist when $p < p_3^*$. First, consider the case $p_3^* < p_1^*$ depicted in Figure 3, which occurs if auditor L's audit cost c_L is not too high. Then, for very high inconsistency costs $k > k_V^*$, the firm prefers to play equilibrium $\mathrm{I^{JA}}$, as the prevalence of some joint tax audits ($\mu_L^*(x_L) > 0$) would reduce the firm's expected tax payments compared to equilibrium $\mathrm{V^{NA}}$ (see Proposition 6 below). In the figure, k_V^* is, however, outside the plot range, suggesting that this equilibrium is unlikely to occur when tax rate differences are low compared to when the differences are high. Second, consider the case $p_1^* < p < p_3^*$, which requires that c_L is higher than c_H. For example, in Figure 3, $p_1^* < p_3^*$ would require $c_L > 0.0\overline{6}$, all else equal. When tax rule inconsistency takes these weakly intermediate values, the firm always prefers to play

equilibrium II^{JA} as its resulting expected tax payments in state y_B are lower. Taken together, we cannot rank these potential national and joint audit equilibria according to weak payoff dominance and thus cannot make a prediction on which equilibrium will arise. However, we expect that firms will try to persuade tax authorities to conduct joint tax audits if they report the disputed income in the low-tax country.

The presented equilibria correspond to settings in which the difference in tax rates between the countries is similar and the residual risk of double taxation is substantial, but there are limited disputes on the application of tax rules. We expect that national tax audits are the likely outcome in these scenarios.

The following equilibria arise when p is larger than p_3^* but smaller than p_2^*.

Proposition 4. *If $p_3^* < p < p_2^*$ and*

(i) if $k < k_{VI}^*$, we obtain equilibrium VI^{NA}.

The firm chooses a mixed reporting strategy α^* in y_H and β^* in y_B. The tax authorities do not conduct joint tax audits. Auditor H chooses a mixed auditing strategy γ^* of reports x_L, and auditor L chooses a mixed auditing strategy δ^* of reports x_H.

(ii) if $k > k_{III}^*$, we obtain equilibrium III^{JA}.

The firm chooses a mixed reporting strategy α^* in y_H and always reports x_H in y_B ($\beta^* = 1$). The tax authorities always conduct joint tax audits of reports x_H, and never of reports x_L. Auditor H chooses a mixed auditing strategy γ^* of reports x_L, and auditor L would always audit reports x_H ($\delta^* = 1$).

In equilibrium VI^{NA}, the inconsistency costs are too low ($k < k_{VI}^*$) for joint tax audits to be strictly preferred by the authorities despite the intermediate tax rule inconsistency p. Compared to equilibrium V^{NA}, auditor L now audits with positive probability $\delta^* > 0$, because state y_B is sufficiently likely when $p > p_3^*$. As a response, the firm engages in some moderate income shifting to balance the double taxation arising from the national audits by both auditors.

In equilibrium III^{JA}, the tax authorities always initiate joint tax audits after a report x_H when the inconsistency costs are sufficiently high ($k > k^*_{III}$).[14] The other strategies on the equilibrium path are mostly in line with equilibrium V^{NA}. The firm engages in some aggressive income shifting α^* and auditor H audits reports x_L with probability γ^*. A pure strategy by either of the two players cannot be sustained in equilibrium. Further, the firm chooses report x_H in state y_B ($\beta^* = 1$), because auditor H's audit threat and the relatively high double taxation amount deter moderate income shifting. Auditor L acts optimally off the equilibrium path and creates a credible threat that inconsistency costs after a report x_H occur ($\delta^* = 1$), inducing the tax authorities to coordinate on a joint tax audit.

Our results imply that when the inconsistency costs take intermediate values ($k^*_{III} < k < k^*_{VI}$), both equilibria coexist and no prediction can be made concerning the equilibrium that will be played. Again, the firm will promote the use of joint tax audits as the expected tax payments are lower in expectation, while at least one tax authority is better off in the national audit equilibrium. Intuitively, the firm acknowledges that a certain minimum level of inconsistency costs k^*_{III} is necessary for an equilibrium, although it unambiguously prefers a joint tax audit independent of this minimum level. By contrast, one tax authority is only willing to give up the higher expected tax payments in the purely national audit equilibrium when the inconsistency costs exceed k^*_{VI}. In Figure 3, tax authority L is reluctant to give up the purely national audit for $p^*_3 < p < 0.48$, while authority H is reluctant for $0.48 < p < p^*_2$. To sum up, only if the inconsistency costs are low (high), we can conclude that the pure national (partial joint) audit equilibrium will be played.

The presented equilibria correspond to settings in which the (in-)consistency in the application of tax rules takes intermediate values. Also, the equilibria require that the residual risk that double taxation prevails is high or that the tax rate differential between the countries is low. The former describes many transactions between European countries and non-European countries such as China and India, as the latter two reject mandatory binding arbitration in their tax treaties.

[14] Our equilibrium refinement to focus on weakly payoff dominant equilibria excludes equilibrium II^{JA} in this parameter range. As we show in section 5, the expected tax payments in II^{JA} are identical but the tax authorities' deadweight losses are higher.

The latter can occur even between European countries if the characteristics of the transaction favour national litigation over dispute resolution via MAP or arbitration.[15]

Lastly, we present the equilibria that arise when p is larger than p_2^*.

Proposition 5. *If $p > p_2^*$ and*

(i) if $k < k_{IV}^*$, we obtain equilibrium IV^{NA}.

The firm always reports x_H in y_H ($\alpha^* = 1$) and chooses a mixed reporting strategy β^* in y_B. The tax authorities do not conduct joint tax audits. Auditor H always audits reports x_L ($\gamma^* = 1$), and auditor L chooses a mixed auditing strategy δ^* of reports x_H.

(ii) if $k > k_{III}^*$, we obtain equilibrium III^{JA} (see Proposition 4 (ii)).

Equilibrium IV^{NA} constitutes an aggressive national audit equilibrium when the inconsistency costs are sufficiently low ($k < k_{IV}^*$). Here, compared to VI^{NA}, the even higher level of inconsistency induces auditor H to adopt a pure audit strategy of always auditing x_L. Consequently, the firm does not engage in aggressive income shifting ($\alpha^* = 1$). In addition, the firm engages in some moderate income shifting and auditor L audits some reports x_H with probability δ^* that is higher than under VI^{NA}.

Since the national audit probabilities are higher in equilibrium IV^{NA} than in VI^{NA}, the required inconsistency costs for a joint tax audit decrease: $k_{IV}^* < k_{VI}^*$. Notably, Figure 3 shows that a range with coexistence of equilibria IV^{NA} and III^{JA} exists, but is negligible in terms of its expected occurrence. The reason is that both auditors' audit probabilities discontinuously increase, sharply increasing the authorities' expected inconsistency costs in IV^{NA}. When the inconsistency costs are sufficiently high ($k > k_{III}^*$), we obtain III^{JA} in which joint tax audits are initiated after reports x_H. Interestingly, this joint audit equilibrium involves more aggressive income shifting as compared to the respective national audit counterparts IV^{NA} and VI^{NA}. As this result becomes more likely when the countries' tax rates are similar, we find that joint tax audits can lead to more aggressive income shifting to (non-traditional) low-tax countries.

Equilibrium III^{JA} typically arises when the residual double taxation probability is high and the countries disagree on the application of tax rules. The range in which this equilibrium is the

[15] The threshold values for the required inconsistency costs can, for example, correspond to the three tertiles of average MAP duration of countries as reported in Appendix A.

unique outcome expands significantly when tax rules are inconsistently applied. We expect that joint tax audits are most commonly initiated by the respective authorities in such cases, even when inconsistency costs are moderate.

Table 4 shows the equilibria illustrated in Figure 3. We omit equilibria I^{JA} and II^{JA}, as these equilibria have already been depicted in Table 3.[16]

[Table 4 about here]

5 Economic effects of joint tax audits

5.1 *Firm's expected tax payments*

In this section, we examine how joint tax audits affect the firm's expected tax payments. Proposition 6 summarises the result.

Proposition 6. *The existence of joint tax audits*

(i) increases the firm's expected tax payments when $\varepsilon < \frac{\tau_H - \tau_L}{2\tau_H}$ *and decreases them when* $\frac{\tau_H - \tau_L}{2\tau_H} < \varepsilon < \underline{\varepsilon}$ *in equilibria* I^{JA} *and* II^{JA} *(low residual double taxation risk case);*

(ii) decreases the firm's expected tax payments in equilibria I^{JA}, II^{JA} *and* III^{JA} *when* $\varepsilon > \overline{\varepsilon}$ *(high residual double taxation risk case).*

The effect of joint tax audits on expected tax payments is evaluated relative to the national audit benchmark that would prevail in their absence. Across all equilibria, the expected tax payments in the consistent states y_L and y_H remain unchanged. In state y_L, the firm always reports x_L, a dominant strategy that leads to a tax payment of τ_L, irrespective of subsequent audit decisions. Similarly, in state y_H, the expected tax payment equals τ_H in all equilibria. To illustrate, consider equilibria III^{JA} and IV^{NA}. In IV^{NA}, the firm adopts a pure strategy $\alpha^*_{IV^{NA}} = 1$, reporting x_H in y_H and thereby paying τ_H with certainty, since double taxation

[16] The case $\underline{\varepsilon} < \varepsilon < \overline{\varepsilon}$ does not lead to additional qualitative insights beyond the high residual double taxation risk case. While there is an additional national audit equilibrium when $p^*_1 < p < p^*_2$ and inconsistency costs are sufficiently low (equilibrium III^{NA}), no additional joint tax audit equilibrium emerges. Further, we also have a considerable range where the purely national audit and partial joint audit equilibrium coexist when inconsistency costs take intermediate values. Depending on parameters, both joint audits after reports x_L and x_H can occur, with joint audits conditional on x_L (on x_H) becoming more likely when ε is lower (higher).

is not possible in the consistent state. By contrast, in III$^{\text{JA}}$, the firm randomises in y_H with probability $\alpha^*_{III^{JA}} = (b-2c_H)/(b-c_H) > 0$. However, the mere fact that it randomises implies that the firm's expected tax payment from reporting x_L or x_H must be equal, that is, τ_H. These observations suggest that any differences in tax payments induced by the presence of joint tax audits originate from the inconsistent state y_B.

We show that when the residual risk of double taxation is sufficiently low ($\varepsilon < \frac{\tau_H - \tau_L}{2\tau_H}$), joint tax audits increase expected tax payments. This is because, in the corresponding national audit equilibria I$^{\text{NA}}$ and II$^{\text{NA}}$, the firm engages in moderate income shifting ($\beta^* = 0$), reporting disputed income in the low-tax country. Given the low residual risk of double taxation, the firm anticipates paying close to τ_L on the disputed income in state y_B. By contrast, in a joint tax audit, the two authorities coordinate and agree to split the income, with tax authority H receiving a substantial share. As a result, expected tax payments rise to $\frac{\tau_L + \tau_H}{2}$. Thus, while joint audits eliminate double taxation, they also prevent the firm from fully leveraging the tax rate differential, thereby increasing its overall tax payments.

Further, we demonstrate that once the residual risk of double taxation becomes sufficiently high, joint tax audits reduce the firm's expected tax payments. Notably, this result holds irrespective of the residual double taxation risk case or the degree of tax rule inconsistency between the countries. The underlying mechanism is straightforward. Because joint tax audits require both authorities to agree on a common report (e.g., a common transfer price), a high residual risk of double taxation ε undermines the prospects of reaching such an agreement. This reflects a general coordination friction that mirrors findings on Bilateral Advance Pricing Agreements (De Waegenaere et al., 2007), and we also find this for joint tax audits when tax rule inconsistency is low ($p < p_3^*$). When inconsistency is high ($p > p_3^*$), however, the impact of ε becomes more complex. On the one hand, ε increases the thresholds k^*_{IV} and k^*_{VI}, thereby narrowing the parameter regions where the equilibrium with joint audit is unique. On the other hand, it also expands the conditions under which equilibrium III$^{\text{JA}}$ emerges, allowing joint audits to become viable over a wider range of inconsistency costs. Hence, the overall effect of ε on the occurrence of joint audits is ambiguous. While it raises coordination barriers from

the authorities' perspective, it can simultaneously promote joint audits by making them more attractive to the firm due to lower expected tax payments.

5.2 *Tax audit efficiency*

In this section, we examine how joint tax audits affect tax audit efficiency. Since the firm's tax payments correspond to tax revenues for the authorities, they represent zero-sum transfers and do not affect efficiency. We define tax audit efficiency as the inverse of the tax authorities' expected deadweight losses, which arise from inconsistency and coordination costs. In other words, the lower these audit-related losses, the higher the tax audit efficiency.[17]

The following observation has already been used for equilibrium selection, but we highlight it explicitly due to its counter-intuitive nature and conceptual significance.

Corollary 2. *Due to aggressive income shifting ($1-\alpha^* > 0$), tax audit efficiency in equilibrium III^{JA} is higher than in equilibrium II^{JA}.*

In particular, we apply Corollary 2 in the high residual double taxation risk case, selecting equilibrium III^{JA} over II^{JA} whenever both exist within the same parameter range. Given that the expected tax payments are identical, the lower deadweight losses in III^{JA} render it the weakly payoff-dominant outcome. A particularly striking implication of this result is that tax audit efficiency improves not *despite* but *because* of aggressive income shifting. While such behaviour might initially appear to undermine enforcement objectives, it can in fact enhance efficiency in our setting. Specifically, the firm's willingness to shift income in the consistent state y_H allows joint audits to be more effectively directed toward genuine disputes, without distorting tax payments. Thus, aggressive income shifting, typically viewed as a concern, can serve a beneficial role in improving the allocation of audit resources between national and joint procedures.

[17] We exclude the tax auditors' payoffs from our definition of tax audit efficiency. This omission is without loss of generality in equilibria where auditor H plays a mixed strategy or is off the equilibrium path; auditor L always has an expected payoff of zero. In these cases, our efficiency concept effectively coincides with social welfare. Only in equilibria II^{NA} and IV^{NA} does it slightly understate overall welfare. However, under the plausible assumption that auditor H's net benefit of uncovering income shifting $b - c_H$ is negligible relative to tax revenues, inconsistency costs, and coordination costs, our efficiency measure remains a valid proxy for welfare.

Next, Proposition 7 summarises how the existence of joint tax audits affects tax audit efficiency.

Proposition 7. *The existence of joint tax audits*

(i) increases tax audit efficiency in case the residual double taxation risk is low;

(ii) can increase or decrease efficiency in case the residual double taxation risk is high.

When the residual double taxation risk is low (part (i)), joint audits are efficient if implemented. However, they may not be established even when they would improve overall efficiency. Mutual consent ensures that both authorities benefit, yet also creates a coordination barrier. Tax authority L blocks cooperation, as it only considers its own avoided inconsistency costs and ignores potentially greater costs faced by tax authority H. This leads to coordination failures rooted in decentralised decision-making despite potential efficiency gains.

When the residual double taxation risk is high (part (ii)), joint tax audits can be inefficient. Consider equilibrium V^{NA} under low inconsistency ($p < p_3^*$). This equilibrium is efficient because national audits only occur in consistent states, avoiding any deadweight losses in the inconsistent state. However, equilibria I^{JA} and II^{JA} may coexist, since the firm seeks to avoid high tax payments in the inconsistent state under national audits. Coordination on a joint audit equilibrium, even if inefficient, can still emerge, as all players' strategies are mutual best responses in these equilibria. This highlights a tension between individual rationality and collective efficiency. Joint audits, while desirable from the firm's perspective, generate higher coordination burdens for the tax authorities.

These inefficiencies also arise at intermediate levels of tax rule inconsistency ($p_3^* < p < p_2^*$). The dotted line in Figure 3 indicates the threshold above which equilibrium III^{JA} is efficient. Below this line, joint audits may still emerge as equilibrium outcomes, but they are inefficient due to high coordination costs relative to expected inconsistency costs. This type of inefficiency is specific to joint tax audits and contrasts with other dispute prevention tools such as bilateral APAs (De Waegenaere et al., 2007) or cooperative compliance programs (De Simone et al., 2013). The result arises because of the different firm behaviour in equilibrium III^{JA} as compared to VI^{NA}. By never engaging in moderate income shifting when joint audits as an instrument

exist, the firm facilitates these audits even for lower levels of inconsistency costs ($k^*_{III} < k^*_{VI}$). Note that this mechanism is in contrast to the low residual double taxation risk case, where the firm always engages in moderate income shifting *independent* of the respective joint or national audit equilibrium.

Overall, our analysis reveals two interesting results. First, joint tax audits tend to be least efficient precisely when firms are most likely to promote them. Second, we find that marginal increases in tax rule consistency at $p = p^*_2$ can be detrimental to tax audit efficiency, as they may trigger premature coordination. However, marginal increases in consistency at $p = p^*_3$ always increase tax audit efficiency, highlighting the non-trivial role of harmonising tax rules (De Waegenaere et al., 2006; Diller et al., 2025).

6 Conclusions

We investigate tax authorities' use of joint tax audits in cross-border tax cases of a multinational firm. Joint tax audits have emerged as a coordinated enforcement tool, aimed at resolving potential tax disputes early before cases escalate into costly resolution procedures. Our model features a firm's income shifting decisions, tax authorities' joint audit decisions, and, when these are not established, tax auditors' national audit decisions. We pose two interrelated research questions. First, under what circumstances do joint tax audits arise? Second, how do joint audits affect the firm's expected tax payments and tax audit efficiency, measured by the tax authorities' expected deadweight losses from auditing?

We find that whether joint tax audits arise depends on the firm's residual double taxation risk *absent* joint tax audits. When this risk is low (e.g., due to mandatory binding arbitration), joint audits only occur if they reduce tax authorities' expected deadweight losses, comprising coordination and inconsistency costs, relative to national audits. However, not all efficiency-enhancing joint audits are established, as mutual consent by all authorities is required. When the residual double taxation risk is high and tax rule inconsistency is not too low, joint audits can occur more often, as the required inconsistency costs are lower than under low double taxation risk.

The result that more joint audits *can* occur does not imply that these *must* occur. Unless the required inconsistency costs are sufficiently high, the tax authorities favour national audits, while the firm prefers (some) joint audits due to lower expected tax payments. If joint audits occur when the residual double taxation risk is high, their occurrence does not guarantee improvements in tax audit efficiency although both authorities give their consent. The reason is that the firm alters its income shifting behaviour, which can trigger inefficient joint audits. In particular, joint audits tend to be most inefficient when firms are most likely to promote them.

Our findings have regulatory implications. When the residual double taxation risk is low, a regulatory cost-sharing mechanism that reallocates coordination costs from the low-tax to the high-tax authority could enable more coordinated enforcement and efficient outcomes. This is because the low-tax authority blocks some efficient joint audits in these cases. For example, the Fiscalis Programme within the European Union can fulfil this objective if specifically designed for that purpose. By contrast, when the residual double taxation risk is high, a third-party cost-sharing approach involving the firm is more suitable, as either tax authority may block the joint audit. If the firm shares part of the coordination burden, such mechanisms could better align the firm's preferences with overall efficiency goals.

This study offers guidance for future empirical research. In particular, the introduction of DAC7 provides a valuable opportunity to examine changes in tax audit efficiency, as it establishes a legally binding framework for joint tax audits within Europe and encourages their broader use. Empirical analyses could focus on the effect of joint audits on audit completion times in cross-border settings. Such analyses would require detailed cross-country data on audit outcomes and durations, as well as proxies—potentially survey-based—for the degree of tax rule inconsistency. Key control variables include country-pair MAP durations and tax rate differentials. As an alternative approach, researchers could investigate whether and to what extent the broader use of joint tax audits affects the number of APAs or MAPs initiated. Since these procedures are generally considered costly and time-consuming, a reduction in their use may indirectly signal greater tax audit efficiency.

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Appendix A

[Figure 4 about here]

Appendix B

For the equilibrium proofs, let us define the following functions

$$\Phi_H^{x_L} = \tau_H \left[\frac{\frac{1-p}{2}(1-\alpha)(1-\gamma)(1+\pi)}{\frac{1-p}{2}(2-\alpha)+p(1-\beta)} + \frac{p(1-\beta)}{\frac{1-p}{2}(2-\alpha)+p(1-\beta)} \left(\frac{1}{2} - \gamma(\varepsilon - k) \right) \right],$$

$$\Phi_L^{x_L} = \tau_L \left[\frac{p(1-\beta)}{\frac{1-p}{2}(2-\alpha)+p(1-\beta)} \left(\gamma k - \frac{1}{2} \right) - \frac{\frac{1-p}{2}(1-\alpha)}{\frac{1-p}{2}(2-\alpha)+p(1-\beta)} (1-\gamma) \right],$$

$$\Phi_H^{x_H} = \tau_H \frac{p\beta}{p\beta + \frac{1-p}{2}\alpha} \left(\delta k - \frac{1}{2} \right),$$

$$\Phi_L^{x_H} = \tau_L \frac{p\beta}{p\beta + \frac{1-p}{2}\alpha} \left(\delta(k-\varepsilon) + \frac{1}{2} \right).$$

In addition, let us introduce the following notation.

Definition. *For a given equilibrium $\omega \in \Omega$, where Ω is the set of all equilibria identified in this paper, we define $k_i^x = (\Phi_i^x)^{-1}(K|\omega)$ as the unique value of k that solves $\Phi_i^x = K$ with $x \in \{x_L, x_H\}$, given that all strategies are at their equilibrium values under equilibrium ω.*

Lemma 1

We have to show that $\mathbb{E}[v_H(JA|x_L)] - \mathbb{E}[v_H(NA|x_L)] \geq \mathbb{E}[v_L(JA|x_L)] - \mathbb{E}[v_L(NA|x_L)]$, which simplifies to $\Phi_H^{x_L} \geq \Phi_L^{x_L}$. Consider $\gamma = 1$, which is sufficient to show the result, as $\gamma = 1$ decreases $\Phi_H^{x_L}$ and increases $\Phi_L^{x_L}$. Simplifying yields $\tau_H(k - \varepsilon + \frac{1}{2}) \geq \tau_L(k - \frac{1}{2})$. With $\varepsilon \leq 1$ and $\tau_H \geq \tau_L$, Lemma 1 is shown.

Low residual double taxation risk equilibria

Let us note that the requirement $\varepsilon < \varepsilon_2^*/2$ guarantees that equilibrium III$^{\text{JA}}$ does not exist in the low residual double taxation risk case (see proof of Proposition 4 and 5 (ii)). III$^{\text{JA}}$ weakly payoff dominates all other equilibria in which joint tax audits occur (see also Proposition 6 and 7).

Proposition 1 (i)

We show that $\mu_H^*(x_H) = \mu_L^*(x_H) = \mu_L^*(x_L) = 0$, $\mu_H^*(x_L) \geq 0$, and

$$\alpha^* = \frac{(1-p)(b-2c_H)+2p(b-c_H)}{(1-p)(b-c_H)}, \beta^* = 0, \gamma^* = \frac{\tau_H - \tau_L}{\tau_H(1+\pi)-\tau_L}, \delta^* = 0,$$

constitutes equilibrium I^{NA} when $\varepsilon < \underline{\varepsilon} = \min\left\{\frac{\tau_H-\tau_L}{\tau_H}, \frac{\tau_H(1+\pi)-\tau_L}{2\tau_H}\right\} = \min\{\varepsilon_1^*, \varepsilon_2^*/2\}$, $p < p_1^* = \frac{c_H}{2(b-c_H)+c_H}$ and $k < k_I^*$, where $k_I^* = (\Phi_L^{x_L})^{-1}\left(K|I^{NA}\right)$.

The firm is willing to randomise in y_H, because a report x_L yields payoff $\gamma^*(-\tau_H(1+\pi) - \tau_L(1-\gamma^*)) = -\tau_H$, which equals the payoff from reporting x_H. α^* is feasible because $p < p_1^*$ ensures $\alpha^* < 1$. In state y_B, the firm chooses $\beta^* = 0$, as reporting x_H yields a payoff of $-\tau_H$ and reporting x_L a payoff of $-\tau_L - \varepsilon\tau_H\gamma^* > -\tau_H$ due to $\varepsilon < \varepsilon_2^*$. Auditor H is willing to randomise because not auditing yields a payoff of zero and auditing x_L yields a payoff of $\frac{(1-p)(1-\alpha^*)+2p}{(1-p)(1-\alpha^*)+(1+p)}b - c_H = 0$. Auditor L chooses $\delta^* = 0$ since $\beta^* = 0$.

The tax authorities choose $\mu_H^*(x_H) = \mu_L^*(x_H) = 0$ due to $\delta^* = \beta^* = 0$. Tax authority L chooses $\mu_L^*(x_L) = 0$, because under this equilibrium, $\Phi_L^{x_L} < K$ as long as $k < k_I^*$. From Lemma 1, we know that $\Phi_L^{x_L} < \Phi_H^{x_L}$. Thus, we have $\mu_H^*(x_L) \geq 0$.

Proposition 1 (ii)

We show that $\mu_H^*(x_H) = \mu_L^*(x_H) = 0$, $\mu_H^*(x_L) = 1$, $\beta^* = 0$, $\delta^* = 0$, and

$$\alpha^* = \frac{(1-p)(b-2c_H)+2p(b-c_H)}{(1-p)(b-c_H)}, \gamma^* = \frac{((1-p)(2-\alpha^*)+2p)\frac{K}{\tau_L}+(1-p)(1-\alpha^*)+p}{2pk+(1-p)(1-\alpha^*)},$$
$$\mu_L^*(x_L) = \frac{\tau_H - (\gamma^*\tau_H(1+\pi)+(1-\gamma^*)\tau_L)}{\tau_H(1+\pi)-(\gamma^*\tau_H(1+\pi)+(1-\gamma^*)\tau_L)},$$

constitutes equilibrium I^{JA} when $\varepsilon < \underline{\varepsilon} = \min\{\varepsilon_1^*, \varepsilon_2^*/2\}$, $p < p_1^* = \frac{c_H}{2(b-c_H)+c_H}$ and $k > k_I^*$, where $k_I^* = (\Phi_L^{x_L})^{-1}\left(K|I^{NA}\right)$.

The firm is willing to randomise in y_H, because a report x_L yields payoff

$$-\tau_H(1+\pi)\left[\mu_L^*(x_L) + (1-\mu_L^*(x_L))\gamma^*\right] - \tau_L(1-\mu_L^*(x_L))(1-\gamma^*) = -\tau_H,$$

which equals the payoff from reporting x_H. α^* is feasible because $p < p_1^*$ ensures $\alpha^* < 1$. In state y_B, the firm chooses $\beta^* = 0$, as reporting x_H yields a payoff of $-\tau_H$ and reporting x_L a payoff of $-\mu_L^*(x_L)\frac{\tau_L+\tau_H}{2} - (1-\mu_L^*(x_L))(\tau_L + \gamma^*\varepsilon\tau_H) > -\tau_H$, as with $\mu_L^*(x_L) = 0$ and $\gamma^* = 1$, a sufficient condition for the inequality is found to be $\varepsilon < \varepsilon_1^*$. Auditor H is willing to randomise because not auditing yields a payoff of zero and auditing x_L yields a payoff of $\frac{(1-p)(1-\alpha^*)+2p}{(1-p)(1-\alpha^*)+(1+p)}b - c_H = 0$. γ^* is feasible because $\gamma^* < 1$ requires $k > \left[((1-p)(1-\alpha^*)+(1+p))\frac{K}{\tau_L} + p\right]/2p$, which is guaranteed when $k > k_I^*$. Auditor L chooses $\delta^* = 0$ since $\beta^* = 0$.

The tax authorities choose $\mu_H^*(x_H) = \mu_L^*(x_H) = 0$ due to $\delta^* = \beta^* = 0$. Tax authority L is willing to randomise, because under this equilibrium, $\Phi_L^{x_L}(\alpha^*, \beta^*, \gamma^*) = K$. $\mu_L^*(x_L)$ is feasible because $\mu_L^*(x_L) > 0$ requires $k > k_I^*$. From Lemma 1, we know that $\Phi_L^{x_L} < \Phi_H^{x_L}$. Thus, we have $\mu_H^*(x_L) = 1$.

Proposition 2 (i)

We show that $\mu_H^*(x_H) = \mu_L^*(x_H) = \mu_L^*(x_L) = 0$, $\mu_H^*(x_L) \geq 0$, and

$$\alpha^* = 1, \beta^* = 0, \gamma^* = 1, \delta^* = 0,$$

constitutes equilibrium II^{NA} when $\varepsilon < \underline{\varepsilon} = \min\{\varepsilon_1^*, \varepsilon_2^*/2\}$, $p > p_1^* = \frac{c_H}{2(b-c_H)+c_H}$ and $k < k_{II}^*$, where $k_{II}^* = (\Phi_L^{x_L})^{-1}\left(K|II^{NA}\right)$.

In state y_H, the firm chooses $\alpha^* = 1$ because when $\gamma^* = 1$, a report x_L yields payoff $-\tau_H(1+\pi) < -\tau_H$, where the latter equals the payoff from reporting x_H. In state y_B, the firm chooses $\beta^* = 0$, as reporting x_H yields a payoff of $-\tau_H$ and reporting x_L a payoff of $-\tau_L - \varepsilon\tau_H > -\tau_H$ due to $\varepsilon < \varepsilon_1^*$. Auditor H chooses $\gamma^* = 1$, since $\frac{2p}{(1+p)}b - c_H > 0$ when $p > p_1^*$. Auditor L chooses $\delta^* = 0$ since $\beta^* = 0$.

The tax authorities choose $\mu_H^*(x_H) = \mu_L^*(x_H) = 0$ due to $\delta^* = \beta^* = 0$. Tax authority L chooses $\mu_L^*(x_L) = 0$, because under this equilibrium, $\Phi_L^{x_L} < K$ as long as $k < k_{II}^*$. From Lemma 1, we know that $\Phi_L^{x_L} < \Phi_H^{x_L}$. Thus, we have $\mu_H^*(x_L) \geq 0$.

Proposition 2 (ii)

We show that $\mu_H^*(x_H) = \mu_L^*(x_H) = 0$, $\mu_L^*(x_L) = \mu_H^*(x_L) = 1$, and

$$\alpha^* = 1, \beta^* = 0, \gamma^* = 1, \delta^* = 0,$$

constitutes equilibrium II^{JA} when $\varepsilon < \underline{\varepsilon} = \min\{\varepsilon_1^*, \varepsilon_2^*/2\}$, $p > p_1^* = \frac{c_H}{2(b-c_H)+c_H}$ and $k > k_{II}^*$, where $k_{II}^* = (\Phi_L^{x_L})^{-1}\left(K|II^{NA}\right)$.

In state y_H, the firm chooses $\alpha^* = 1$ because when $\mu_L^*(x_L)\mu_H^*(x_L) = 1$, a report x_L yields payoff $-\tau_H(1+\pi) < -\tau_H$, where the latter equals the payoff from reporting x_H. In state y_B, the firm chooses $\beta^* = 0$, as reporting x_H yields a payoff of $-\tau_H$ and reporting x_L a payoff of $-(\tau_L+\tau_H)/2 > -\tau_H$. Auditor H chooses $\gamma^* = 1$ off the equilibrium path, since $\frac{2p}{(1+p)}b - c_H > 0$ when $p > p_1^*$. Auditor L chooses $\delta^* = 0$ since $\beta^* = 0$.

The tax authorities choose $\mu_H^*(x_H) = \mu_L^*(x_H) = 0$ due to $\delta^* = \beta^* = 0$. Tax authority L chooses $\mu_L^*(x_L) = 1$, because under this equilibrium, $\Phi_L^{x_L}(\alpha^*, \beta^*, \gamma^*) > K$ if $k > k_{II}^*$. From Lemma 1, we know that $\Phi_L^{x_L} < \Phi_H^{x_L}$. Thus, we also have $\mu_H^*(x_L) = 1$.

Corollary 1

First, let us make the required inconsistency costs for joint audit equilibria explicit. These are

$$k_I^* = \frac{\left[(1+p+(1-p)(1-\alpha^*))\frac{K}{\tau_L} + (1-p)(1-\alpha^*) + p\right]\frac{\tau_H(1+\pi)-\tau_L}{\tau_H-\tau_L} - (1-p)(1-\alpha^*)}{2p},$$

$$k_{II}^* = \frac{(1+p)\frac{K}{\tau_L} + p}{2p}.$$

It is straightforward to see that $\lim_{\tau_L \to 0} k_I^* = \infty$ and $\lim_{\tau_L \to 0} k_{II}^* = \infty$, as α^* is independent of τ_L.

Second, observe that $k_{II}^* < k_I^*$, because $\Phi_L^{x_L}$ increases in α and increases in γ. As γ and α are higher under equilibrium II^{NA} than under I^{NA}, $k_{II}^* < k_I^*$ is shown.

High residual double taxation risk equilibria

Proposition 3 (i)

We show that $\mu_H^*(x_H) = \mu_L^*(x_L) = 0$, $\mu_H^*(x_L) \geq 0$, $\mu_L^*(x_H) \geq 0$ and

$$\alpha^* = \frac{b-2c_H}{b-c_H}, \beta^* = 1, \gamma^* = \frac{\tau_H - \tau_L}{\tau_H(1+\pi) - \tau_L}, \delta^* = 0,$$

constitutes equilibrium V^{NA} when $\varepsilon > \overline{\varepsilon} = \frac{\tau_H(1+\pi)-\tau_L}{\tau_H}$ and $p < p_3^* = \frac{(b-2c_H)c_L}{(b-2c_H)c_L+2(b-c_H)(b-c_L)}$.

The firm is willing to randomise in y_H, because a report x_L yields payoff $\gamma^*(-\tau_H(1+\pi) - \tau_L(1-\gamma^*)) = -\tau_H$, which equals the payoff from reporting x_H. In state y_B, the firm chooses $\beta^* = 1$, as reporting x_H yields a payoff of $-\tau_H$ and reporting x_L a payoff of $-\tau_L - \varepsilon\tau_H\gamma^* < -\tau_H$ due to $\varepsilon > \overline{\varepsilon}$. Auditor H is willing to randomise because not auditing yields a payoff of zero and auditing x_L yields a payoff of $\frac{1-\alpha^*}{2-\alpha^*}b - c_H = 0$. Auditor L chooses $\delta^* = 0$ since auditing report x_H would yield $\frac{2p}{2p+(1-p)\alpha^*}b - c_L < 0$, which is due to $p < p_3^*$.

The tax authorities choose $\mu_H^*(x_H) = \mu_L^*(x_L) = 0$ due to $\delta^* = 0$ and $\beta^* = 1$, and $\mu_L^*(x_H) \geq 0$ as well as $\mu_H^*(x_L) \geq 0$.

Proposition 3 (ii)

See proof of Proposition 2 (ii), which is independent of ε when $p_1^* < p < p_3^*$.

Proposition 3 (iii)

We show that $\mu_H^*(x_H) = \mu_L^*(x_H) = 0$, $\mu_H^*(x_L) = 1$, $\beta^* = 0$, $\delta^* = 0$, and

$$\alpha^* = \frac{(1-p)(b-2c_H)+2p(b-c_H)}{(1-p)(b-c_H)}, \gamma^* = \frac{((1-p)(2-\alpha^*)+2p)\frac{K}{\tau_L}+(1-p)(1-\alpha^*)+p}{2pk+(1-p)(1-\alpha^*)},$$
$$\mu_L^*(x_L) = \frac{\tau_H - (\gamma^*\tau_H(1+\pi)+(1-\gamma^*)\tau_L)}{\tau_H(1+\pi) - (\gamma^*\tau_H(1+\pi)+(1-\gamma^*)\tau_L)},$$

constitutes equilibrium I^{JA} when $\varepsilon > \overline{\varepsilon} = \frac{\tau_H(1+\pi)-\tau_L}{\tau_H}$, $p < p_1^* = \frac{c_H}{2(b-c_H)+c_H}$ and $k > k_V^*$, where $k_V^* > k_I^* = (\Phi_L^{x_L})^{-1}\left(K|I^{NA}\right)$.

The proof follows the similar logic as the one for Proposition 1 (ii). The key difference is that, in state y_B, the firm is willing to choose $\beta^* = 0$ less often, as reporting x_L yields a payoff

of $-\mu_L^*(x_L)\frac{\tau_L+\tau_H}{2}-(1-\mu_L^*(x_L))(\tau_L+\gamma^*\varepsilon\tau_H)$, which strictly decreases in ε (γ^* and $\mu_L^*(x_L)$ are independent of ε). Also, observe that $\lim_{\varepsilon\to\overline{\varepsilon},\ k\to k_I^*} -\mu_L^*(x_L)\frac{\tau_L+\tau_H}{2}-(1-\mu_L^*(x_L))(\tau_L+\gamma^*\varepsilon\tau_H) = -\tau_H$, which equals the payoff of reporting x_H. Thus, for $\varepsilon>\overline{\varepsilon}$, $\beta^*=0$ additionally requires that γ^* is sufficiently low. Since γ^* strictly decreases in k and with $\lim_{k\to\infty} -\mu_L^*(x_L)\frac{\tau_L+\tau_H}{2}-(1-\mu_L^*(x_L))(\tau_L+\gamma^*\varepsilon\tau_H) > -\tau_H$, there exists a threshold value $k_V^*>k_I^*$, such that $\beta^*=0$ is the firm's best response and equilibrium I^{JA} obtains.

Proposition 4 (i)

We show that $\mu_L^*(x_L)=0$, $\mu_H^*(x_L)\geq 0$, $\mu_L^*(x_H)=0$ or $\mu_H^*(x_H)=0$, and

$$\alpha^*=\frac{(b-c_L)(b(1+p)-2c_H)}{(b-c_H)b(1-p)},\ \beta^*=\frac{(b(1+p)-2c_H)c_L}{(b-c_H)2bp},$$
$$\gamma^*=\frac{\tau_H-\tau_L}{\tau_H(1+\pi)-\tau_L},\qquad \delta^*=\gamma^*\frac{\tau_L-\tau_H(1+\pi-\varepsilon)}{\varepsilon\tau_L},$$

constitutes equilibrium $\mathrm{VI}^{\mathrm{NA}}$ when $\varepsilon>\overline{\varepsilon}=\frac{\tau_H(1+\pi)-\tau_L}{\tau_H}$, $p_3^*=\frac{(b-2c_H)c_L}{(b-2c_H)c_L+2(b-c_H)(b-c_L)}<p<p_2^*=\frac{(b-c_H)c_L+(b-c_L)c_H}{(b-c_H)c_L+(b-c_L)c_H+2(b-c_H)(b-c_L)}$ and $k<k_{VI}^*$, where $k_{VI}^*=\min\left\{k_L^{x_L},\max\{k_L^{x_H},k_H^{x_H}\}\right\}$ and $k_i^x=(\Phi_i^x)^{-1}\left(K|VI^{NA}\right)$.

The firm is willing to randomise in y_H, because a report x_L yields payoff $\gamma^*(-\tau_H(1+\pi)-\tau_L(1-\gamma^*))=-\tau_H$, which equals the payoff from reporting x_H. α^* is feasible because $p<p_2^*$ ensures $\alpha^*<1$. The firm is willing to randomise in state y_B, as reporting x_L and x_H yield a payoff of $-\tau_H-\varepsilon\tau_L\delta^*=-\tau_L-\varepsilon\tau_H\gamma^*$. β^* is feasible because $p>p_3^*$ ensures $\beta^*>0$. Auditor H is willing to randomise because not auditing yields a payoff of zero and auditing x_L yields a payoff of $\frac{(1-p)(1-\alpha^*)+2p(1-\beta^*)}{(1-p)(2-\alpha^*)+2p(1-\beta^*)}b-c_H=0$. Auditor L is willing to randomise because not auditing yields a payoff of zero and auditing x_H yields a payoff of $\frac{2p\beta^*}{2p\beta^*+(1-p)\alpha^*}b-c_L=0$. δ^* is feasible because $\varepsilon>\overline{\varepsilon}$ ensures $\delta^*>0$.

Tax authority L chooses $\mu_L^*(x_L)=0$ due to $k<k_L^{x_L}$, and tax authority H $\mu_H^*(x_L)\geq 0$. Further, either tax authority L or H choose $\mu_i(x_H)=0$ due to $k<\max\{k_L^{x_H},k_H^{x_H}\}$. Concretely, if $k_L^{x_H}<k_H^{x_H}$, we have $\mu_H(x_H)=0$ and $\mu_L(x_H)\geq 0$; otherwise we have $\mu_L(x_H)=0$ and $\mu_H(x_H)\geq 0$.

Proposition 4 (ii)

We show that $\mu_H^*(x_H) = \mu_L^*(x_H) = 1$, $\mu_L^*(x_L) = 0$, $\mu_H^*(x_L) \geq 0$ and

$$\alpha^* = \frac{b-2c_H}{b-c_H}, \beta^* = 1, \gamma^* = \frac{\tau_H - \tau_L}{\tau_H(1+\pi) - \tau_L}, \delta^* = 1,$$

constitutes equilibrium III$^{\text{JA}}$ when $\varepsilon > \overline{\varepsilon} = \frac{\tau_H(1+\pi)-\tau_L}{\tau_H}$, $p > p_3^* = \frac{(b-2c_H)c_L}{(b-2c_H)c_L+2(b-c_H)(b-c_L)}$ and $k > k_{III}^*$, where $k_{III}^* = \max\{k_L^{x_H}, k_H^{x_H}\}$ and $k_i^{x_H} = \left(\Phi_i^{x_H}\right)^{-1}\left(K|III^{JA}\right)$.

The firm is willing to randomise in y_H, because a report x_L yields payoff $\gamma^*(-\tau_H(1+\pi) - \tau_L(1-\gamma^*)) = -\tau_H$, which equals the payoff from reporting x_H. In state y_B, the firm chooses $\beta^* = 1$, as reporting x_L yields a payoff of $-\tau_L - \varepsilon\tau_H\gamma^*$ and reporting x_H a payoff of $-(\tau_L+\tau_H)/2 > -\tau_L - \varepsilon\tau_H\gamma^*$ due to $\varepsilon > \frac{\tau_H(1+\pi)-\tau_L}{2\tau_H}$. Auditor H is willing to randomise because not auditing yields a payoff of zero and auditing x_L yields a payoff of $\frac{(1-p)(1-\alpha^*)}{(1-p)(2-\alpha^*)}b - c_H = 0$. Auditor L chooses $\delta^* = 1$ off the equilibrium path since $\frac{2p}{2p+(1-p)\alpha^*} - c_L > 0$ when $p > p_3^*$.

The tax authorities choose $\mu_H^*(x_H) = \mu_L^*(x_H) = 1$ due to $k > k_{III}^*$. Tax authority L chooses $\mu_L^*(x_L) = 0$ due to $\beta^* = 1$, and tax authority H chooses $\mu_H^*(x_L) \geq 0$. In addition, equilibrium III$^{\text{JA}}$ weakly payoff dominates II$^{\text{JA}}$ whenever II$^{\text{JA}}$ is feasible.

Proposition 5 (i)

We show that $\mu_L^*(x_L) = 0$, $\mu_H^*(x_L) \geq 0$, $\mu_L^*(x_H) = 0$ or $\mu_H^*(x_H) = 0$, and

$$\alpha^* = 1, \beta^* = \frac{(1-p)c_L}{2p(b-c_L)}, \gamma^* = 1, \delta^* = \frac{\tau_L - \tau_H(1-\varepsilon)}{\varepsilon\tau_L},$$

constitutes equilibrium IV$^{\text{NA}}$ when $\varepsilon > \frac{\tau_H(1+\pi)-\tau_L}{\tau_H}$, $p > p_2^* = \frac{(b-c_H)c_L+(b-c_L)c_H}{(b-c_H)c_L+(b-c_L)c_H+2(b-c_H)(b-c_L)}$ and $k < k_{IV}^*$, where $k_{IV}^* = \min\left\{k_L^{x_L}, \max\{k_L^{x_H}, k_H^{x_H}\}\right\}$ and $k_i^x = (\Phi_i^x)^{-1}\left(K|IV^{NA}\right)$.

In state y_H, the firm chooses $\alpha^* = 1$ due to $\gamma^* = 1$. The firm is willing to randomise in state y_B, as reporting x_L and x_H yield a payoff of $-\tau_H - \varepsilon\tau_L\delta^* = -\tau_L - \varepsilon\tau_H$. δ^* is feasible because $p > p_2^*$ implies $\beta^* < 1$. Auditor H chooses $\gamma^* = 1$, since $\frac{2p(1-\beta^*)}{2p(1-\beta^*)+1-p}b - c_H > 0$ when $p > p_2^*$. Auditor L is willing to randomise because not auditing yields a payoff of zero and auditing x_H yields a payoff of $\frac{2p\beta^*}{2p\beta^*+1-p}b - c_L = 0$. δ^* is feasible because $\varepsilon > \varepsilon_1^*$ ensures $\delta^* > 0$.

Tax authority L chooses $\mu_L^*(x_L) = 0$ due to $k < k_L^{x_L}$, and tax authority H $\mu_H^*(x_L) \geq 0$. Further, either tax authority L or H choose $\mu_i^*(x_H) = 0$ due to $k < \max\{k_L^{x_H}, k_H^{x_H}\}$. Concretely, if $k_L^{x_H} < k_H^{x_H}$, we have $\mu_H^*(x_H) = 0$ and $\mu_L^*(x_H) \geq 0$; otherwise we have $\mu_L^*(x_H) = 0$ and $\mu_H^*(x_H) \geq 0$.

Proposition 5 (ii)

See proof of Proposition 4 (ii).

Proposition 6

The firm's expected tax liabilities in the equilibria with joint tax audits are given by

$$T_{I^{JA}} = \frac{1-p}{2}(\tau_L + \tau_H) + p\left[\mu_L^*(x_L)\frac{\tau_L + \tau_H}{2} + (1 - \mu_L^*(x_L))\left(\tau_L + \varepsilon\gamma_{I^{JA}}^*\tau_H\right)\right],$$
$$T_{II^{JA}} = \frac{1-p}{2}(\tau_L + \tau_H) + p\left[\frac{\tau_L + \tau_H}{2}\right] = T_{III^{JA}}.$$

The change in expected tax liabilities induced by the existence of joint tax audits requires comparing the above expected tax liabilities and the liabilities in the respective national audit benchmark that would be played if joint tax audits did not exist. These benchmark equilibria depend on the low or high residual double taxation risk case.

First, consider the low residual double taxation risk case. The expected tax liabilities in the national audit equilibria are

$$T_{I^{NA}} = \frac{1-p}{2}(\tau_L + \tau_H) + p\left[\tau_L + \varepsilon\tau_H\gamma_{I^{NA}}^*\right],$$
$$T_{II^{NA}} = \frac{1-p}{2}(\tau_L + \tau_H) + p\left[\tau_L + \varepsilon\tau_H\right].$$

When $p > p_1^*$, the change in expected tax liabilities is given by

$$T_{II^{JA}} - T_{II^{NA}} = p\left[\frac{\tau_L + \tau_H}{2} - \tau_L - \varepsilon\tau_H\right] = p\left[\frac{\tau_H - \tau_L}{2} - \varepsilon\tau_H\right].$$

Thus, we can see that increasing tax liabilities $T_{II^{JA}} - T_{II^{NA}} > 0$ require $\varepsilon < \frac{\tau_H - \tau_L}{2\tau_H}$. Also, observe that $\frac{\tau_H - \tau_L}{2\tau_H} < \min\left\{\frac{\tau_H - \tau_L}{\tau_H}, \frac{\tau_H(1+\pi) - \tau_L}{2\tau_H}\right\} = \underline{\varepsilon}$, such that the threshold for increasing and decreasing tax liabilities is unique in the low residual double taxation risk case.

When $p < p_1^*$, the change in expected tax liabilities is given by

$$\begin{aligned} T_{I^{JA}} - T_{I^{NA}} &= p\left[\mu_L^*(x_L)\frac{\tau_L+\tau_H}{2} + (1-\mu_L^*(x_L))\left(\tau_L + \varepsilon\gamma_{I^{JA}}^*\tau_H\right) - \tau_L - \varepsilon\tau_H\gamma_{I^{NA}}^*\right] \\ &= p\left[\mu_L^*(x_L)\frac{\tau_H-\tau_L}{2} + \varepsilon\tau_H\left[(1-\mu_L^*(x_L))\,\gamma_{I^{JA}}^* - \gamma_{I^{NA}}^*\right]\right] \end{aligned}$$

Since the firm is indifferent in state y_H in both equilibrium I^{NA} and I^{JA}, this necessarily implies that $\mu_L^*(x_L) + (1-\mu_L^*(x_L))\gamma_{I^{JA}}^* = \gamma_{I^{NA}}^*$. Inserting and simplifying yields

$$T_{I^{JA}} - T_{I^{NA}} = p\mu_L^*(x_L)\left[\frac{\tau_H-\tau_L}{2} - \varepsilon\tau_H\right],$$

with the identical implications as for $T_{II^{JA}} - T_{II^{NA}}$. This shows part (i).

Concerning part (ii), let us note the expected tax liabilities in the national audit benchmarks

$$\begin{aligned} T_{V^{NA}} &= \frac{1-p}{2}(\tau_L+\tau_H) + p\tau_H, \\ T_{VI^{NA}} &= \frac{1-p}{2}(\tau_L+\tau_H) + p\left[\tau_L + \varepsilon\tau_H\frac{\tau_H-\tau_L}{\tau_H(1+\pi)-\tau_L}\right], \\ T_{IV^{NA}} &= \frac{1-p}{2}(\tau_L+\tau_H) + p\left[\tau_L+\varepsilon\tau_H\right]. \end{aligned}$$

When $p < p_3^*$, $T_{II^{JA}} - T_{V^{NA}} < 0$ can be observed straightforwardly. Further, the *existence* of equilibrium I^{JA} in the high residual double taxation risk case requires $T_{I^{JA}} - T_{V^{NA}} < 0$. In the proof of Proposition 3 (iii), we show that these situations exist when $k > k_V^*$. Lastly, we show that $T_{III^{JA}} - T_{VI^{NA}} < 0$, which also implies $T_{III^{JA}} - T_{IV^{NA}} < 0$:

$$T_{III^{JA}} - T_{VI^{NA}} = p\left[\frac{\tau_H-\tau_L}{2} - \varepsilon\tau_H\frac{\tau_H-\tau_L}{\tau_H(1+\pi)-\tau_L}\right].$$

Since $T_{III^{JA}} - T_{VI^{NA}}$ decreases in ε, it is sufficient to show that $T_{III^{JA}} - T_{VI^{NA}} < 0$ when $\varepsilon = \overline{\varepsilon} = \frac{\tau_H(1+\pi)-\tau_L}{\tau_H-\tau_L}$. Inserting $\overline{\varepsilon}$ and simplifying yields $T_{III^{JA}} - T_{VI^{NA}} = -p(\tau_H-\tau_L)/2 < 0$. This completes the proof of part (ii).

Corollary 2 and Proposition 7

Let us make the authorities' deadweight losses in all equilibria explicit. In the equilibria with joint tax audits, these are given by

$$L_{I^{JA}} = \mu_L^*(x_L)K\left(2-(1-p)\alpha^*\right) + p(1-\mu_L^*(x_L))\gamma_{I^{JA}}^* k\left(\tau_L+\tau_H\right),$$
$$L_{II^{JA}} = (1+p)K, \qquad L_{III^{JA}} = \left(2p+(1-p)\,\alpha_{III^{JA}}^*\right)K.$$

In the purely national audit equilibria, we have

$$L_{I^{NA}} = pk\left(\tau_L+\tau_H\right)\gamma_{I^{NA}}^*, \quad L_{II^{NA}} = pk\left(\tau_L+\tau_H\right), \quad L_{V^{NA}} = 0,$$
$$L_{IV^{NA}} = pk\left(\tau_L+\tau_H\right)\left[\beta_{IV^{NA}}^*\delta_{IV^{NA}}^* + \left(1-\beta_{IV^{NA}}^*\right)\right],$$
$$L_{VI^{NA}} = pk\left(\tau_L+\tau_H\right)\left[\beta_{VI^{NA}}^*\delta_{VI^{NA}}^* + \left(1-\beta_{VI^{NA}}^*\right)\gamma_{VI^{NA}}^*)\right].$$

To begin, we show that equilibrium III$^{\text{JA}}$ weakly payoff dominates II$^{\text{JA}}$. Considering $T_{III^{JA}} = T_{II^{JA}}$, this requires $L_{II^{JA}} > L_{III^{JA}}$, which holds because $\alpha_{III^{JA}}^* < 1$.[18] This proves Corollary 2.

Next, we show that the existence of joint tax audits increases tax audit efficiency when the residual double taxation risk is low. We show the underlying mechanics of the proof only for $L_{II^{NA}} > L_{II^{JA}}$; the proof for $L_{I^{NA}} > L_{I^{JA}}$ works similarly. Considering that equilibrium II$^{\text{JA}}$ only exists for $k > k_{II}^* = \frac{(1+p)\frac{K}{\tau_L}+p}{2p}$,[19] we get

$$\begin{aligned} L_{II^{NA}} - L_{II^{JA}}\big|_{k=k_{II}^*} &= p\frac{(1+p)\frac{K}{\tau_L}+p}{2p}\left(\tau_L+\tau_H\right) - (1+p)K \\ &= \frac{p(\tau_L+\tau_H)}{2} + (1+p)\left(\frac{\tau_L+\tau_H}{2\tau_L}-1\right)K > 0, \end{aligned}$$

due to $\frac{\tau_L+\tau_H}{2\tau_L} > 1$. This shows Proposition 7 (i).

When $p < p_3^*$ in the high residual double taxation risk case, we can have equilibrium I$^{\text{JA}}$ and II$^{\text{JA}}$. Observe that the national benchmark V$^{\text{NA}}$ implies $L_{V^{NA}} = 0$. Thus, $L_{I^{JA}} > 0$ and

[18] Here, we exemplify that the auditors' ex ante expected payoffs can be frequently neglected from an efficiency perspective. In equilibrium II$^{\text{JA}}$, the auditors' expected payoffs are zero, as they are off the equilibrium path. In III$^{\text{JA}}$, auditor L's expected payoff is zero for the same reason. For auditor H, the ex ante expected payoff is $\frac{1-p}{2}\gamma_{III^{JA}}^*\left[-c_H+(1-\alpha_{III^{JA}}^*)(b-c_H)\right]$. With $\alpha_{III^{JA}}^* = \frac{b-2c_H}{b-c_H}$ and further simplification, we see that auditor H's expected payoff is also zero.

[19] Note that the efficient threshold is $k_{II}^{eff} = \frac{K(1+p)}{\tau_L+\tau_H} < k_{II}^*$.

$L_{II^{JA}} > 0$ imply that when $p < p_3^*$ and the equilibria with joint tax audits would be played, the existence of joint tax audits decreases tax audit efficiency. For $p_2^* < p < p_3^*$, consider the limiting case $\tau_L = \tau_H$. Then, because both $\gamma_{VI^{NA}}^*$ and $\delta_{VI^{NA}}^*$ converge to zero, we have $\lim_{\tau_L \to \tau_H} L_{VI^{NA}} = 0 < L_{III^{JA}} = \left(2p + (1-p)\,\alpha_{III^{JA}}^*\right) K$, as $\alpha_{III^{JA}}^*$ is independent of τ_i. Similarly, joint tax audits can also be efficient in the high residual double taxation risk case, because $\lim_{k \to \infty} L_{VI^{NA}} = \infty > L_{III^{JA}}$ and $\lim_{k \to \infty} L_{IV^{NA}} = \infty > L_{III^{JA}}$. This shows Proposition 7 (ii).

Also, observe that for $p > p_3^*$, the range in which a joint tax audit equilibrium exists increases, that is, $k_{III}^* = \max\left\{\left(\frac{K}{\tau_H}(2p + (1-p)\alpha^*) + p\right)/2p, \left(\frac{K}{\tau_L}(2p + (1-p)\alpha^*) + p(2\varepsilon - 1)\right)/2p\right\}$ $< k_{II}^* = \left((1+p)\frac{K}{\tau_L} + p\right)/2p$. This can be be observed straightforwardly for the limiting case $\alpha^* = 1$, which strictly increases k_{III}^*.

Figures

Figure 1: Game Tree

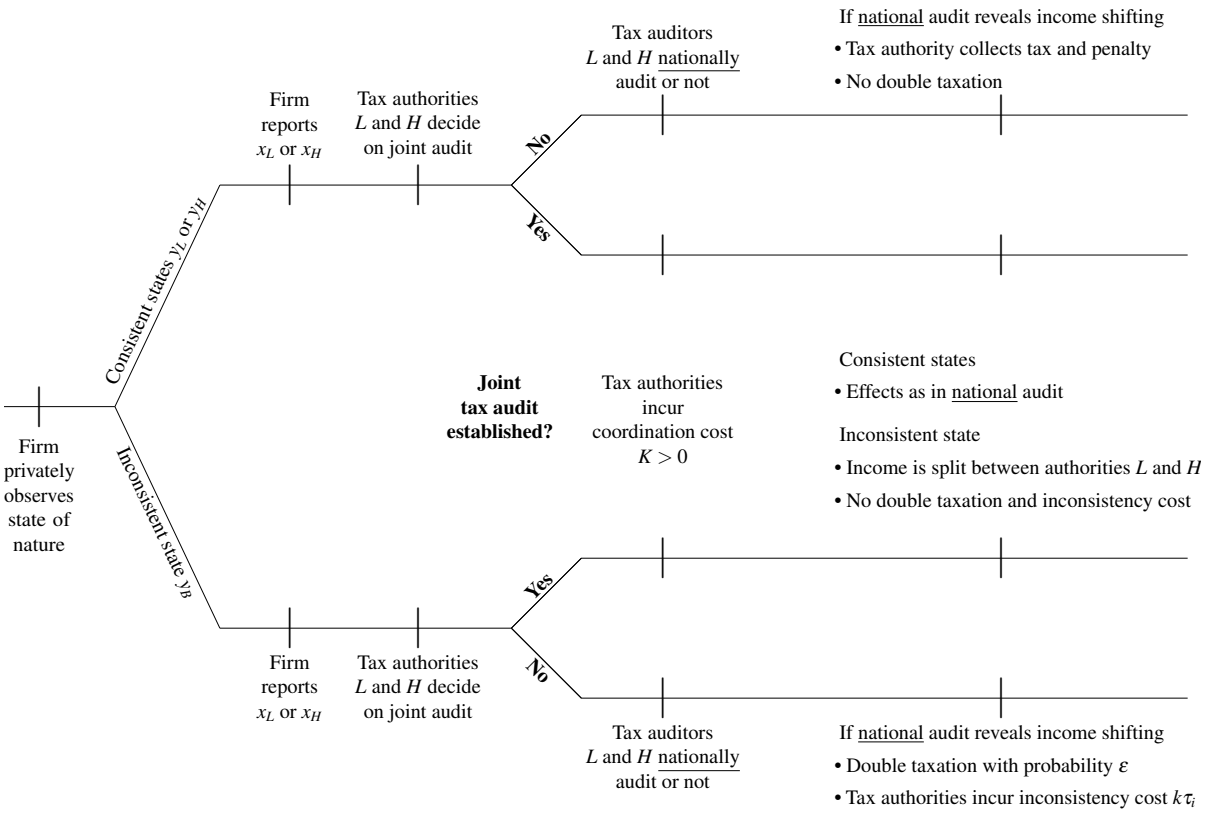
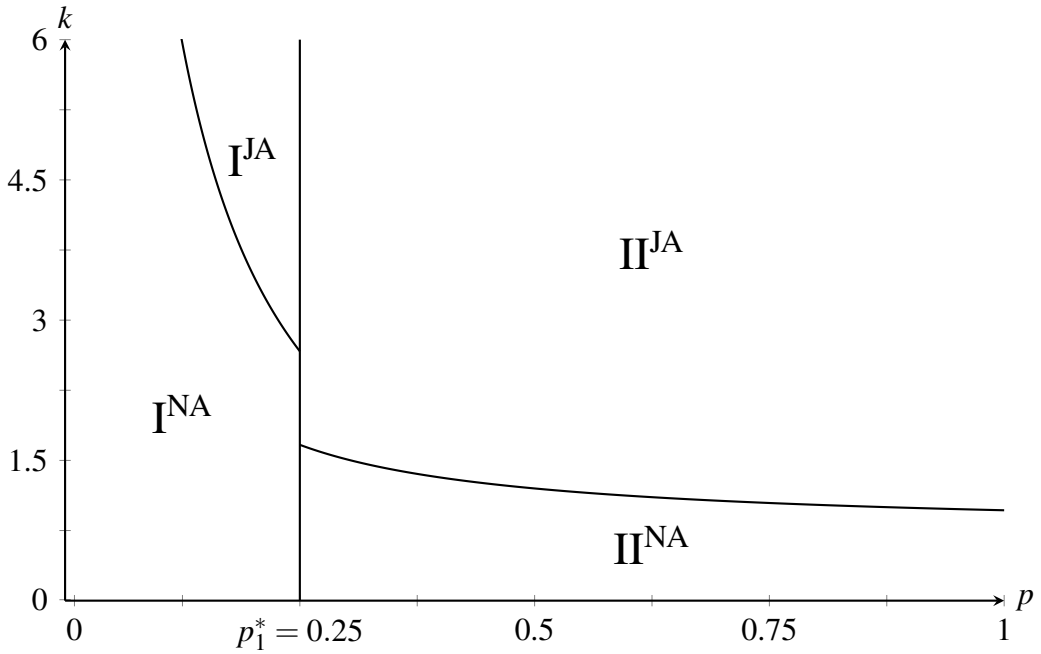
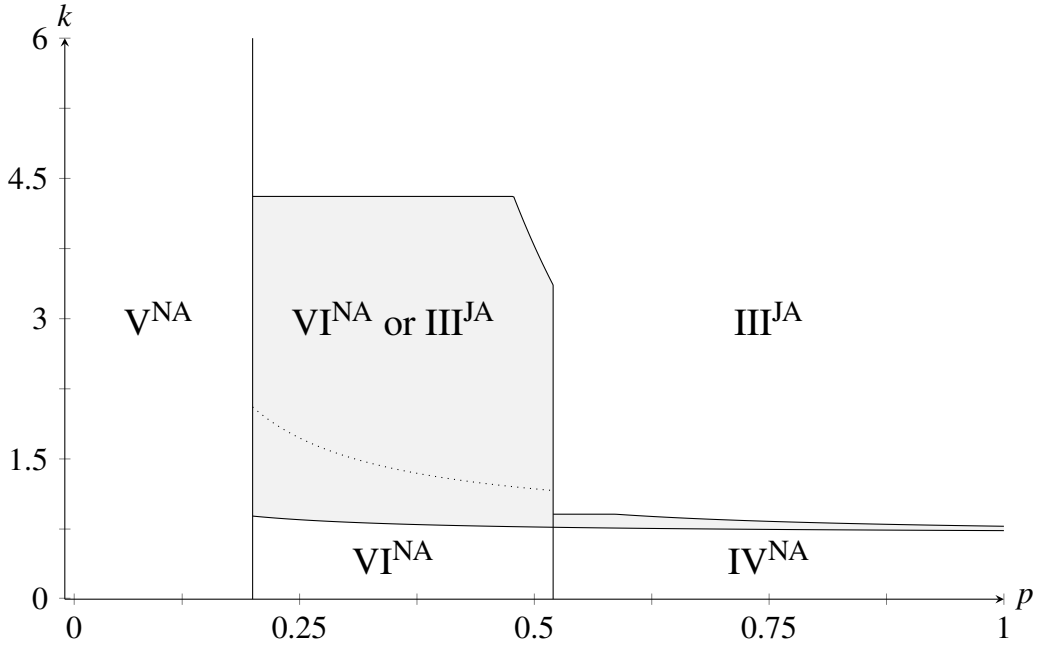


Figure 2: Equilibria regions when residual double taxation risk is low



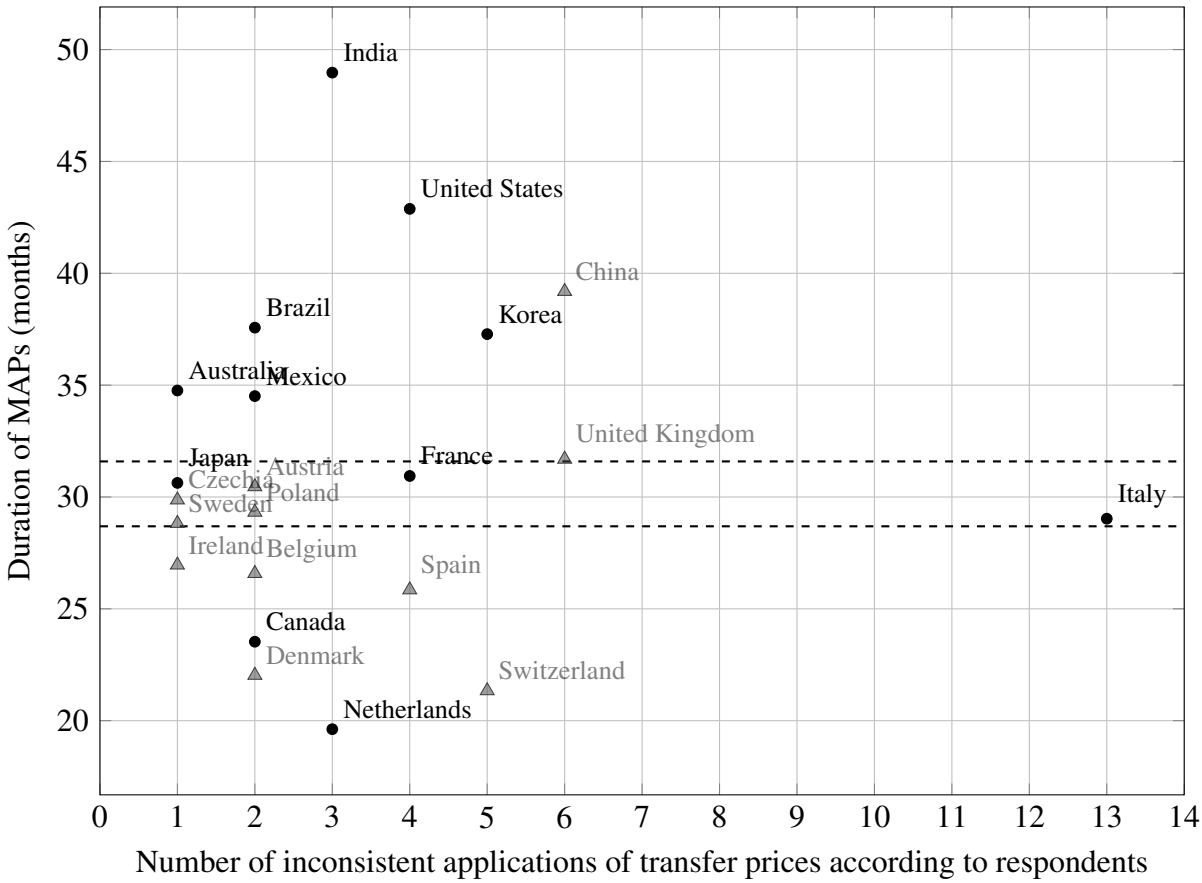
Notes: Parameters are $\tau_H = 30\%$, $\tau_L = 15\%$, $\pi = 30\%$, $b = 0.1$, $c_H = 0.04$, $c_L = 0.06$ and $K = 0.07$, requiring $\varepsilon < \underline{\varepsilon} = 0.4$.

Figure 3: Equilibria regions when the residual double taxation risk is high



Notes: Parameters are $\tau_H = 30\%$, $\tau_L = 25\%$, $\pi = 30\%$, $b = 0.1$, $c_H = 0.04$, $c_L = 0.06$, $K = 0.07$ and $\varepsilon = 0.9 > 0.47 \approx \overline{\varepsilon}$, implying $p_3^* = 0.2 < p_1^* = 0.25 < p_2^* = 0.52$. The gray area indicates regions where multiple equilibria exist. For example, within the gray area when $p > p_2^*$, equilibria IV^{NA} and III^{JA} cannot be ranked according to weak payoff dominance. Equilibrium I^{JA} lies out of the plot range and starts to exist for $k > k_V^*|_{p=p_3^*} \approx 8.2$, with k_V^* reaching its minimum value at p_3^*. The dotted line indicates the value of k above which equilibrium III^{JA} would be ex ante efficient when $p_3^* < p < p_2^*$ (see Proposition 7 below).

Figure 4: Duration of MAPs and transfer pricing inconsistencies after tax audits from a German perspective



Notes: The figure ranks countries by the average duration of MAPs in months (based on Martini et al. (2025)), which we use as a proxy for k, and by the number of transfer pricing inconsistencies identified after tax audits from a German perspective (data based on a survey of German transfer pricing practitioners (Diller et al., 2021), as reported in Diller et al. (2025)), which serves as a proxy for p. We caution that the survey is not necessarily representative for the German firm population but nevertheless gives an indication of how inconsistent applications of transfer prices p can be approximated. Countries are colour-coded based on their corporate tax rate differential relative to Germany (data from Martini et al. (2025)): black circles indicate a low differential (< 4.8 percentage points), gray triangles a high differential (> 4.8 percentage points), with the threshold corresponding to the median. Dashed horizontal lines indicate the 33rd and 66th percentiles of MAP duration (28.7 and 31.6 months, respectively); these thresholds are also used to classify countries into low, medium, and high values of k.

Tables

Table 1: Payoffs in a national tax audit

			Low-tax country		High-tax country	
		Firm	Auditor L	Tax authority	Auditor H	Tax authority
	x_L, H audit	$-\tau_L$	0	τ_L	$-c_H$	0
State	x_L, H no audit	$-\tau_L$	0	τ_L	0	0
y_L	x_H, L audit	$-\tau_L(1+\pi)$	$b-c_L$	$\tau_L(1+\pi)$	0	0
	x_H, L no audit	$-\tau_H$	0	0	0	τ_H
	x_L, H audit	$-\tau_H(1+\pi)$	0	0	$b-c_H$	$\tau_H(1+\pi)$
State	x_L, H no audit	$-\tau_L$	0	τ_L	0	0
y_H	x_H, L audit	$-\tau_H$	$-c_L$	0	0	τ_H
	x_H, L no audit	$-\tau_H$	0	0	0	τ_H
	x_L, H audit	$-\tau_L-\varepsilon\tau_H$	0	$\tau_L(1-k)$	$b-c_H$	$(\varepsilon-k)\tau_H$
State	x_L, H no audit	$-\tau_L$	0	τ_L	0	0
y_B	x_H, L audit	$-\tau_H-\varepsilon\tau_L$	$b-c_L$	$(\varepsilon-k)\tau_L$	0	$\tau_H(1-k)$
	x_H, L no audit	$-\tau_H$	0	0	0	τ_H

Table 2: Payoffs in a joint tax audit

		Firm	Tax authority L	Tax authority H
State	x_L	$-\tau_L$	$\tau_L - K$	$-K$
y_L	x_H	$-\tau_L(1+\pi)$	$\tau_L(1+\pi) - K$	$-K$
State	x_L	$-\tau_H(1+\pi)$	$-K$	$\tau_H(1+\pi) - K$
y_H	x_H	$-\tau_H$	$-K$	$\tau_H - K$
State	x_L	$-\frac{\tau_L+\tau_H}{2}$	$\frac{\tau_L}{2} - K$	$\frac{\tau_H}{2} - K$
y_B	x_H	$-\frac{\tau_L+\tau_H}{2}$	$\frac{\tau_L}{2} - K$	$\frac{\tau_H}{2} - K$

Table 3: Equilibria strategies (low residual double taxation risk)

Strategy	Equil. I^{NA}	Equil. II^{NA}	Equil. I^{JA}	Equil. II^{JA}
$\mu_L(x_L)\mu_H(x_L)$	0	0	$\mu_L^*(x_L)$	1
$\mu_L(x_H)\mu_H(x_H)$	0	0	0	0
α	α^*	1	α^*	1
β	0	0	0	0
γ	γ^*	1	γ^*	1
δ	0	0	0	0

Table 4: Equilibria strategies (high residual double taxation risk)

Strategy	Equil. IV^{NA}	Equil. V^{NA}	Equil. VI^{NA}	Equil. III^{JA}
$\mu_L(x_L)\mu_H(x_L)$	0	0	0	0
$\mu_L(x_H)\mu_H(x_H)$	0	0	0	1
α	1	α^*	α^*	α^*
β	β^*	1	β^*	1
γ	1	γ^*	γ^*	γ^*
δ	δ^*	0	δ^*	1

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