Optimal Avoidability in Cross-Border Minimum Taxation

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August 15, 2026

Abstract

Many tax regimes collect revenue to the extent that other governments do not. This paper develops a theory of how such cross-border minimum taxes should be designed, focusing on choices that affect avoidance of the regime. Making a minimum tax more difficult to avoid retains more firms within the regime but weakens competition among tax havens. Havens then raise their rates toward the minimum, reducing the top-up tax rate on shifted profit. As a result, an avoidable minimum tax can raise more revenue for the governments that impose it than an unavoidable one.

JEL Codes: H25, H26, H77

Keywords: Global minimum tax, minimum taxation, tax competition, tax cooperation

*University of San Diego (adamkern@sandiego.edu). For helpful discussions, I thank Joe Bankman, Tom Brennan, Kim Clausing, Wei Cui, Dhammika Dharmapala, Miranda Fleischer, Daniel Hemel, Eckhard Janeba, Niels Johannesen, Michael Love, Andrew Lyon, Amparo Mercader, Lucy Msall, Diane Ring, Adam Rosenzweig, Dan Shaviro, David Weisbach, seminar participants at the University of San Diego, and participants at meetings of the National Tax Association and the American Law and Economics Association. I also thank the editor, Ben Lockwood, and two anonymous referees for valuable comments and suggestions.

1. Introduction

People who face a heavy tax burden often can escape by moving to a more lenient land. Mobility of this kind shapes many choices in tax policy, including which bases to tax, at what rates, and how to enforce. A large literature analyzes how governments should respond.[1]

In practice, governments often have responded to mobility by enacting cross-border minimum taxes. Under these policies, one government will impose tax if (but only if) the tax collected by another government is too low.[2] Suppose, for example, that the minimum tax rate is 15 percent. If a firm books profit in a jurisdiction that taxes at a rate of 5 percent, the minimum tax will collect the remaining 10 percent; if the foreign jurisdiction taxes the firm at a rate of 15 percent or more, the minimum tax collects nothing. Actual regimes that implement this structure abound. Worldwide income taxes that allow foreign tax credits, in effect, impose minimum taxes on foreign income (Shaviro 2021). Anti-deferral regimes impose minimum taxes on the passive income of foreign subsidiaries;[3] a provision of U.S. law now called NCTI (formerly GILTI) does the same for active income.[4] Most ambitiously, the global minimum tax has extended the structure across a coalition of nearly 140 countries, applying a minimum tax to much of the profit earned by many of the world's largest firms (OECD 2021).

How should cross-border minimum taxes be designed? This question implicates many margins of choice, including whether to fortify the minimum tax with anti-inversion rules or other backstops, how vigorously to police the boundaries of the regime, whether to assemble a multilateral coalition, whether to accommodate a defecting member of a coalition, and so on. Across these margins, the prevailing advice is to make the minimum tax as difficult to avoid as is feasible (Kamin et al. 2019; Clausing 2020; Avi-Yonah, Kim, and Sam 2022; Clausing & Sarin 2023).[5] The intuition supporting this advice is straightforward. Cross-border minimum taxes are supposed to

[1] See, e.g., Mirrlees 1982; Zodrow & Mieszkowski 1986; Wilson 1986; Wildasin 1988; Kanbur & Keen 1993; Keen 2001; Boadway & Tremblay 2012; Keen & Konrad 2013; Lehmann, Simula, and Trannoy 2014; Mongrain & Wilson 2018; Johannesen 2022; Hebous & Keen 2023; Janeba & Schjelderup 2023; Janeba & Schulz 2023.

[2] More precisely, a cross-border minimum tax specifies a minimum rate μ and collects tax at a rate $\max\{\mu - t, 0\}$, where t is the foreign tax rate.

[3] These anti-deferral regimes now exist in over 50 countries (OECD 2026a). One prominent example is the U.S. Subpart F, principally codified at I.R.C. §§951 (a)(1)(A), 952–954.

[4] I.R.C. §951A. Between 2017 and 2025, NCTI was called "GILTI." It was renamed by the One Big Beautiful Bill Act of 2025.

[5] Of course, existing work recognizes that the administrative and compliance costs of closing an opportunity for avoidance might exceed the benefits of doing so (see Slemrod 2019). The mechanism discussed in this paper is distinct: even when enforcement is costless, strategic responses from tax havens can make some avoidability optimal.

prevent tax avoidance; they do not perform that function if they themselves can be avoided.

We show that this intuition is incomplete. A cross-border minimum tax can be too difficult to avoid: past a threshold that we characterize, further anti-avoidance measures reduce the revenue of the governments that impose the minimum tax. The reason lies in the strategic responses of tax havens. As the minimum tax becomes less avoidable, havens raise their rates to the minimum, capturing revenue that the minimum tax coalition might otherwise have collected;[6] when the tax can be avoided, havens must compete for the firms that escape, and competition holds their rates down—preserving the coalition's ability to collect top-up tax.

To make this mechanism transparent, we study it in a simple model of tax competition. Our model builds on recent work by Johannesen (2022), Hebous & Keen (2023), and Cui (2024); our key departure from prior work is that we allow the minimum tax to be avoidable. In our model, firms may respond to taxation in two ways. First, they may *exit* the minimum tax coalition's jurisdiction entirely—for example, by relocating their ultimate parent entity to a non-member country. Exiting firms escape both the coalition's primary tax and its minimum tax. Second, firms that remain within the coalition's jurisdiction may *shift profit* to a tax haven. Shifting firms avoid the coalition's primary tax but remain subject to its minimum tax. Tax havens compete for shifted profit by posting a single tax rate. This non-discrimination assumption—that havens cannot set different rates for exiting and shifting firms—is essential to our results; its institutional foundations and limits are discussed in the conclusion.

We present three main results. First, tax havens set higher rates when the minimum tax is more difficult to avoid. This behavior responds to a pricing dilemma. Havens must set a tax rate that applies to two types of firms: "contestable" firms that exit the minimum tax regime and "captive" firms that remain subject to it. Contestable firms keep the full benefit of any reduction in a tax haven's rate and accordingly are extremely sensitive to that rate. Captive firms must pay tax at the minimum rate regardless of the haven's rate, making them insensitive to rate changes below the minimum. Ideally, havens would charge different rates to each group—a low rate to attract contestable firms and a high rate to extract revenue from captive ones. But when tax havens

[6] Throughout this paper, we use "coalition" to refer to the jurisdiction or jurisdictions that enact a cross-border minimum tax. This term encompasses both unilateral regimes (such as GILTI/NCTI, enacted by the United States alone) and multilateral regimes (such as the global minimum tax). A unilateral regime can be understood as a coalition of one.

cannot discriminate between types of firms, they must set a single rate for both. As the minimum tax becomes more difficult to avoid, the captive base grows larger relative to the contestable base, and havens raise their rates accordingly. The resulting equilibrium corresponds to Varian's (1980) model of sales, with contestable firms in the role of informed customers and captive firms in that of uninformed customers.

The havens' behavior presents the coalition with a trade-off. On the one hand, strengthening the minimum tax expands the coalition's tax base by deterring firms from exiting. On the other hand, by prompting havens to set rates closer to the minimum, it erodes the rate at which the coalition collects top-up tax. The coalition must therefore weigh the gains from additional base against the losses from a lower top-up rate.

Our second result identifies an implication of this trade-off: making the minimum tax more difficult to avoid has diminishing marginal returns in the coalition's revenue. Strengthening the minimum tax expands the coalition's tax base but erodes its top-up tax rate. The cost of this erosion grows with the base to which it applies. Because the cost of rate erosion increases faster than the benefit of base expansion, each step toward unavoidability yields diminishing returns.

Our third result characterizes when an avoidable minimum tax maximizes the coalition's revenue. This occurs when the coalition's primary tax rate is sufficiently low relative to both the minimum rate and the prevalence of profit-shifting. Below this threshold, the coalition gains more from forcing havens to compete than it loses from allowing some firms to exit.

We then consider two extensions. In the first, we expand the objective so that it encompasses not just the coalition's revenue but global tax revenue. This extension helps to clarify the mechanism through which the minimum tax's avoidability benefits the coalition: it transfers revenue—leakily—from tax havens to the coalition. Thus, evaluative criteria that place positive weight on havens' revenue call for a less avoidable minimum tax than a self-interested coalition would choose. At the limit, a criterion that gives equal weight to all countries' revenue always recommends an unavoidable minimum tax.

In our second extension, we enrich the coalition's choice so that it optimizes over not just the stringency of its minimum tax, but also the rates of its primary tax and its minimum tax. This extension helps to clarify the conditions under which our main results are policy-relevant. If the coalition can freely choose all three policies, it can guarantee that firms cease profit-shifting entirely, and an unavoidable minimum tax is optimal. But if the coalition is even modestly constrained, such that it cannot fully eradicate profit-shifting, an avoidable minimum tax remains optimal under conditions derived from our baseline model.

Our analysis joins two overlapping literatures. There is an extensive legal literature on the design of minimum taxes.[7] The economic literature on tax competition is no less vast.[8] We extend a workhorse model of tax competition to deliver novel insights about an important legal form.

Most closely related are recent models of tax competition under cross-border minimum taxes developed by Johannesen (2022), Sanchirico (2022), Hebous and Keen (2023), Cui (2024), Haufler and Kato (2026), and Hindriks and Nishimura (2026). These papers analyze how havens and taxpayers respond strategically to minimum taxation. We build on this work by relaxing the assumption—maintained by Johannesen, Hebous & Keen, and Cui—that the minimum tax is unavoidable. This allows us to study how competitive dynamics evolve as avoidability changes and to characterize when some degree of avoidability is optimal. Other related work examines adjacent strategic margins. Hindriks and Nishimura (2026) study how the minimum tax rate affects cooperation in enforcement; the central strategic margin in our analysis is instead how the avoidability of the regime affects haven tax rate-setting. Haufler and Kato (2026) study a minimum tax regime with partial coverage but allow havens to set separate rates for covered and uncovered firms.

Our contribution generalizes Sanchirico (2022), who studies a binary design choice that determines the avoidability of a minimum tax. We generalize Sanchirico's framework in two ways that prove consequential. First, we replace Sanchirico's binary choice with a continuous stringency parameter σ that captures how easily firms can exit. This generalization nests Sanchirico's results as polar cases: when $\sigma = 0$ (fully avoidable), tax havens compete down to a zero rate; when $\sigma = 1$ (unavoidable), havens set rates at the minimum. Our continuous specification reveals how outcomes evolve between these extremes. Second, we model the minimum tax coalition as collecting

[7] See, e.g., Grubert & Altshuler 2013; Hines & Logue 2014; Kamin et al. 2019; Shaviro 2021; Devereux & Vella 2023; Faulhaber 2023; Cui 2024; Gamage & Glogower 2024; Kysar 2024; Kern 2026.

[8] Theoretical: See, e.g., Mirrlees 1982; Zodrow & Mieszkowski 1986; Wilson 1986; Wildasin 1988; Kanbur & Keen 1993; Keen 2001; Boadway & Tremblay 2012; Keen & Konrad 2013; Lehmann, Simula, and Trannoy 2014; Mongrain & Wilson 2018; Johannesen 2022; Hebous & Keen 2023; Janeba & Schjelderup 2023; Janeba & Schulz 2023. Empirical: Hines & Rice 1994; Devereux & Griffith 1998; Desai, Foley, and Hines 2006; Devereux, Lockwood, and Redoano 2008; Kleven, Landais, and Saez 2013; Akcigit, Baslandze, and Stantcheva 2016; Moretti & Wilson 2017; Chirinko & Wilson 2017; Egger, Nigai, and Strecker 2019.

revenue through two channels—top-up tax and primary tax—rather than one. Analyzing both channels enables a richer characterization of the optimal minimum tax.

2. Model

Consider the perspective of a coalition (denoted C) that is designing a minimum tax. The minimum tax rate is μ, and the coalition's primary tax rate is T (with $1 \geq T \geq \mu > 0$).

2.1. The Tax Base

The tax base is distributed uniformly over a continuum of taxpayers of total mass 1. For convenience, we refer to taxpayers as "firms" and the tax base as "profit," but the model extends to other settings where taxpayers can move tax bases across jurisdictions. Following the literature, we treat the size of the tax base as fixed (Johannesen 2022; Hebous & Keen 2023). This focuses attention on competition for "paper profits," which reveals the essential strategic dynamics while avoiding the complexity of modeling real factor markets.

2.2. The Coalition's Choice

The coalition chooses among a variety of legal instruments—such as expanding or contracting the coalition, enacting or repealing anti-inversion rules, and imposing or eliminating a backstop to the minimum tax—that affect firms' ability to exit from the coalition's jurisdiction. Let $x \in \mathcal{X}$ denote a package of such policies.

Although these policies differ in form, each affects the same feature of the policy environment: the division of firms between those that exit from the coalition's jurisdiction and those that remain.[9] Let $e(x) \in [0, 1]$ denote the equilibrium share of exiting firms, and let $\sigma \equiv 1 - e$ be the complementary share of firms that remain. Because policies that induce the same division of firms are outcome-equivalent, we characterize the coalition's choice in terms of σ, which we call the (effective) *stringency* of the minimum tax.

[9] For simplicity, we abstract away from direct costs of implementation and from potential selection effects. A selection effect could arise if there is a correlation between the firm-level characteristics that determine exit and firms' costs of shifting profit. Our result that the havens' expected tax rate is increasing with the stringency of the minimum tax is robust to selection effects. Our other main results are robust to a positive correlation between the ease of exit and that of shifting profit. That direction of correlation is empirically plausible, since there is some evidence that certain characteristics—such as firm size—facilitate multiple techniques of tax planning (Desai & Hines 2002; Dharmapala 2014). But if the correlation is sufficiently negative, the coalition's revenue need not be concave in the stringency of the minimum tax, and a negative correlation generally makes an unavoidable minimum tax optimal under a wider range of conditions.

Firms that exit avoid both the coalition's primary tax and its minimum tax. We model firms' exit decisions in reduced form, taking the equilibrium division induced by x as given when analyzing the subsequent choices of firms and havens.[10] This allows us to isolate how that division shapes the competitive environment without modeling the various legal and organizational routes through which exit can occur.

2.3. Profit-Shifting

Firms that do not exit choose whether to shift their profits to one of two symmetric tax havens, H_1 and H_2. Each retained firm has an idiosyncratic shifting cost ϕ_i, expressed as a share of profit; the cross-sectional distribution of these costs among retained firms is uniform on $[0, \bar{\phi}]$. This cost represents the attorneys' fees, accounting expenses, and administrative inefficiencies that arise when shifting profit. If a firm shifts profit, it avoids the coalition's primary tax but remains subject to the minimum tax.

2.4. Havens' Choices

Each haven selects a tax rate $t_i \in [0, 1]$ on all profit that is booked to it. We assume that each haven must apply the same tax rate to all profit shifted to it; in other words, neither haven can discriminate between firms.

2.5. Objectives

Each firm maximizes its profit, net of taxes and costs of tax avoidance. Each government maximizes its tax revenue.[11]

2.6. Timing and Equilibrium Concept

Players act in the following sequence:

1. The coalition designs the minimum tax, choosing a policy package x that has stringency σ.

2. Havens simultaneously set their tax rates.

[10] This reduced-form representation is compatible with multiple microfoundations. For example, one could posit that firms differ in their legal or organizational capacity z_i to exit from the minimum tax while policy package x makes exit feasible only when $z_i > \hat{z}(x)$ (Mirrlees 1982; Haufler & Kato 2026). Alternatively, one could posit that firms differ in their costs of exit and x shifts the distribution of those costs (Kanbur & Keen 1993; Slemrod & Wilson 2009; Lehmann, Simula, and Trannoy 2014; Mongrain & Wilson 2018).

[11] Revenue maximization is a tractable approximation of welfare maximization when taxes induce no real responses and consumers place a high marginal value on a public good that is financed with tax revenue (Kanbur & Keen 1993).

3. Exiting firms choose between the two havens, while firms that remain subject to the minimum tax choose whether and where to shift profit.

We seek a subgame perfect Nash equilibrium.

3. Analysis

We solve the model by backward induction. We begin by analyzing the equilibrium strategies of firms (subsection 3.1), continue to tax havens (subsection 3.2), and then proceed to the coalition (subsection 3.3).

3.1. Firms' Strategies

As noted, the coalition's choice of x induces a share e of firms to exit. Since the cost of settling in each haven is equivalent, these firms book their profit in whichever haven offers the lower tax rate.

Remaining firms choose whether to shift profit to a haven. A firm that does not shift pays tax at the coalition's primary tax rate T; a firm that shifts profit avoids the coalition's primary tax but remains subject to the minimum tax, paying an effective rate of μ.[12] Thus, a retained firm's best response is to shift profit if and only if the tax saved thereby exceeds its cost of shifting: $T - \mu > \phi_i$.

Given the uniform distribution of shifting costs, the equilibrium share of retained firms that shift is:

$$s(T, \mu) = F_\phi(T - \mu) = \min\left\{\frac{T - \mu}{\bar{\phi}}, 1\right\}. \tag{1}$$

In the baseline analysis, we focus on the interior case $0 < T - \mu < \bar{\phi}$, so that

$$s = \frac{T - \mu}{\bar{\phi}} \in (0, 1). \tag{2}$$

This isolates the nondegenerate case in which the retained base contains firms that pay primary tax as well as firms that shift and pay top-up tax. At $s = 1$, the primary tax base disappears; at $s = 0$, the top-up tax base disappears. Section 5 admits both boundary cases.

[12] Proposition 1 verifies that equilibrium haven rates do not exceed μ. Thus, the haven tax rate and the top-up tax rate paid by a shifting firm sum to μ.

3.2. Competition Between Havens

From the tax havens' perspective, the minimum tax divides firms into two distinct market segments: those that exit from the minimum tax and those that remain subject to it. Subsection 3.2.1 describes this market segmentation, subsection 3.2.2 develops the intuition behind the havens' pricing problem, and subsection 3.2.3 formally derives the equilibrium tax rates that emerge. An important consequence is that havens' tax rates rise as the minimum tax becomes more difficult to avoid.

3.2.1. The Competitive Environment

The minimum tax divides firms into two categories. The first category contains firms that exit from the minimum tax regime. These "exiting" firms escape both the coalition's primary tax and its minimum tax, paying only the tax imposed by the haven to which they book their profits. Because they keep the full benefit of any cut in a haven's tax rate, exiting firms are highly responsive to small differences in havens' rates. They will redirect all their profits to whichever haven offers even a slightly better deal.

The second group comprises firms that remain subject to the minimum tax but shift their profits to a tax haven. Because these "shifting" firms are bound by the minimum tax, they do not benefit from havens' rate cuts below the minimum. If the minimum tax rate is 15%, a shifting firm will pay the same effective tax rate whether a haven charges 1% or 14%. Thus, shifting firms are completely insensitive to tax rates below the minimum.

This segmentation divides firms' profits into two distinct tax bases. The *contestable base* consists of profits earned by exiting firms. Since exiting firms pay no marginal cost for shifting profit to one haven rather than the other, this base is perfectly mobile. The total contestable base available to both havens equals e.

The *captive base* consists of profits from shifting firms. Whenever these firms are indifferent between the two havens, a tie-breaking rule allocates half their mass to each haven. This gives each haven a captive base of $k \equiv \frac{1}{2}(1-e)s = \frac{1}{2}\sigma s$.

The relative size of these two bases structures competition between the havens. We capture this relationship through the *contestable-to-captive ratio*

$$r(\sigma) \equiv \frac{e}{k} = \frac{2(1-\sigma)}{\sigma s}. \tag{3}$$

For the boundary case $\sigma = 0$, we adopt the convention $r = \infty$. Thus, $r = 0$ corresponds to an entirely captive base, $0 < r < \infty$ to the interior case where both bases are present, and $r = \infty$ to an entirely contestable base.

3.2.2. A Pricing Dilemma

Tax havens face a dilemma. They must serve two clienteles: contestable firms and captive ones. Ideally, they would tailor their taxes to each type, posting a low rate to attract the former and a high rate to extract revenue from the latter. By assumption, however, they cannot discriminate across different firms. This constraint forces havens to set a single tax rate that serves both clienteles imperfectly.

This dilemma is analogous to a familiar one faced by producers in the private sector (Varian 1980). Consider a movie theater that serves two distinct groups of customers. Some customers are "captive"—they have already decided to watch the movie and will buy a ticket whether it costs \$10 or \$20. These customers are relatively insensitive to small price changes. Other customers are "contestable"—they are deciding between the movie theater and staying home. If tickets cost \$10, they will come; if tickets cost \$15, they will skip the show entirely.

Ideally, the theater would charge different prices to each group: \$20 to the captive moviegoers who will pay it, and \$10 to the price-sensitive customers who need the discount. But if the theater must post a single price on the marquee, it faces a trade-off. Setting a low price attracts contestable customers but leaves money on the table from captive ones. Setting a high price captures more revenue from captive customers but loses contestable consumers. The optimal price balances these two competing concerns.

Tax havens must strike a similar balance. When contestable and captive bases are present, neither haven will maintain rates at the minimum; that would mean losing all contestable firms to the other haven, which would offer a slightly lower rate. But they also will not drop their rates to zero, since that would mean giving up all revenue from their captive base. Instead, they will select some intermediate rate that reflects the relative size of their contestable and captive bases.

3.2.3. The Havens' Tax Rate

We now identify the havens' equilibrium tax rates.

Proposition 1. *The haven-pricing subgame has a unique equilibrium. (a) If $0 < r < \infty$, the equilibrium is mixed: each haven draws a rate t from a common cumulative distribution function G, given on its support by*

$$G(t) = \frac{(1+r) - \mu/t}{r}, \qquad t \in \left[\frac{\mu}{1+r}, \mu\right]. \tag{4}$$

The common expected tax rate is

$$\mathbb{E}[t] = \mu\,\frac{\ln(1+r)}{r}. \tag{5}$$

(b) In the two polar cases, the equilibrium is pure: $t_1 = t_2 = \mu$ when $r = 0$, and $t_1 = t_2 = 0$ when $r = \infty$.

The proof is in the Appendix. For $0 < r < \infty$, the haven-pricing game is isomorphic to the two-seller version of Varian's (1980) model of sales: the contestable base corresponds to informed customers, each haven's captive base to its uninformed customers, and μ to the reservation price. When exit is rare relative to shifting (i.e., r is small), havens face a predominantly captive base and can maintain rates relatively close to the minimum μ. By contrast, when many firms exit rather than shift (i.e., r is large), intense competition for the contestable base drives tax rates towards zero.

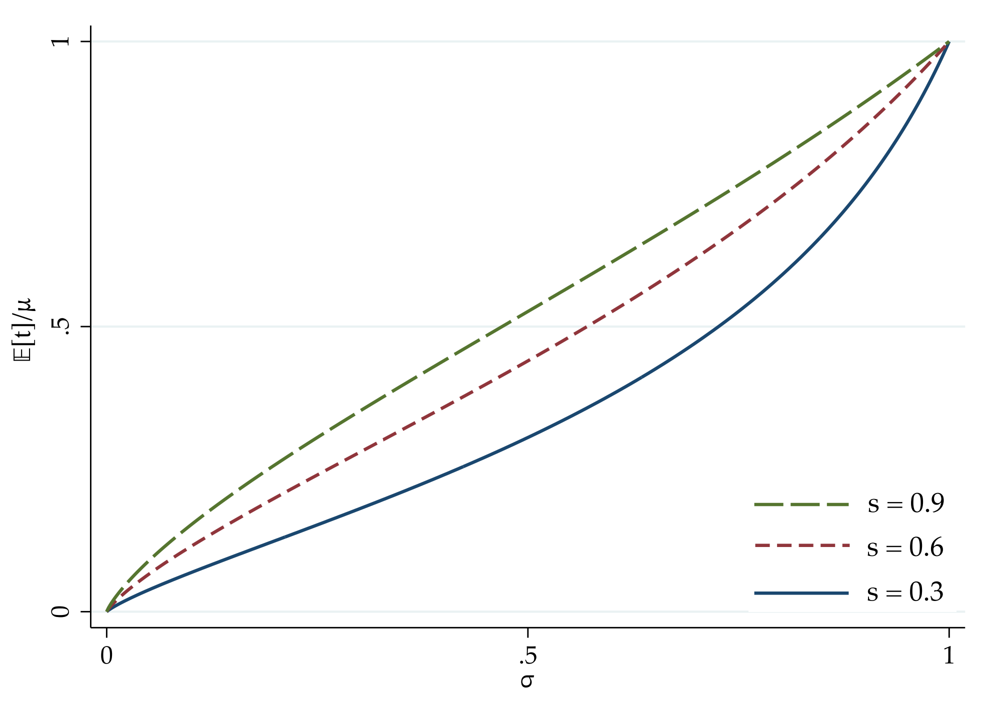
The polar cases are the limits of the interior equilibrium. As r approaches 0, G converges to a point mass at μ; as r approaches ∞, it converges to a point mass at 0. Accordingly, equation (5) extends continuously to both endpoints. This result is intuitive. If the entire base is captive ($r = 0$), the havens extract what revenue they can; if the entire base is contestable ($r = \infty$), Bertrand competition drives the havens to impose no tax.

Because $r(\sigma)$ in equation (3) is decreasing in σ, Proposition 1 yields:

Corollary 1. *The havens' expected tax rate is increasing in σ.*

As the minimum tax becomes more difficult to avoid, fewer firms exit, shrinking the contestable base and enlarging each haven's captive base. Because the contestable-to-captive ratio falls, the havens' expected tax rate rises (see Figure 1). This result nests the special case (discussed in Johannesen 2022 and Cui 2024) in which the minimum tax is unavoidable and havens set their rate at the minimum.

Figure 1: Expected Haven Tax Rate for Three Values of s



Notes: This figure plots the equilibrium expected haven tax rate $\mathbb{E}[t]$, expressed as a share of the minimum tax rate μ, against σ for three values of s. The expected rate is given by equation (5). As σ increases, so does $\mathbb{E}[t]$, until $\mathbb{E}[t] = \mu$ when $\sigma = 1$.

3.3. The Optimal Minimum Tax

We now determine the coalition's optimal minimum tax. The preceding analysis revealed that tax havens raise their rates as the minimum tax becomes more difficult to avoid. This raises a trade-off for the coalition: While strengthening the minimum tax expands the coalition's tax base, it also undermines the rate at which the coalition collects top-up tax. Subsection 3.3.1 characterizes this base-rate trade-off, and the following two subsections describe two consequences of it. Subsection 3.3.2 shows that strengthening the minimum tax has diminishing marginal returns in the coalition's revenue. Subsection 3.3.3 identifies the conditions under which an avoidable minimum tax outperforms an unavoidable one.

3.3.1. A Base-Rate Trade-Off

The strategic behavior of havens presents a trade-off to the coalition. When the coalition considers strengthening the minimum tax, it faces two effects that work in opposite directions.

First, strengthening the minimum tax increases the number of firms that are subject to tax by the coalition. If the coalition raises σ, it makes exit more costly, inducing some firms that would have exited to remain within the coalition's jurisdiction. These firms must either (a) pay tax at the coalition's primary rate T or (b) shift their profit to a haven, where the coalition will collect top-up tax at a rate of $\mu - t$. Either way, the coalition's tax base grows.

Second, however, strengthening the minimum tax also erodes the rate at which the coalition collects top-up tax. As fewer firms exit, the composition of the havens' base shifts from contestable firms to captive firms. As the contestable-to-captive ratio r falls, the expected haven rate $\mathbb{E}[t]$ approaches the minimum rate μ. That erodes the coalition's top-up tax rate.

3.3.2. Diminishing Returns to Strengthening the Minimum Tax

This trade-off between base expansion and rate erosion leads to our second proposition.

Proposition 2. *The coalition's tax revenue $R_C(\sigma)$ is strictly concave in σ.*

Coalition revenue can be decomposed as

$$R_C(\sigma) = R_C^P(\sigma) + R_C^\Delta(\sigma), \tag{6}$$

where

$$R_C^P(\sigma) \equiv \sigma(1-s)T \qquad \text{and} \qquad R_C^\Delta(\sigma) \equiv \sigma s\big(\mu - \mathbb{E}[t]\big). \tag{7}$$

The first component, R_C^P, is the coalition's primary tax revenue; the second component, R_C^Δ, is the coalition's top-up tax revenue.

Claim 2.1. *The coalition's primary tax revenue $R_C^P(\sigma)$ is linear in σ.*

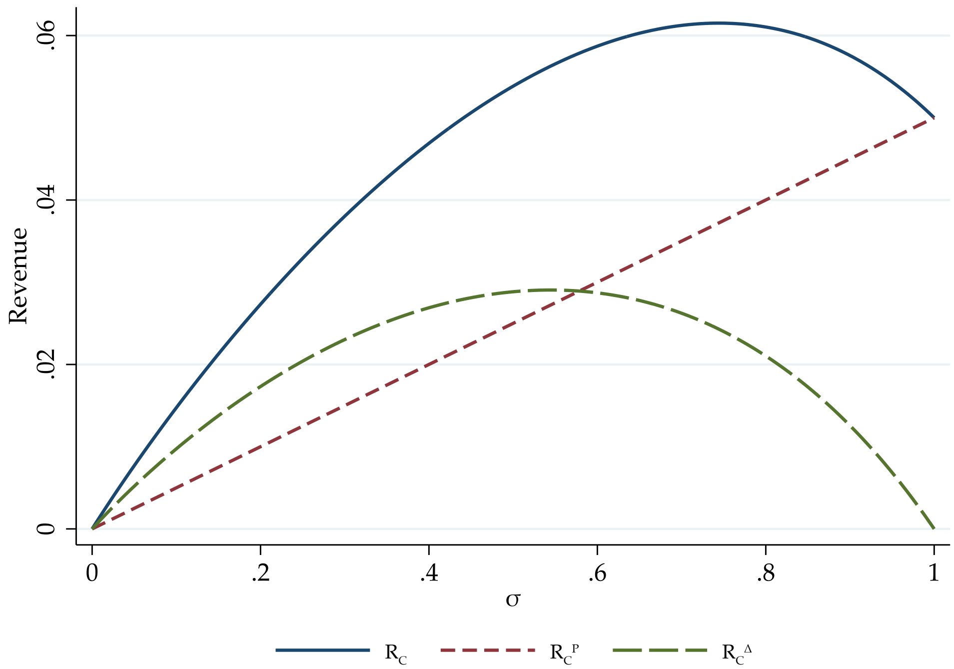
Strengthening the minimum tax increases the base that is subject to primary taxation in a linear fashion. Moreover, the tax rate applied to this base, T, is constant. This implies that the coalition's primary tax revenue is linear in σ.

Claim 2.2. *The coalition's top-up tax revenue $R_C^\Delta(\sigma)$ is strictly concave in σ.*

The proof is in the Appendix. Here is the intuition. As noted in Section 3.3.1, strengthening the minimum tax affects the coalition's top-up tax revenue by expanding the tax's base but lowering its rate. The size of the base expansion effect is unaffected by the current level of σ. However, as the level of σ rises, the rate erosion effect grows. Moreover, havens raise their rates—and the coalition's top-up tax rate falls accordingly—at a sufficiently rapid pace that the coalition's top-up tax revenue is strictly concave in σ.

Claim 2.1 and Claim 2.2 jointly entail Proposition 2 (see Figure 2 for an illustration). Strengthening the minimum tax yields diminishing marginal returns in the coalition's revenue.

Figure 2: Diminishing Returns to Strengthening the Minimum Tax



Notes: This figure shows the coalition's total revenue R_C, primary tax revenue R_C^P, and top-up tax revenue R_C^Δ over σ, for $\mu = 0.15$, $T = 0.2$, and $s = 0.75$. The coalition's primary tax revenue is linear in σ, while its top-up tax revenue is strictly concave in σ, making total revenue strictly concave in σ as well.

3.3.3. When is Avoidability Optimal?

The foregoing analysis establishes that the coalition's revenue is strictly concave in the stringency of the minimum tax. This raises a natural question: Does the marginal impact of strengthening the minimum tax ever become negative? Might the optimal minimum tax be (to some extent) avoidable? The answer is "yes."

Proposition 3. *An avoidable minimum tax is optimal if and only if*

$$(1 - s)T < \mu. \tag{8}$$

The proof is in the Appendix; we sketch it here. Consider a minimum tax that is nearly unavoidable. Because σ is the share of firms that remain, a marginal increase in σ directly adds one unit of retained base. Of that base, a share $1 - s$ pays primary tax at rate T, generating $(1 - s)T$ of revenue. At the same time, eliminating the last unit of contestable base allows havens to raise their rates to the minimum, extinguishing μ of top-up revenue at the margin. Hence,

$$R'_C(1^-) = (1 - s)T - \mu. \tag{9}$$

By strict concavity, an avoidable minimum tax is optimal if and only if this boundary derivative is negative. Rearranging yields equation (8).

Proposition 3 reveals a surprising relationship between profit-shifting and the optimal degree of avoidability. When profit-shifting is easier (hence, s is larger), an avoidable minimum tax is *more* likely to be optimal. When many firms will shift profit, the coalition's revenue depends more heavily on top-up taxation. That makes it worthwhile to preserve a relatively high rate of top-up tax by allowing some firms to exit and forcing havens to compete below the minimum rate.

4. Coalition Revenue vs. Global Revenue

The baseline analysis evaluated the minimum tax from the perspective of a self-interested coalition. This section takes a broader perspective, one that gives positive weight to the revenue of tax havens as well.

4.1. Avoidability and the Transfer of Revenue

Begin by noting how avoidability can benefit the coalition. By inducing havens to compete more aggressively, avoidability transfers revenue—leakily—from havens to the coalition. For any firm that remains subject to the minimum tax and shifts profit, the haven tax rate and the coalition's top-up tax rate sum to μ. A reduction in the haven rate therefore raises the coalition's top-up rate one-for-one, transferring revenue from tax havens to the coalition. This transfer is leaky, however, because relaxing the minimum tax also allows some firms to exit. Exiting firms pay only the haven rate, and greater avoidability both expands the exiting base and lowers the rate imposed on it. Global revenue therefore falls.

4.2. Optimal Avoidability Under Broader Revenue Weights

As these observations suggest, assigning positive weight to the revenue of tax havens generally supports making the minimum tax more stringent. Let $\alpha \in [0,1]$ denote the weight placed on a dollar collected by a haven relative to a dollar collected by the coalition, and define

$$R_\alpha(\sigma) \equiv R_C(\sigma) + \alpha R_H(\sigma), \tag{10}$$

where $R_H(\sigma)$ denotes the havens' combined revenue. At $\alpha = 0$, the objective is coalition revenue; at $\alpha = 1$, it is global tax revenue.

Proposition 4. *For each $\alpha \in [0,1]$, $R_\alpha(\sigma)$ has a unique maximizer, denoted σ^*_α. (a) If $0 \leq \alpha_1 < \alpha_2 \leq 1$, then $\sigma^*_{\alpha_2} \geq \sigma^*_{\alpha_1}$, with strict inequality whenever $\sigma^*_{\alpha_1} < 1$. (b) The optimal minimum tax is avoidable if and only if*

$$(1-s)T < \mu(1-\alpha s). \tag{11}$$

The proof is in the Appendix. For the intuition, note that the objective $R_\alpha(\sigma)$ can be written as a weighted average of coalition revenue and global revenue:

$$R_\alpha(\sigma) = (1-\alpha)R_C(\sigma) + \alpha\big[R_C(\sigma) + R_H(\sigma)\big]. \tag{12}$$

As α rises, the criterion discounts the coalition's purely redistributive gain from avoidability and places more weight on the global revenue lost through leakage. In equilibrium, each haven's expected revenue equals μ times its captive base, so the havens' combined revenue is $R_H(\sigma) = \mu s \sigma$. Weighting this revenue by α adds the constant $\alpha\mu s$ to the marginal return to stringency; since R_α remains strictly concave, optimal stringency rises with α, strictly until it reaches one. At $\sigma = 1$, this changes the marginal return from $(1-s)T - \mu$ to $(1-s)T - \mu(1-\alpha s)$, yielding equation (11).

5. Endogenous Coalition Tax Rates

The baseline model considered a coalition that chooses the stringency of its minimum tax while taking its tax rates as given. We now return to the baseline setting of a revenue-maximizing coalition but enrich the coalition's choice so that it selects tax rates alongside the stringency of the minimum tax.

Consider first a coalition that can freely choose tax rates over the interval $[0, 1]$ (subject to the mild assumption that the primary tax rate is weakly greater than the minimum tax rate).

Proposition 5. *If the coalition can choose any $\mu \in [0, 1]$ and any $T \in [\mu, 1]$, then the optimal minimum tax is unavoidable.*

Proposition 5 is established with a dominance argument. Consider the feasible policy of setting the primary tax rate and the minimum tax rate to be equal and positive and making the minimum tax unavoidable. Since there is no difference between the primary tax rate and the minimum rate, no firms shift profit; since exit is impossible, all firms remain. Hence, the coalition's revenue equals T. By equations (6) and (7), together with $\mu - \mathbb{E}[t] \leq T$, expected coalition revenue under any candidate (μ, T, σ) with $\sigma < 1$ satisfies $R_C \leq \sigma T < T$.

The preceding result turns on the coalition's ability to eliminate profit-shifting by setting its primary and minimum rates to be equal. If the coalition is constrained to maintain even a small gap between those rates, an avoidable minimum tax can again be optimal. Let $\underline{\omega} > 0$ denote the minimum required gap between the primary and minimum rates, and let $\bar{T} \leq 1$ denote the highest feasible primary rate. Assume that $0 < \underline{\omega} < \bar{T}$.

Proposition 6. *Suppose that the coalition chooses (μ, T, σ) subject to*

$$0 \leq \mu \leq T \leq \bar{T}, \qquad T - \mu \geq \underline{\omega}, \qquad \sigma \in [0, 1].$$

Let (μ^*, T^*, σ^*) be any optimal policy and write $s^* \equiv s(T^*, \mu^*)$. Then

$$\sigma^* < 1 \quad \Longleftrightarrow \quad (1 - s^*)T^* < \mu^* \quad \Longleftrightarrow \quad \bar{T} > \bar{\phi}.$$

Proposition 6 shows that the criterion from Proposition 3 survives the endogeneity of the coalition's tax rates. Because the coalition must maintain some gap between its primary tax rate and the minimum tax rate, it cannot eliminate profit-shifting entirely, and the dominance argument behind Proposition 5 does not hold. Instead, as in the baseline model, the marginal benefit of making the minimum tax unavoidable is $(1 - s^*)T^*$—the primary-tax revenue collected from the marginal unit of retained base—while its marginal cost is μ^*, the top-up tax revenue lost as haven competition disappears. The final equivalence gives this criterion a primitive interpretation.

6. Conclusion

Cross-border minimum taxes are pervasive, but their optimal design has been imperfectly understood. This paper analyzes a wide range of policy choices in terms of how they affect a cross-border minimum tax's avoidability. From the perspective of a coalition that enacts such a tax, optimal design reflects a trade-off: strengthening the minimum tax expands the coalition's tax base, but it also prompts tax havens to raise their rates toward the minimum, eroding the coalition's top-up tax rate. An avoidable minimum tax outperforms an unavoidable one when the coalition's primary tax rate is sufficiently low relative to the minimum rate and the prevalence of profit-shifting.

The policy relevance of our results turns on two scope conditions. The first is a constraint on the coalition's ability to eradicate profit-shifting by setting sufficiently close primary and minimum tax rates. A wide range of forces may impose this constraint in practice. Minimum tax coalitions are often diverse, with some members of the coalition preferring relatively high tax rates and others preferring relatively low ones. Similarly, the minimum tax might apply exclusively to relatively mobile firms while the primary tax applies to mobile and immobile firms alike, implying that the optimal primary tax rate for the broader population is higher than the optimal minimum tax rate for the relatively mobile population. For these and other reasons, substantial gaps between minimum tax rates and primary tax rates are widespread. The tax rate under NCTI ranges between 12.6 percent and 14 percent, well below the primary U.S. corporate tax rate of 21 percent;[13] similarly, the global minimum tax is imposed at a rate of 15 percent, approximately 6 points below the average statutory corporate tax rate within the OECD's Inclusive Framework, the coalition that agreed to implement the global minimum tax (OECD 2026a).

A second scope condition concerns tax havens' ability to discriminate across firms. The mechanism identified here presupposes that havens cannot perfectly segment the contestable and captive tax bases by conditioning firms' tax burdens on their exposure to the minimum tax. The plausibility of this assumption varies across contexts. For example, U.S. cross-border minimum taxes

[13] I.R.C. §§11(b), 250(a)(1)(B), 951A(a), 960(d)(1).

are implemented through the U.S. foreign tax credit, which is disallowed when foreign countries attempt to "soak up" the credit by imposing taxes that are conditioned on the credit's availability.[14] This rule prevents discrimination. By contrast, the global minimum tax allows countries to tax in-scope firms at the minimum rate of 15 percent through "qualified domestic minimum top-up taxes" (QDMTTs), even if they simultaneously offer a lower tax rate to out-of-scope firms (OECD 2021, arts. 1.1 and 10.1). That structure relieves the pricing dilemma studied here. Yet even within the global minimum tax, the pricing dilemma may persist. In 2025, the United States partially withdrew from the global minimum tax under an agreement that forbids countries from discriminating in favor of U.S. firms through selective application of QDMTTs (OECD 2026b). Shortly after this agreement took effect, Curaçao abandoned its planned QDMTT, reportedly to remain attractive to U.S. firms (Ministry of Finance of Curaçao 2026).

These qualifications help to define our results. With perfect rate flexibility, a minimum tax coalition could eliminate profit-shifting; with perfect segmentation, tax havens could escape their pricing dilemma. Our model concerns the intermediate case in which the coalition must tolerate some shifted profit and havens must price contestable and captive firms together. In that setting, strengthening a minimum tax may transfer revenue to tax havens by softening competition among them. For minimum tax coalitions, then, the relevant design question is not simply whether a reform strengthens the minimum tax, but how that reform structures competition among havens.

[14] Treas. Reg. § 1.901-2(e)(6)(i).

Appendix

A. Proof of Proposition 1

We first consider the nondegenerate case of $0 < r < \infty$, so that $e > 0$ and $k > 0$. The proof has three steps. Step 1 rules out pure-strategy equilibria. Step 2 shows that every equilibrium strategy is supported on $[0, \mu]$. This reduces the haven-pricing subgame to the zero-cost, two-seller version of Varian's (1980) model of sales. Step 3 uses the characterization of that game to establish uniqueness, derive the equilibrium distribution and its mean, and verify the resulting strategy against deviations outside its support. The polar cases $r = 0$ and $r = \infty$ are discussed at the end.

For use in Steps 1 and 2, let

$$B(q) \equiv \sigma F_{\phi}(T - q), \qquad q \geq \mu, \tag{A.1}$$

denote the total retained base that shifts when the lowest effective tax rate is q. In particular,

$$B(\mu) = \sigma s = 2k, \tag{A.2}$$

and $B(q)$ is weakly decreasing in q.

Step 1: No Pure-Strategy Equilibrium. We divide pure-strategy profiles into two exhaustive cases: the havens set unequal rates or they set the same rate.

First suppose that the rates are unequal, and write $t_{\ell} < t_h$. If $t_h \leq \mu$, the lower-rate haven serves the base $k + e$. It can raise t_{ℓ} slightly while remaining below t_h, preserve this base, and strictly increase its revenue. If instead $t_h > \mu$, the higher-rate haven attracts no firms and earns zero. By deviating to μ, it receives at least its captive base $k = B(\mu)/2$, and therefore earns at least $\mu k > 0$. Hence no profile with unequal rates is an equilibrium.

Now suppose that the havens set the same rate t. If $t = 0$, either haven can deviate to some $\varepsilon \in (0, \mu]$, retain its captive base, and earn $\varepsilon k > 0$. If $0 < t \leq \mu$, a deviation to $t - \varepsilon$ changes the deviating haven's revenue by

$$(t - \varepsilon)(k + e) - t\left(k + \frac{e}{2}\right) = \frac{te}{2} - \varepsilon(k + e), \tag{A.3}$$

which is positive for sufficiently small $\varepsilon > 0$. Finally, if $t > \mu$, each haven earns $\frac{t}{2}\left[e + B(t)\right]$. For $0 < \varepsilon < \min\{t - \mu, t/2\}$, a deviation to $t - \varepsilon$ captures rather than splits the available base and weakly expands the retained shifting base. It therefore yields

$$\begin{aligned}(t-\varepsilon)\left[e + B(t-\varepsilon)\right] &\geq (t-\varepsilon)\left[e + B(t)\right] \\ &> \frac{t}{2}\left[e + B(t)\right].\end{aligned} \tag{A.4}$$

Every pure-strategy profile therefore admits a profitable deviation. Hence no pure-strategy Nash equilibrium exists, and any equilibrium must involve mixing.

Step 2: Equilibrium Support Is Bounded by μ. Our strategy is to use $t = \mu$ to establish a strictly positive payoff floor. If an equilibrium support extended above μ, that floor would force both havens to place an atom at the maximal rate in their supports; a slight undercut of that atom would then be profitable.

Let G_i and G_j denote the havens' equilibrium mixed strategies, and let v_i denote haven i's equilibrium payoff. By setting μ, each haven receives at least its captive base k, regardless of the rival's rate. Hence

$$v_i \geq R_i(\mu; G_j) \geq \mu k > 0. \tag{A.5}$$

Suppose, toward a contradiction, that an equilibrium support extends above μ. Let

$$\bar{t}_i \equiv \sup \operatorname{supp}(G_i), \qquad \bar{t} \equiv \max\{\bar{t}_1, \bar{t}_2\} > \mu, \tag{A.6}$$

and label i a haven whose upper endpoint is $\bar{t}$. Because G_i assigns probability one to best responses, there exists a sequence of best-response rates $t_n \uparrow \bar{t}$. For sufficiently large n, $t_n > \mu$. At such a rate, haven i receives any tax base only if haven j sets a rate at least as high. Because the total tax base is at most one,

$$\mu k \leq v_i = R_i(t_n; G_j) \leq t_n \Pr(t_j \geq t_n). \tag{A.7}$$

Moreover, $t_j \leq \bar{t}$ almost surely. Therefore,

$$a_j \equiv \Pr(t_j = \bar{t}) = \lim_{n \to \infty} \Pr(t_j \geq t_n) \geq \frac{\mu k}{\bar{t}} > 0. \tag{A.8}$$

Thus, haven j places an atom at $\bar{t}$. Because j selects $\bar{t}$ with positive probability, $\bar{t}$ must be a best response for j. Haven i must therefore also place an atom at $\bar{t}$: otherwise, i would set a strictly lower rate with probability one, so j would attract no firms when it selected $\bar{t} > \mu$ and would earn zero, contradicting its strictly positive equilibrium payoff. Hence $\bar{t}$ is a common atom; in particular, since haven i selects $\bar{t}$ with positive probability, $\bar{t}$ is a best response for i, and $R_i(\bar{t}; G_j) = v_i$.

If haven i selects $\bar{t}$, it receives firms only when haven j also selects $\bar{t}$, in which event the havens split the available base. Thus,

$$R_i(\bar{t}; G_j) = \frac{a_j \bar{t}}{2}\big[e + B(\bar{t})\big]. \tag{A.9}$$

Now choose

$$0 < \varepsilon < \min\left\{\bar{t} - \mu, \frac{\bar{t}}{2}\right\}. \tag{A.10}$$

By selecting $\bar{t} - \varepsilon > \mu$, haven i captures the entire available base whenever haven j selects $\bar{t}$. Because B is weakly decreasing,

$$\begin{aligned} R_i(\bar{t} - \varepsilon; G_j) &\geq a_j(\bar{t} - \varepsilon)\big[e + B(\bar{t} - \varepsilon)\big] \\ &\geq a_j(\bar{t} - \varepsilon)\big[e + B(\bar{t})\big] \\ &> \frac{a_j \bar{t}}{2}\big[e + B(\bar{t})\big] = R_i(\bar{t}; G_j) = v_i. \end{aligned} \tag{A.11}$$

The deviation is profitable, contradicting equilibrium. Therefore,

$$\bar{t}_i \leq \mu \qquad \text{for each haven } i. \tag{A.12}$$

Thus, every mixed-strategy equilibrium assigns probability one to rates in $[0, \mu]$.

Step 3: Characterization, Existence, and Uniqueness. By Step 2, every equilibrium of the full haven-pricing game assigns probability one to rates in $[0, \mu]$. The restricted game is isomorphic to the zero-cost, two-seller version of Varian's model of sales. Each haven corresponds to a seller; the haven's tax rate corresponds to the seller's price; μ corresponds to the reservation price; k corresponds to the uninformed customers captive to each seller; and e corresponds to the informed customers who purchase from the lower-priced seller. Baye, Kovenock, and de Vries show that the two-seller version of this game has a unique equilibrium: it is symmetric and atomless, and both sellers randomize over the same connected interval ending at the reservation price (1992, Theorem 1 and the discussion immediately following Lemma 16). Hence any equilibrium of the full haven-pricing game must be symmetric and atomless, with common support $[t_L, \mu]$.

Let G denote the common CDF. If haven i selects $t \in [t_L, \mu]$, it always receives its captive base k and wins the contestable base whenever its rival selects a higher rate. Its expected revenue is therefore

$$R_i(t; G) = t\Big[k + e\big(1 - G(t)\big)\Big] = tk\Big[1 + r\big(1 - G(t)\big)\Big]. \tag{A.13}$$

Because G is atomless, selecting the upper endpoint μ yields revenue μk. Indifference throughout the support therefore requires

$$t\Big[1 + r\big(1 - G(t)\big)\Big] = \mu. \tag{A.14}$$

Solving for $G(t)$ gives

$$\boxed{G(t) = \frac{(1+r) - \mu/t}{r}, \qquad t \in [t_L, \mu]}. \tag{A.15}$$

The condition $G(t_L) = 0$ determines the lower endpoint:

$$\boxed{t_L = \frac{\mu}{1+r}}. \tag{A.16}$$

The candidate equilibrium distribution is therefore

$$G(t) = \begin{cases} 0, & 0 \le t < t_L, \\ \dfrac{(1+r) - \mu/t}{r}, & t_L \le t \le \mu, \\ 1, & \mu < t \le 1. \end{cases} \tag{A.17}$$

This is a valid atomless CDF: it is continuous, satisfies $G(t_L) = 0$ and $G(\mu) = 1$, and is strictly increasing on the interior of its support because

$$G'(t) = \frac{\mu}{rt^2} > 0, \qquad t \in (t_L, \mu). \tag{A.18}$$

It remains to verify that this distribution is an equilibrium of the full haven-pricing game. Against a rival using G, the revenue from any pure rate $t \in [0,1]$ is

$$R_i(t;G) = \begin{cases} t(k+e) < t_L(k+e) = \mu k, & 0 \le t < t_L, \\ \mu k, & t_L \le t \le \mu, \\ 0 < \mu k, & \mu < t \le 1. \end{cases} \tag{A.19}$$

A rate below t_L wins the contestable base with certainty but sacrifices too much revenue per unit of base. Every rate in $[t_L, \mu]$ yields μk by construction. Finally, a rate above μ attracts no firms because the rival sets a rate at or below μ with probability one. Thus, every rate in the support is a best response, and no rate outside the support is profitable. Hence (G, G) is an equilibrium of the full haven-pricing game.

Using the density above, the expected haven rate is

$$\begin{aligned} \mathbb{E}[t_i] &= \int_{t_L}^{\mu} tG'(t)\,dt \\ &= \frac{\mu}{r}\int_{t_L}^{\mu} \frac{1}{t}\,dt \\ &= \frac{\mu}{r}\ln\left(\frac{\mu}{t_L}\right) \\ &= \boxed{\mu\frac{\ln(1+r)}{r}}. \end{aligned} \tag{A.20}$$

Step 2 implies that every equilibrium of the full game is also an equilibrium of the game restricted to $[0, \mu]$, and the two-seller Varian result establishes that the restricted game has no other equilibrium. Hence (G, G) is the unique equilibrium of the full haven-pricing game.

Finally, consider the polar cases. If $r = 0$, each haven has only a captive base, and the unique equilibrium is $t_1 = t_2 = \mu$. If $r = \infty$, the game reduces to standard Bertrand competition, and the unique equilibrium is $t_1 = t_2 = 0$. □

B. Proof of Claim 2.2

The proof proceeds in three steps. First, we derive a curvature condition on the expected haven rate that is equivalent to strict concavity of top-up revenue. Second, we show that the equilibrium expected haven rate satisfies this condition. Third, we combine the two steps to establish the claim.

Step 1: Strict Concavity is Equivalent to a Curvature Condition on $\mathbb{E}[t]$. Differentiating top-up tax revenue once and twice gives, respectively,

$$R_C^{\Delta\prime} = s\left[\left(\mu - \mathbb{E}[t]\right) - \sigma(\mathbb{E}[t])'\right], \tag{B.1}$$

and

$$R_C^{\Delta\prime\prime} = s\left[-2(\mathbb{E}[t])' - \sigma(\mathbb{E}[t])''\right]. \tag{B.2}$$

Recall that the expected haven rate is increasing in stringency—$(\mathbb{E}[t])' > 0$—so the first term in $R_C^{\Delta\prime\prime}$ is negative. If $(\mathbb{E}[t])'' \geq 0$, then the second term in $R_C^{\Delta\prime\prime}$ is nonpositive, so $R_C^{\Delta\prime\prime} < 0$. The only obstacle to establishing strict concavity of R_C^{Δ} arises where the expected haven rate is itself locally concave, so that $-\sigma(\mathbb{E}[t])'' > 0$.

To characterize how much concavity in the expected haven rate can be accommodated, factor $(\mathbb{E}[t])'$:

$$R_C^{\Delta\prime\prime} = s\cdot(\mathbb{E}[t])'\left[-2+\sigma\left(-\frac{(\mathbb{E}[t])''}{(\mathbb{E}[t])'}\right)\right]. \tag{B.3}$$

Since $s > 0$ and $(\mathbb{E}[t])' > 0$, it follows that

$$R_C^{\Delta\prime\prime}(\sigma) < 0 \quad\Longleftrightarrow\quad -\frac{(\mathbb{E}[t])''}{(\mathbb{E}[t])'} < \frac{2}{\sigma}. \tag{B.4}$$

Thus, top-up tax revenue is strictly concave just in case the expected haven rate is *not too concave* in the sense of equation (B.4).

Step 2: $\mathbb{E}[t]$ satisfies equation (B.4). It will be convenient to refer to a version of $\mathbb{E}[t]$ that is normalized by μ. Write $g(r) \equiv \frac{\ln(1+r)}{r}$ and $g(0) \equiv 1$.

By the chain rule,

$$(\mathbb{E}[t])' = \mu g'(r)r', \tag{B.5}$$

and

$$(\mathbb{E}[t])'' = \mu\left[g''(r)(r')^2 + g'(r)r''\right]. \tag{B.6}$$

Observe that $g'(r) < 0 < g''(r)$. Hence, suppressing arguments,

$$
\begin{aligned}
-\frac{(\mathbb{E}[t])''}{(\mathbb{E}[t])'} &= -\frac{g''(r)(r')^2 + g'(r)r''}{g'(r)r'} \\
&= \underbrace{\left(\frac{g''(r)}{-g'(r)}\right)r'}_{<0} - \frac{r''}{r'} \\
&< -\frac{r''}{r'}.
\end{aligned}
\tag{B.7}
$$

The derivatives of the contestable-to-captive ratio are

$$
r'(\sigma) = -\frac{2}{s\sigma^2}, \qquad r''(\sigma) = \frac{4}{s\sigma^3}. \tag{B.8}
$$

Consequently,

$$
-\frac{r''(\sigma)}{r'(\sigma)} = \frac{2}{\sigma}. \tag{B.9}
$$

Combining these results gives

$$
-\frac{(\mathbb{E}[t])''}{(\mathbb{E}[t])'} < \frac{2}{\sigma}, \tag{B.10}
$$

which is precisely equation (B.4).

Step 3: Conclusion. Substituting the inequality established in Step 2 into the factorization from Step 1 yields

$$
-2 + \sigma\left(-\frac{(\mathbb{E}[t])''}{(\mathbb{E}[t])'}\right) < 0. \tag{B.11}
$$

Because $s \cdot (\mathbb{E}[t])' > 0$, it follows that

$$
R_C^{\Delta\prime\prime}(\sigma) < 0 \qquad \text{for every } \sigma \in (0, 1]. \tag{B.12}
$$

Finally, R_C^{Δ} has a continuous extension to the endpoint $\sigma = 0$, with $R_C^{\Delta}(0) = 0$.

Therefore, R_C^{Δ} is strictly concave on $[0, 1]$. $\square$

C. Proof of Proposition 3

Our strategy is to sign the left derivative of R_C at $\sigma = 1$. By Proposition 2, R_C is strictly concave, so the sign of $R_C'(1^-)$ determines whether $\sigma^* = 1$ or $\sigma^* < 1$.

Coalition revenue is given by equations (6) and (7). At $\sigma = 1$, $r = 0$ and $\mathbb{E}[t] = \mu$. Moreover, using $\mathbb{E}[t] = \mu g(r(\sigma))$, we have $g'(0) = -1/2$ and $r'(1^-) = -2/s$. Therefore,

$$\begin{aligned} R_C'(1^-) &= (1-s)T - s \cdot (\mathbb{E}[t])'(1^-) \\ &= (1-s)T - s\mu g'(0) r'(1^-) \\ &= (1-s)T - \mu. \end{aligned} \tag{C.1}$$

It follows that

$$\sigma^* < 1 \quad \Longleftrightarrow \quad R_C'(1^-) < 0 \quad \Longleftrightarrow \quad \boxed{(1-s)T < \mu}. \tag{C.2}$$

Thus, an avoidable minimum tax is optimal if and only if $(1-s)T < \mu$. □

D. Proof of Proposition 4

For $0 < \sigma < 1$, Proposition 1(a) implies that each haven is indifferent among all rates in the support of its equilibrium strategy. At the upper endpoint $t = \mu$, a haven wins the contestable base with probability zero and therefore earns μk on its captive base. The same expression holds at $\sigma = 0$ and $\sigma = 1$ under the polar equilibria in Proposition 1(b). Since $k = \sigma s/2$, the havens' combined revenue is

$$R_H(\sigma) = 2\mu k = \mu s \sigma. \tag{D.1}$$

It follows that

$$R_\alpha(\sigma) = R_C(\sigma) + \alpha \mu s \sigma. \tag{D.2}$$

By Proposition 2, R_C is strictly concave in σ. Adding a linear function preserves strict concavity, so R_α has a unique maximizer σ_α^*. Moreover, for every $\sigma > 0$,

$$R_\alpha(\sigma) \geq R_C^P(\sigma) = \sigma(1-s)T > 0 = R_\alpha(0), \tag{D.3}$$

so $\sigma_\alpha^* > 0$.

For part (a), fix $0 \leq \alpha_1 < \alpha_2 \leq 1$, and write $\sigma_j \equiv \sigma_{\alpha_j}^*$ for $j = 1, 2$. The marginal objectives satisfy

$$R_{\alpha_2}'(\sigma) = R_{\alpha_1}'(\sigma) + (\alpha_2 - \alpha_1)\mu s. \tag{D.4}$$

Suppose first that $\sigma_1 < 1$. Since $\sigma_1 > 0$, the maximizer is interior, and hence $R_{\alpha_1}'(\sigma_1) = 0$. Therefore,

$$R'_{\alpha_2}(\sigma_1) = (\alpha_2 - \alpha_1)\mu s > 0. \tag{D.5}$$

Strict concavity then implies that $\sigma_2 > \sigma_1$. If instead $\sigma_1 = 1$, optimality at the upper boundary gives $R'_{\alpha_1}(1^-) \geq 0$. Hence $R'_{\alpha_2}(1^-) > 0$, so concavity implies that R_{α_2} is strictly increasing and $\sigma_2 = 1$. Thus,

$$\sigma^*_{\alpha_2} \geq \sigma^*_{\alpha_1}, \tag{D.6}$$

with strict inequality whenever $\sigma^*_{\alpha_1} < 1$. This proves part (a).

For part (b), equation (9) gives $R'_C(1^-) = (1-s)T - \mu$. Consequently,

$$\begin{aligned} R'_\alpha(1^-) &= R'_C(1^-) + \alpha\mu s \\ &= (1-s)T - \mu(1-\alpha s). \end{aligned} \tag{D.7}$$

Because R_α is strictly concave, its unique maximizer lies strictly below 1 if and only if this left derivative is negative. Therefore,

$$\sigma^*_\alpha < 1 \iff R'_\alpha(1^-) < 0 \iff \boxed{(1-s)T < \mu(1-\alpha s)}. \tag{D.8}$$

Thus, the optimal minimum tax is avoidable if and only if $(1-s)T < \mu(1-\alpha s)$. □

E. Proof of Proposition 6

The proof has three steps. First, we show that every optimum uses the highest feasible primary rate. Second, we characterize optimal stringency conditional on the chosen rates, including the boundary cases. Third, we reduce that characterization to the primitive condition $\bar{T} > \bar{\phi}$.

Step 1: Selection of the Highest Feasible Primary Rate. The feasible set is compact, and coalition revenue is continuous, so an optimum exists. Consider the feasible policy

$$(\mu_0, T_0, \sigma_0) = \left(\bar{T} - \underline{\omega}, \bar{T}, \frac{1}{2}\right). \tag{E.1}$$

It has $\mu_0 > 0$ and $s_0 \equiv s(T_0, \mu_0) > 0$. Because $\sigma_0 < 1$, the contestable-to-captive ratio is positive, so Proposition 1 implies $\mathbb{E}[t] < \mu_0$. Hence

$$R_C(\mu_0, T_0, \sigma_0) \geq \sigma_0 s_0 \big(\mu_0 - \mathbb{E}[t]\big) > 0. \tag{E.2}$$

Thus every optimum earns positive revenue and satisfies $\sigma^* > 0$.

Now fix any feasible policy with $\sigma > 0$ and $T < \bar{T}$. Write $s \equiv s(T, \mu)$ and

$$r \equiv \frac{2(1-\sigma)}{\sigma s}, \qquad g(r) \equiv \frac{\ln(1+r)}{r}, \qquad g(0) \equiv 1. \tag{E.3}$$

Holding the rate gap and σ fixed also keeps s and r fixed. A common increase $\Delta = \bar{T} - T$ in T and μ therefore changes coalition revenue by

$$\begin{aligned} R_C(\mu+\Delta, T+\Delta, \sigma) - R_C(\mu, T, \sigma) &= \sigma\Delta\big[(1-s) + s(1-g(r))\big] \\ &= \sigma\Delta\big[1 - sg(r)\big]. \end{aligned} \tag{E.4}$$

Note that $s > 0$ because $s(T, \mu) = \min\{\frac{T-\mu}{\phi}, 1\}$ and $T - \mu \geq \underline{\omega} > 0$. Because $0 < s \leq 1$ and $0 < g(r) \leq 1$, the right-hand side of equation (E.4) is strictly positive unless $s = 1$ and $g(r) = 1$. The latter equality requires $r = 0$, and hence $\sigma = 1$. But a policy with $s = \sigma = 1$ earns zero coalition revenue and cannot be optimal. Therefore,

$$T^* = \bar{T}. \tag{E.5}$$

Step 2: Conditionally Optimal Stringency. Since $T^* - \mu^* \geq \underline{\omega} > 0$, we have $s^* > 0$, so the boundary case $s^* = 0$ cannot arise. Suppose first that $\mu^* > 0$. The strict-concavity calculation in the proof of Proposition 2 and the endpoint calculation in the proof of Proposition 3 require $s > 0$, but not $s < 1$. They therefore apply when $s^* = 1$ and give

$$R_C'(1^-) = (1-s^*)T^* - \mu^*. \tag{E.6}$$

Strict concavity then implies

$$\boxed{\sigma^* < 1 \quad \Longleftrightarrow \quad (1-s^*)T^* < \mu^*}. \tag{E.7}$$

It remains to consider $\mu^* = 0$. Conditional on such rates,

$$R_C(\sigma) = \sigma(1 - s^*)T^*. \tag{E.8}$$

If $s^* < 1$, this expression is strictly increasing in σ, so $\sigma^* = 1$. If $s^* = 1$, it is identically zero, contradicting the positive optimal value established in Step 1. Thus, when $\mu^* = 0$, we again have $\sigma^* = 1$, while $(1 - s^*)T^* < \mu^*$ is false. The equivalence therefore holds for every optimal policy, including the boundary case $s^* = 1$.

Step 3: Primitive Characterization. Let

$$d^* \equiv T^* - \mu^* = \bar{T} - \mu^* \in [\underline{\omega}, \bar{T}]. \tag{E.9}$$

Using $s^* = \min\{d^*/\bar{\phi}, 1\}$,

$$(1 - s^*)T^* - \mu^* = \begin{cases} \dfrac{d^*}{\bar{\phi}}\left(\bar{\phi} - \bar{T}\right), & d^* \leq \bar{\phi}, \\ \\ -\mu^*, & d^* > \bar{\phi}. \end{cases} \tag{E.10}$$

If $\bar{T} \leq \bar{\phi}$, then $d^* \leq \bar{T} \leq \bar{\phi}$, so the first expression is nonnegative. If $\bar{T} > \bar{\phi}$ and $d^* \leq \bar{\phi}$, the first expression is strictly negative. If instead $d^* > \bar{\phi}$, then $s^* = 1$; moreover, $\mu^* > 0$, since $\mu^* = 0$ would make coalition revenue identically zero. Hence the second expression is also strictly negative. Therefore,

$$\boxed{(1 - s^*)T^* < \mu^* \quad \Longleftrightarrow \quad \bar{T} > \bar{\phi}}. \tag{E.11}$$

Combining this result with Step 2 proves the proposition. $\square$

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