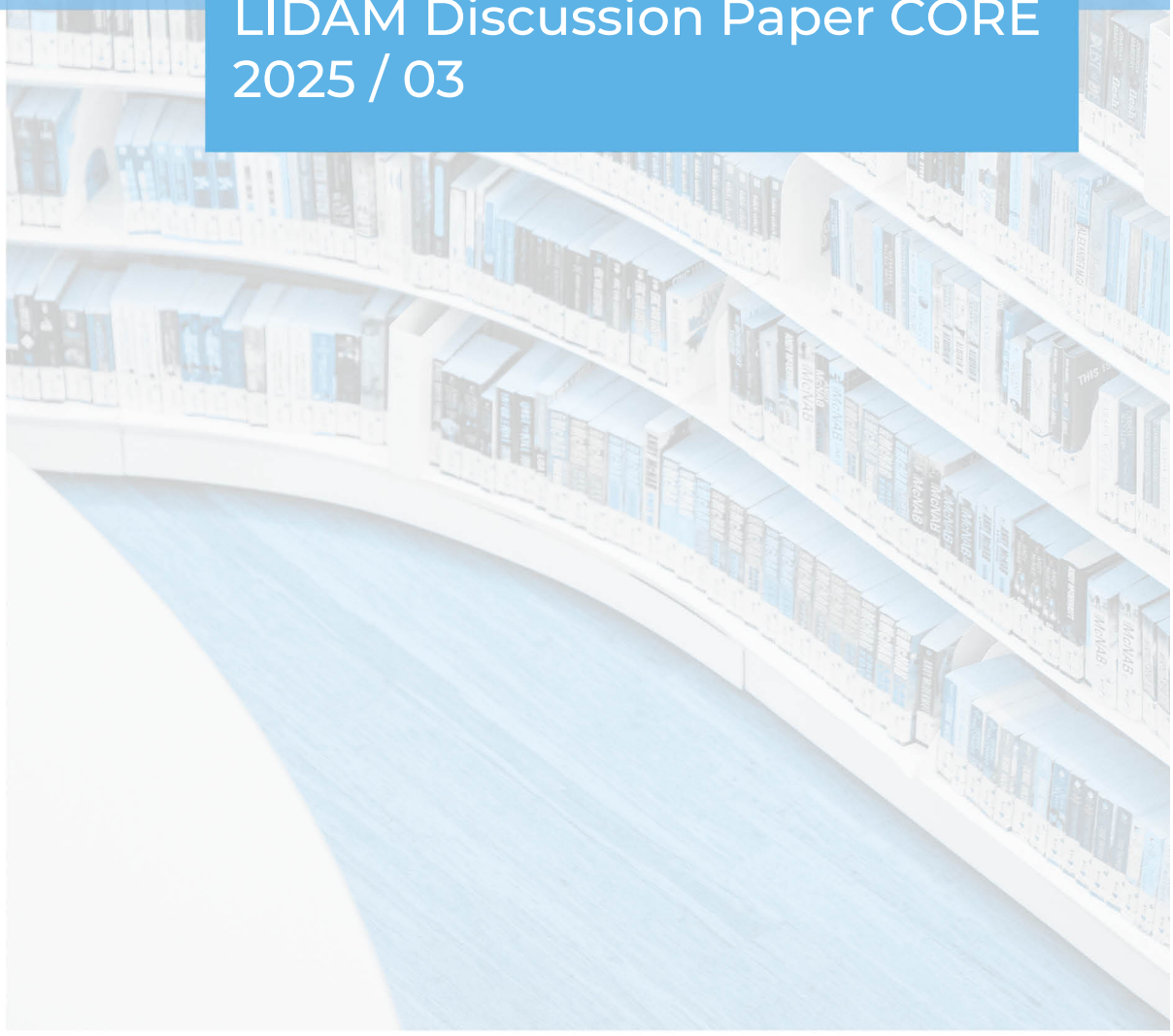
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The Enforcement Dilemma of the Global Minimum Tax *

Jean HINDRIKS[†] and Yukihiro NISHIMURA[‡§]

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Abstract

To tackle profit shifting, the OECD/G20 Inclusive Framework proposes a Global Minimum Tax. The general presumption is that high-tax countries will gain and low-tax countries will lose because the minimum tax will reduce their inward profit shifting. Recent papers have shown that the minimum tax can be welfare improving for all countries even if the welfare of the firm owners are taken into account (Johannesen 2022, Hebous and Keen 2023). The purpose of this paper is to extent that analysis to endogenous enforcement choices. By means of a formal model of international tax competition with heterogeneous countries, we study explicitely how the minimum tax will change the dynamics of tax competition, profit allocation and enforcement incentives. We show that in this broader framework, there exists a critical threshold for the minimum tax beyond which the low-tax country will defect from international enforcement cooperation, making the high-tax country worse off. We also show that our analysis is robust to the presence of tax haven.

Keywords: Profit shifting; Tax competition; Tax enforcement;
JEL Classification: C72, F23, F68, H25, H87.

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1 Introduction

New technologies and the globalization of the economy have facilitated tax avoidance through the shifting of profits by multinational enterprises (MNEs) to low-tax jurisdictions. The problem of base erosion and profit shifting (BEPS) is well documented. Bilicka (2019) used administrative firm-level data to "match" multinational companies with domestic stand alone companies in the United Kingdom, based on the size of their assets and the industry in which they operate. She finds that foreign multinational subsidiaries under-report their taxable profits by 50 percent relative to domestic standalones. Dowd et al. (2017) and Bustos et al. (2019) provide evidence of extensive profit shifting respectively for the United States and Chile. Using country-by-country reporting data made available in the US, Garcia-Bernardo et al (2022) show that multinational corporations shifted USD 1 trillion of profits in 2016. Using new macroeconomic data, Tørsløv et al. (2022) show that 36% of multinational profits are booked in low-tax destinations. They calculate that if shifted profits were reallocated to their source countries "Domestic profits would increase by about 20% in high-tax European Union countries, and 10% in the United States" (Tørsløv et al.,2022).

In 2020, the OECD/G20 Inclusive Framework on the BEPS project released blueprints which include "global minimum tax measures". 131 countries and jurisdictions recently joined this new plan to tackle the BEPS problem, which suggests a global minimum corporate income tax rate of 15% (see OECD, 2021b). Minimum taxation means that if an MNE declares its operations in a jurisdiction taxing less than the minimum tax, the headquarter country would have the right to tax the difference. As stated by the most recent OECD appraisal, much of the gains in tax collection would come from minimal taxation.

However, this argument ignores the strategic interaction between minimum taxation and tax enforcement. Tørsløv et al. (2023) and Bustos et al. (2019) have shown the empirical importance of addressing seriously the tax enforcement issue to understand why it has been difficult to combat profit shifting so far. The emphasis of the OECD/G20 BEPS project is rather on international tax enforcement, including designing effective Controlled Foreign Company (CFC) rules, tightening transfer pricing regulations, and increasing auditing probabilities, implementing standardized regulations (minimum standards) that strengthen information reporting and enforcement, increasing the effectiveness of transfer pricing regulations, or simply increasing resources devoted to tax monitoring efforts.

This paper contributes to our understanding of the strategic interaction between the global minimum tax, the tax competition and the international

enforcement. A central feature of our analysis is that international enforcement cooperation is more effective than unilateral enforcement reforms, notably when the low-tax countries can lack incentives to combat profit shifting. Recent evidence from a natural experiment in Chile suggests that unilateral enforcement reforms to limit profit shifting did not succeed in reducing profit shifting, but increased tax planning services from tax consultants (Bustos et al., 2022). Compared to estimates by Tørsløv et al. (2022) suggesting a revenue loss of about 20% in Chile due to profit shifting, the (unilateral) enforcement reform closed the revenue gap at best by 2.35%.

Building upon Hindriks and Nishimura (2021), we develop a framework in which effective international tax enforcement requires enforcement coordination between countries.[1] We consider a simple two-country model with different market sizes yielding different tax incentives. The MNE shifts profits from the division in the high-tax country to that in the low-tax country, subject to a concealment cost. Countries choose their enforcement effort levels and tax rates to maximize their tax revenue net of the enforcement costs. The overall international tax enforcement is the joint product of each country's enforcement level, leading to a non-trivial incentive problem.

A key feature of our model is that both the low-tax and high-tax countries care about international tax enforcement to raise corporate tax payments due to suboptimal taxes, but they face different tax enforcement incentives. Another feature of our model is that effective enforcement requires international coordination which potentially can benefit the low-tax country. Interestingly, our model can fit the recent empirical evidence suggesting that profit shifting semi-elasticity depends on the tax level with different semi-elasticity for high and low tax rates.[2] This empirical result is driven in our model by the interplay between enforcement and tax rates.

We show that the minimum taxation can induce the low-tax countries to defect from cooperative enforcements, making the high-tax country worse off. Our paper is closely related to Hebous and Keen (2023) showing that minimum tax can be Pareto improving by curbing profit shifting and raising equilibrium taxes. We add to that argument the dynamics of enforcement and tax policies in response to the minimum tax. Our paper is also related

[1]Hindriks and Nishimura (2021) study the role of enforcement technology on the scope for enforcement cooperation, but they do not address the issue of the minimum tax. Our contribution is to develop an explicit model where the minimum tax shapes tax competition and international enforcement cooperation. We also extend the model to the presence of tax haven in Section 5

[2]Recent empirical research differentiates the profit-shifting elasticity between high-tax (developed) and low-tax (developing) countries (Dowd et al., 2017, Davies et al. 2018, Beer et al. 2020, Johannesen et al. 2020, Garcia-Bernardo et al. 2022).

to Johannesen (2022) showing that the minimum tax can harm high-tax countries if it was set too low, and is always Pareto improving if the minimum tax is sufficiently high to shut down profit shifting. Our model is voluntarily twisted to favor minimum taxation, in the sense that minimum taxation benefits both the low- and high-tax countries when enforcement is exogenous (Keen and Konrad, 2013). We do so by ignoring the welfare cost of the minimum tax for the firm owners. Hebous and Keen (2023) and Johannesen (2002) show that the firm owners welfare weight is critical to determine the maximal Pareto improving minimum tax.[3] Our objective is to show that enforcement incentives are also critical to determine the maximum Pareto improving minimum tax.

The model voluntarily abstracts from many relevant details.[4] We aim to provide a simple workhorse model that can be useful to provide closed form solutions which is notoriously difficult to achieve with multiple policy instruments (see e.g. Cremer and Gahvari 2000). Our key contribution is to write up a model of minimum tax that can be solved explicitly where enforcement choices have a key strategic effect on taxes and profit allocation. Our main result that the minimum tax can fire back on enforcement cooperation is specific to the model with unavoidable limitations. But it is an appealing insights that deserves further theoretical and empirical consideration.[5]

The rest of the paper is organized as follows. Section 2 describes the basic two-country model, profit shifting incentives and tax choices under minimum taxation. Section 3 compares the coordinated and uncoordinated enforcement policies in response to the minimum tax when enforcements are either substitutes or complements. Section 4 studies the potential breakup of international enforcement cooperation. Section 5 extends the model with a non-cooperative tax haven. Section 6 concludes.

[3]Their welfare analysis trades off the revenue cost of profit shifting and the tax saving gains of firm owners, assuming that enforcement is exogenous.

[4]We do not consider the allocation of production activities in response to a change of corporate tax rates and tax enforcement (see Suarez Serrato, 2018, Altshuler and Grubert 2016, Dharmapala 2020). The reason is that we assume a pure profit that tax does not distort the production allocation (Diamond and Mirrlees, 1971). The extension of the minimum tax analysis to profit and activity shifting is interesting avenue for further research as discussed in the conclusion.

[5]Using the new cross country data on international tax enforcements, as in Tørsløv et al. (2022), can be helpful in this respect.

2 Framework

2.1 The model

There are two countries, denoted by 1 and 2. A multinational enterprise (MNE) has branches in each country. From the production decisions in country $i = 1, 2$, the firm generates π_i in country i. Total profit is normalized to one and is distributed as follows

$$\pi_1 = \frac{1+\epsilon}{2},\ \pi_2 = \frac{1-\epsilon}{2},\ \epsilon \in [0, 1) \tag{1}$$

$\epsilon > 0$ is a parameter for the market asymmetry, where country 1 has the larger domestic market.[6] For instance, if $\epsilon = 0.4$ then country 1 has initial profit share of $\pi_1 = \frac{1+0.4}{2} = 0.7$ (before profit shifting). Then, at some cost, the MNE shifts profits between branches to minimize its total tax liability. In other words, it decides how much profit to report, $\tilde{\pi}_i$ in each country i, subject to quadratic and non fiscally-deductible shifting cost.[7]

$$C\left(\pi_i - \tilde{\pi}_i\right) = \delta(e_i, e_j)\left(\pi_i - \tilde{\pi}_i\right)^2.$$

Several explanations are in order. First, $\delta(e_i, e_j)$ is a reduced-form of the international enforcement. It acts as a scaling factor for resource costs associated with profit shifting.[8] Thus enforcement choices in our model are interpreted as increasing the cost of profit shifting. It reflects the cost of hiring accounting experts to produce the required documents, expected penalties to be paid to the government, or the expected market sanction when caught shifting profit (i.e., public revelation of profit shifting by MNE can trigger consumers' sanction even if such tax avoidance is legal). Gupta and Lynch (2016) show that enforcement efforts increase tax revenues. Hoopes et al. (2012) show that tax enforcement reduces tax avoidance. A standard assumption is that shifting costs are increasing and convex in the amount of profit shifted, $|\pi_i - \tilde{\pi}_i|$.

[6] Our basic specification of the profit tax competition resembles the Nielsen (2001) basic set up of commodity tax competition model with cross-border shopping. Agrawal and Wildasin (2020) use similar specification of asymmetry to draw the parallel between profit-shifting and cross-border shopping models. It is usual to refer to the large country with capital letter and to the small country with small letter. We prefer to use numbers because we will later add a third country.

[7] The quadratic specification is widely used. See for example, Peralta et al. (2006), Devereux et al. (2008), and Keen and Konrad (2013). See also Huizinga and Laeven (2008) for a slightly different specification.

[8] Agrawal and Wildasin (2020) consider the impact on tax competition of technology shock exogenously changing the enforcement cost.

Second, $\delta(e_i, e_j)$ is a reduced form of international tax capacity related to profit shifting. It depends on the specific enforcement efforts within each country, such as tougher monitoring, more efficient information sharing, and the efforts to negotiate and reach agreements with the other country's tax authority. $\delta(e_i, e_j)$ is an increasing function of e_i and e_j, such that stricter enforcement implies a higher tax capacity $\delta(.)$. Moreover, in reality, dispersed (unilateral) enforcement efforts between involved countries are less effective in aggregate.[9] For instance, a lack of tax-relevant information provided by the host country makes the taxable income unclear to the home country, and the tax authorities cannot tax effectively. To formalize the international enforcement technology, we adopt the following CES formula:

$$\delta(e_1, e_2) = \left(0.5\, {e_1}^{-\rho} + 0.5\, {e_2}^{-\rho}\right)^{-\frac{1}{\rho}}, \quad \rho \geq -1. \tag{2}$$

The international enforcement technology is a joint technology in which national enforcement choices are relevant and (possibly) interdependent. This international enforcement modeling involves a collective action problem in which efforts can be either complements or substitutes. Enforcement cooperation is a solution to internalize enforcement externalities between countries. Even the low-tax country could benefit from cooperative enforcement limiting the scope for profit shifting, given its potential to level up equilibrium taxes and revenues. The polar cases are:
(i) $\rho = -1$, perfect substitutes: $\delta(e_1, e_2) = 0.5e_1 + 0.5e_2$;
(ii) $\rho \to 0$, Cobb–Douglas complements $\delta(e_1, e_2) = e_1^{0.5} e_2^{0.5}$); and
(iii) $\rho \to \infty$, perfect complements $\delta(e_1, e_2) = \min[e_1, e_2]$, where total enforcement is based on the weakest-link. Formally, $\sigma = \frac{1}{1+\rho} \geq 0$ is the enforcement substitution elasticity.

Different BEPS actions change the form of interaction between enforcements. For example, if during the mutual agreement procedure, the low-tax country can exercise veto power on the transfer price and taxable incomes of the MNEs, then the enforcement technology becomes closer to the weakest–link formula. For the "minimal standards" actions, enforcements are complements albeit at different degrees. It includes countering harmful tax practices (action 5), prevention of treaty abuse (action 6), country-by-country reporting (action 13) and mutual agreement procedure (action 14). For other BEPS

[9]Klassen and Laplante (2012) showed that profit shifting in a given country depends not only on the enforcement of the regulations in the home country but also on the implementation of the regulations in the host country. Using a spatial econometric approach, Durán-Cabré et al. (2015) provided evidence of strategic complementarities between regional administrations with respect to audit policies among Spanish regional governments.

actions, each country can more easily enforce unilaterally and the enforcements are substitutes. It includes a limitation on interest deduction (action 4), and transfer pricing limitation (actions 8-10). The relevance of the distinction between enforcement complements and substitutes can be related to the information versus prosecution dimension. For the information dimension, enforcements are closer to substitutes. The information provided by the other country on an MNE replaces the information I may have to collect. For the prosecution dimension, enforcements are closer to complements. The tax monitoring to dig up profit shifting in one country is likely to be eased by the contribution of the tax authority in the other country. In practice, it is not obvious to decide in the policy context whether enforcement technology is characterized by complements or substitutes. So we study both cases. A final remark is that the enforcement technology is identical for both countries. That does not mean that both countries are equally effective with their enforcement. In fact, when enforcement are complements, then as complementarity increases (higher ρ), international enforcement is increasingly determined by the enforcement of the low-tax country, with the polar case of the weakest-link where overall enforcement is entirely determined by the low-tax country.[10]

Each country i chooses enforcement e_i and then tax rate t_i to maximize its revenue net of the enforcement cost anticipating declared profit $\tilde{\pi}_i$. Assuming a quadratic cost of enforcement, $c(e_i) = \frac{e_i^2}{2}$, for simplicity, welfare in country i is :

$$W_i = t_i \tilde{\pi}_i - \frac{e_i^2}{2}, \tag{3}$$

We do not include the welfare of the firm owners in the objective function as in Johannesen (2022) or Hebous and Keen (2023) so as to voluntarily twist the model in favor of the minimum tax.[11] We consider a three-stage game with the following sequence of events. In the first stage, both countries set their enforcements. In the second stage, both countries choose their taxes. In the third stage, the multinational enterprise chooses the amount of profit to be shifted. Our analysis seeks to show how enforcements can shape international taxes and profit allocation.[12] Our sequence of events fits well

[10]We assume equal shares of 0.5 in the CES function. However the analysis could be extended to unequal shares when considering that some countries have less effective enforcement (such as in less developped countries).

[11]The implication of capital ownership in tax competition model are discussed in Hindriks and Nishimura (2017).

[12]We assume that enforcements are chosen before taxes. Cremer and Gahvari (2000) assumed the simultaneous choice of audit and tax rates in a model where countries compete in effective taxes combining both instruments. Adopting a similar sequence in our analysis

with the overall OECD (2021a) framework which is to promote international tax enforcement leaving national discretion on tax choices in order to curb the harmful profit shifting for revenue maximizing governments.

2.2 Profit shifting incentives

Given the tax $t = (t_1, t_2)$ and enforcement choices $e = (e_1, e_2)$, the MNE chooses the declared profit, $(\tilde{\pi}_1, \tilde{\pi}_2)$, to maximize its after-tax profit net of the profit-shifting cost:

$$Max(1 - t_1)\tilde{\pi}_1 + (1 - t_2)\tilde{\pi}_2 - \delta(e)(\pi_1 - \tilde{\pi}_1)^2,$$

subject to

$$\tilde{\pi}_1 + \tilde{\pi}_2 = \pi_1 + \pi_2$$

.
The solution is:

$$\pi_1 - \tilde{\pi}_1 = -(\pi_2 - \tilde{\pi}_2) = \frac{t_1 - t_2}{2\delta(e)} \tag{4}$$

Profit shifting is proportional to the tax differential and inversely proportional to enforcement levels. Thus, when enforcement is exogenous, the profit shifting (semi-)elasticity with respect to tax rate differential is constant when enforcement is fixed. This is the empirical result arising from cross-border profit shifting when averaging out the semi-elasticity across countries (Dharmapala and Riedel, 2013; Huizinga and Laeven, 2008; Johansson et al., 2017; Lohse and Riedel, 2013). Johannesen et al. (2020) show that low-income countries face a higher profit-shifting elasticity, which may explain their lower taxes. As we will show shortly, our model provides the missing channel by linking explicitly enforcement incentives to tax rates. In particular, we would expect weaker enforcement incentives when taxes and revenues are low (low-stake enforcement). Overall, the effects of tax rate changes on profit shifting depend on the breadth of international enforcement. When enforcement and taxes are strategic complements, the profit shifting semi-elasticity is higher when taxes are low (because international enforcement is also low). Interestingly, this model prediction fits with recent empirical studies on profit-shifting (Dowd et al. 2017, Johannesen et al., 2020, Garcia-Bernardo et al. 2022). Combining (1) and (4) gives the declared profits:

$$\tilde{\pi}_1 = \frac{1 + \epsilon}{2} - \frac{t_1 - t_2}{2\delta(e)},\ \tilde{\pi}_2 = \frac{1 - \epsilon}{2} + \frac{t_1 - t_2}{2\delta(e)}. \tag{5}$$

would induce the low-tax country to choose zero enforcement given that enforcement cannot affect equilibrium taxes (unless there is a tax haven as in Section 5). As a result, $\delta(e_1, 0) = 0$ for all $\rho \geq 0$, leading to a race to the bottom with zero taxes in both countries.

The reported profit in country 1 consists of the pre-tax profits π_1 that depend on the market size ϵ minus the amount of outward profit shifting $\pi_1 - \tilde{\pi}_1$ in (4).

2.3 Tax choices with minimum tax

Given the enforcement choices $\delta(e)$, in the second stage of the game, each country non-cooperatively chooses its tax rate t_i, anticipating the induced profit allocation (5), so as to maximize its welfare (3). We first derive the Nash equilibrium without the minimum tax. The first-order conditions are:

$$\frac{\partial W_i}{\partial t_i} = \frac{1+\epsilon_i}{2} - \frac{t_i - t_j}{2\delta(e)} + t_i \frac{-1}{2\delta(e)} = 0. \tag{6}$$

It is readily seen from the first-order conditions, that the tax responses are positively sloped (fiscal decisions are strategic complements) and that the slope of the tax response functions is less than one, which guarantees the stability of the tax equilibrium. The tax response functions are continuous such as in the basic cross-border shopping model of Nielsen (2001).[13] The reason is that the marginal shifting cost satisfies $C'(\pi_i - \tilde{\pi}_i) = 0$ for $\pi_i - \tilde{\pi}_i = 0$. The unconstrained tax equilibrium is

$$t_1^N(e) = \delta(e)\left(\frac{3+\epsilon}{3}\right) \quad \text{and} \quad t_2^N(e) = \delta(e)\left(\frac{3-\epsilon}{3}\right). \tag{7}$$

From (7), the binding minimum tax has to be $\underline{t} > t_2^N$.[14] We consider that the minimum tax reform takes the following form.

$$\underline{t} = \lambda t_1^N(e) + (1-\lambda) t_2^N(e), \ \lambda \in (0,1). \tag{8}$$

We consider that the minimum tax rate is set up exogenously as the weighted average of both countries' tax rates and the weight λ is set exogenously to be between 0 (i.e. minimum tax is constraining the low-tax country) and 1 (the minimum tax does not constrain the high-tax country).[15] The issue

[13] By contrast, some asymmetric tax competition models exhibit discontinuity of the tax response when tax differential switches signs (Kanbur and Keen, 1993, Keen and Konrad, 2013, and Mongrain and Wilson,2018).

[14] As noted by Hebous and Keen (2023), it does not matter whether we use the 'Income Inclusion Rule' (topping up to the minimum in the residence) or the 'Undertaxed Payments Rule' (topping up at source) because this minimum tax gives strong incentives for low-tax country to preempt another country to tax the difference by imposing that minimum itself.

[15] The reason we impose that $\lambda \leq 1$ is that we do not want the minimum tax to also constrain the high tax country (see Hebous-Keen 2023 for a discussion of the complications that relaxing this assumption creates with exogenous enforcement).

of addressing minimum tax exogenously helps us see which value of λ each country prefers.[16] Our exogenous minimum tax is a necessary first step to study the endogenous choice of λ in future research. Given the minimum tax, the constrained equilibrium taxes are:

$$t_2^M = \underline{t},\ t_1^M = \delta(e)\left(\frac{1+\epsilon}{2}\right) + \frac{\underline{t}}{2}, \tag{9}$$

and the tax gap is

$$t_1^M - t_2^M = \frac{\delta(e)}{2}\left(\frac{4\epsilon}{3} - \frac{2\epsilon\lambda}{3}\right) > 0. \tag{10}$$

For all $\lambda, \epsilon \in (0,1)$, $t_1^M > t_2^M$ and the tax gap decreases with the minimum tax λ (partial tax harmonization).[17] The minimum tax shifts up the tax rate in the low-tax country. Since taxes are strategic complements (positively sloped tax response function), the tax rate in the high-tax country is also raised but to a lesser extent (the slope of the tax response is less than one as required by the stability of the tax equilibrium). As a result, the tax gap shrinks, and the profit shifting is reduced to the benefit of the high-tax country. That does not mean that tax revenue is reduced in the low-tax country, because its tax rate is increased to a greater extent than in the high-tax country.

Plugging the tax gap (10) into the profit shifting equation (4) gives:

$$\pi_1 - \tilde{\pi}_1 = -(\pi_2 - \tilde{\pi}_2) = \frac{\epsilon}{3} - \frac{\epsilon\lambda}{6}, \tag{11}$$

which is decreasing in λ. So the minimum tax reduces profit shifting. It is a substitute to costly enforcement.

Using the equilibrium taxes and profit allocation, the revenues in both countries $R_i^M(e) = t_i^M(e)\tilde{\pi}_i^M$ $(i = 1, 2)$ under the minimum tax are given by:

[16] See Haufler and Lulfesmann(2015) for a similar approach with a dual tier capital taxation. The parameter λ should not be interpreted as representing the bargaining power of the high-tax country, because we adopt essentially a non-cooperative model to address the central issue of cooperation breakdown. So our approach is quite different from the (efficient) bargaining model over corporate tax bases that rules out cooperation breakdown (Becker and Davies, 2014).

[17] Note that the tax gap is still positive for $\lambda = 1$ and so full tax harmonization is not possible. Cremer and Gahvari (2000) restrict attention to full tax harmonization policy. The GMT policy is more in line with partial tax harmonization, which is also more realistic than full tax harmonization.

Proposition 1 *Under minimum tax $\lambda \in [0,1]$, country asymmetry $\epsilon \in [0,1]$ and enforcement levels $e = (e_1, e_2)$, the equilibrium revenue satisfies.*

$$R_1^M(e) = a_1(\lambda,\epsilon)\delta(e) \geq R_2^M(e) = a_2(\lambda,\epsilon)\delta(e), \tag{12}$$

where
$a_1(\lambda,\epsilon) = \dfrac{(3+\epsilon+\epsilon\lambda)^2}{18} \geq a_2(\lambda,\epsilon) = \dfrac{(3-\epsilon-\epsilon\lambda)(3-\epsilon+2\epsilon\lambda)}{18}$, *and*
$a_2(\lambda,\epsilon) - a_2(0,\epsilon) = \dfrac{\epsilon\lambda(3-\epsilon-2\epsilon\lambda)}{18} > 0$ *for all* $\epsilon, \lambda \in (0,1)$.

Therefore, the minimum tax, by curbing profit shifting and increasing equilibrium taxes, has a positive effect on tax revenue in the high-tax country, when enforcements are exogenous. In the low-tax country, the minimum tax has two opposite effects on its tax revenue: a higher tax rate but a smaller tax base. So for the low-tax country, the profit shifting loss could possibly be offset by the higher tax rate. Indeed, it is readily seen that minimum tax increases also revenue in the low-tax country since $a_2(\lambda,\epsilon) - a_2(0,\epsilon) > 0$ for all $\epsilon, \lambda \in (0,1)$. Thus, our analysis suggests, as in Hebous and Keen (2023), that the minimum tax benefits both low tax as well as high tax countries. But, this result is assuming that enforcement is exogenous. In practice, we should consider that the minimum tax will also change the enforcement incentives. Another feature of our model that is comparable to Hebous and Keen (2023) is that the revenue in the low-tax country is not monotonically increasing with the minimum tax.

[Insert Figure 1 about here]

Figure 1 shows the shape of the tax revenue in the low-tax country with exogenous enforcement. For sufficiently high market asymmetry, tax revenue in the low-tax country is a non-monotonic function of the minimum tax. When $\epsilon = 1$, $R_2^M(e)$ is maximized at $\lambda = 1/2$. With smaller asymmetry, say $\epsilon = 4/5$, the revenue peak is shifted to the right. In fact, for any $\epsilon \geq 3/5$ low-tax country revenue is a bell-shaped function of the minimum tax with a peak at $\lambda = (3-\epsilon)/(4\epsilon)$. In Hebous and Keen (2023), this minimum tax threshold is called the "maximally dominant rate" in the sense that the low-tax country loses from marginal increases in the minimum rate beyond that threshold. When $\epsilon < 3/5$, $R_2^M(e)$ is monotonically increasing with $\lambda \in (0,1)$. The revenue in the high-tax country is always increasing with the minimum tax. From (12), we can also see that the minimum tax increases the revenue gap since $a_1(\lambda,\epsilon) - a_2(\lambda,\epsilon) > 0$ is increasing with λ. This is because the minimum tax reduces the tax gap and so profit shifting.

The analysis so far is assuming exogenous enforcement. We now turn to our main contribution which is to study how the minimum tax will also change enforcement policies and possibly break up enforcement cooperation. To our knowledge, Cremer and Gahvari (2000) were the first to suggest that tax harmonization policy could be offset by a cut in audit rates from the low-tax country in a context where country compete for mobile capital with effective tax rates combining audit rates and nominal tax rates. In their model audit and tax rates are set simultaneously and non cooperatively. Following Hindriks and Nishimura (2021), we consider enforcement choices as determining a level playing field for uncoordinated tax choices. The contribution with respect to Hindriks and Nishimura (2021) is to study the incidence of the minimum tax on the enforcement cooperation incentives.

3 Enforcement cooperation incentives

Anticipating the equilibrium taxes and profit allocation, the governments in each country choose their enforcements, taking into account the existence of a minimum tax. We first examine enforcement cooperation.

3.1 Cooperative Enforcements

Enforcement decisions involve two types of enforcement externalities. First, given the joint enforcement technology, the cost of profit shifting (interpreted as indicator of the tax capacity) depends on the enforcements of both countries creating a public good externality. Second, given the tax response to enforcement, increasing enforcement increases taxes as well as the tax gap. An increase in taxes benefits both countries due to suboptimal taxes, but each country would like to free-ride on the enforcement needed (i.e. building collectively the tax capacity). Those two external effects make coordinated enforcement more effective. When enforcements are coordinated, both countries choose their enforcement levels to maximize their joint welfare. However, in keeping with the current OECD framework for enforcement cooperation, each country can freely choose its tax rates (subject to the minimum tax constraint). Therefore, countries choose $e = (e_1, e_2)$ anticipating tax revenues in (12). That is,

$$\max_{e_i,e_j} \sum_i \left(R_i^M(e_i, e_j) - \frac{e_i^2}{2} \right) = \max_{e_i,e_j} \sum_i \left(a_i(\lambda, \epsilon)\delta(e_i, e_j) - \frac{e_i^2}{2} \right). \quad (13)$$

Given the general enforcement technology (2), the first-order conditions

of the joint welfare maximization are

$$0.5e_i^{-\rho-1}\left(0.5e_1^{-\rho}+0.5e_2^{-\rho}\right)^{\frac{1+\rho}{-\rho}}\left(a_1(\lambda,\epsilon)+a_2(\lambda,\epsilon)\right)=e_i \quad (i=1,2),$$

and the (cost-minimizing equal) cooperative enforcement levels are

$$\hat{e}_1^M=\hat{e}_2^M=\frac{a_1(\lambda,\epsilon)+a_2(\lambda,\epsilon)}{2}.$$

Note that cooperative enforcements are independent of the elasticity of substitution $\sigma=\frac{1}{1+\rho}$. Enforcement cooperation involves the same enforcement levels whether enforcements are complements or substitutes. We summarize our result in the following proposition.

Proposition 2 *Given enforcement technology (2), under minimum tax $\lambda\in[0,1]$, and country asymmetry $\epsilon\in[0,1]$, the cooperative enforcement satisfies*

$$\hat{e}_1^M=\hat{e}_2^M=\frac{a_1(\lambda,\epsilon)+a_2(\lambda,\epsilon)}{2} \tag{14}$$

where coordinated enforcements are identical across countries and increasing with the minimum tax λ.

Enforcement cooperation induces the welfare levels in country i,

$$W_i^C=\left(\frac{a_i(\lambda,\epsilon)+a_j(\lambda,\epsilon)}{4}\right)\left(\frac{3a_i(\lambda,\epsilon)-a_j(\lambda,\epsilon)}{2}\right) \tag{15}$$

3.2 Non-cooperative Enforcements

Under non-cooperative enforcement, each country chooses e_i simultaneously and independently. Given e_j, country i maximizes $W_i(e_i,e_j)=a_i(\lambda,\epsilon)\delta(e_i,e_j)-\frac{e_i^2}{2}$, where $a_i(\lambda,\epsilon)$ is given in Proposition 1. Using enforcement technology (2), the equilibrium non-cooperative enforcement in country $i=1,2$ is

$$e_i^M=0.5\left(0.5\,a_1(\lambda,\epsilon)^{-\frac{\rho}{2+\rho}}+0.5\,a_2(\lambda,\epsilon)^{-\frac{\rho}{2+\rho}}\right)^{\frac{-1-\rho}{\rho}}a_i(\lambda,\epsilon)^{\frac{1}{2+\rho}} \tag{16}$$

The non-cooperative enforcements depend on ρ and the minimum tax λ. Non-cooperative enforcements change with the enforcement technology because uncoordinated enforcement is less effective overall when the complementarity between enforcements increases. We will distinguish when enforcements are substitutes and complements.

3.2.1 Enforcements are substitutes

We consider that enforcements are perfect substitutes ($\rho = -1$) so that the international enforcement is the arithmetic mean of enforcement levels $\delta_{-1} \equiv 0.5e_1 + 0.5e_2$. The first-order conditions yield for all $\lambda \in (0,1)$:

$$e_1^M = \frac{a_1(\lambda,\epsilon)}{2} \geq e_2^M = \frac{a_2(\lambda,\epsilon)}{2}. \tag{17}$$

Each country's choice of enforcement is independent of the other country because $\dfrac{\partial^2 \delta(e_1,e_2)}{\partial e_1 \partial e_2} = 0$ for $\rho = -1$. The enforcement best responses are orthogonal. Each country set its enforcement so as to equate its marginal benefit to its marginal cost. The marginal cost is born entirely by the country. The marginal benefit of enforcement depends on its impact on profit shifting as well as on equilibrium taxes. Increasing enforcement increases the cost of profit shifting. For any given taxes, this reduces profit shifting to the benefit of the high-tax country. However, increasing enforcement also induces both higher taxes and tax gap as shown in (10). When the marginal cost of profit shifting increases, the high-tax country increases its tax rate to a greater extent than the low-tax country. The final allocation of profit is unchanged in equilibrium so that both (revenue maximizing) countries benefit from higher taxes. In other words, enforcements increase tax capacity in each country without affecting their equilibrium tax base. This property is driven by the revenue maximizing governments.

What is then the impact of the minimum tax on equilibrium enforcement levels? Since $a_1(\lambda,\epsilon)$ is increasing in λ, enforcement in the high-tax country is increasing with the minimum tax. For the low-tax country, when $\epsilon > 3/5$, $a_2(\lambda,\epsilon)$ reaches its peak at $\lambda = (3-\epsilon)/(4\epsilon)$ and then decreases beyond. Therefore, the enforcement in the low-tax country may decrease when the minimum tax is pushed too far. Non cooperative enforcement induces the welfare levels

$$W_i^{NC}(\rho = -1) = \left(\frac{a_i(\lambda,\epsilon)}{4}\right)\left(\frac{a_i(\lambda,\epsilon) + 2a_j(\lambda,\epsilon)}{2}\right) \tag{18}$$

Non-cooperative enforcement (17) is below cooperative enforcements (14) because enforcement externalities are no longer internalized. The high-tax country always benefits from enforcement cooperation as it raises equilibrium taxes without reducing its tax base ($W_1^C > W_1^{NC}$ for all $\lambda, \epsilon \in (0,1)$). For the low-tax country, there are opposite effects. The enforcement cooperation involves extra enforcements from the low-tax country to align the enforcements of the high-tax country. As a result, even though enforcement

cooperation also boosts revenues (higher taxes for the same tax base) in the low-tax country, this country may reject enforcement cooperation because of the extra enforcement that is required. The following proposition states the conditions under which the low-tax country benefits or not from enforcement cooperation as a function of the minimum tax rate λ and the country asymmetry rate ϵ. The proof is in the Appendix as well as the the graphical representation of the welfare in the low-tax country under cooperative and non-cooperative enforcement for $\rho = -1$ (see figure 4).

Proposition 3 *Enforcements are perfect substitutes ($\rho = -1$). High-tax country benefits from enforcement cooperation for all $\lambda \in (0,1)$ and $\epsilon \in (0,1)$. As for low-tax country, there exist minimum tax threshold $\lambda^0(\epsilon) \in (0,1)$ and country asymmetry thresholds $0 < \underline{\epsilon}(-1) < \overline{\epsilon}(-1) < 1$ such that*

(i) for all $\lambda \in (0,1)$, low-tax country benefits from enforcement cooperation when $\epsilon < \underline{\epsilon}(-1)$ and does not benefit when $\epsilon > \overline{\epsilon}(-1)$.

(ii) when $\underline{\epsilon}(-1) \leq \epsilon \leq \overline{\epsilon}(-1)]$, low-tax country benefits from enforcement cooperation if and only if $\lambda \leq \lambda^0(\epsilon)$.

(iii) $\lambda^0(\epsilon)$ is decreasing with country asymmetry ϵ.

A key feature of this proposition is that the minimum tax can potentially erode the benefit of enforcement cooperation for the low-tax country. This is a novel effect when we treat not just firm behavior, but also national tax and enforcement policies as endogenous to changes in the minimum tax. Intuitively, the minimum tax puts a floor under the international tax competition acting as a commitment of the low-tax country to set its tax rate exactly at the minimum tax. This tax commitment boosts tax revenues because of the positive tax externality and strategic tax complementarity (Hebous and Keen, 2023, Johannesen, 2022). So, the minimum tax can be Pareto improving when treating national enforcement policy as exogenous. However, the global minimum tax is a fundamental change that affects both tax and enforcement incentives. Our finding is that the minimum tax increases enforcement both in the high-tax and low-tax countries, but when pushed too far, it can potentially induce low-tax countries to defect from enforcement cooperation.[18] As a result, coordinated enforcement is less attractive for the low-tax country when the minimum tax is set too high. Another finding is

[18]This result is different from Cremer and Gahvari (2000). Our argument is based on enforcement cooperation breakdown. Indeed as long as cooperation is maintained, there is a synergy between taxes and enforcements, and the minimum tax increases both enforcements and tax rates. Cremer and Gahvari (2000) consider a different argument of substitution between tax and audit rates in a model of cross-border tax evasion based on

that the low-tax country benefits less from coordinated enforcement if the country asymmetry is too high. This fits well with the widespread difficulty of getting very low-tax countries to join international tax enforcement agreements. We introduce tax haven in Section 5.

3.2.2 Enforcements are complements

When enforcement are complements, there is a new effect of minimum taxation related to the strategic complementarity in the enforcement choices. Indeed, when $\rho > -1$ the enforcement technology involves strategic complementarity $\dfrac{\partial^2 \delta(e_1, e_2)}{\partial e_1 \partial e_2} > 0$. So enforcement productivity by one country increases with the enforcement of the other country. The enforcement decisions are no longer independent from each other as with $\rho = -1$. To illustrate, consider $\rho = 0$ so that $\delta(e) = e_1^{0.5} e_2^{0.5}$. The enforcement best-response functions are :

$$e_i(e_j) = \left(\frac{a_i(\lambda, \epsilon)}{2}\right)^{2/3} e_j^{1/3} \quad (i = 1, 2,\ j \neq i)$$

The enforcement reaction functions are upward-sloping (strategic complementarity). The equilibrium enforcement levels are:

$$e_i^M = \frac{a_i(\lambda, \epsilon)^{3/4} a_j(\lambda, \epsilon)^{1/4}}{2}, \tag{19}$$

where $a_1(\lambda, \epsilon) > a_2(\lambda, \epsilon)$. Comparing (19) with (17), we obtain that e_1^M is lower with $\rho = 0$ (since $a_1(\lambda, \epsilon) > a_1(\lambda, \epsilon)^{3/4} a_2(\lambda, \epsilon)^{1/4}$) whereas e_2^M is higher (since $a_2(\lambda, \epsilon) < a_2(\lambda, \epsilon)^{3/4} a_1(\lambda, \epsilon)^{1/4}$). This result suggests that enforcement complementarity induces a convergence of enforcement levels. The reason is that when enforcements are complements, enforcements are more effective when there are aligned: $\delta(e + \Delta,\ e - \Delta) < \delta(e, e)$ for $\Delta > 0$. However, if increasing complementarity (larger ρ) induces partial enforcement alignment, it is not sufficient to offset the first-order efficiency loss from enforcement dispersion $e_1^M > e_2^M$. Indeed, the overall enforcement level $\delta(e^M)$ is lower with complementarity $\rho = 0$ than with substitutability $\rho = -1$.

Plugging equilibrium non-cooperative enforcements in the welfare functions gives

$$W_i^{NC}(\rho = 0) = \frac{3}{2}\left(\frac{a_i(\lambda, \epsilon)}{4}\right)\left(a_i(\lambda, \epsilon) a_j(\lambda, \epsilon)\right)^{1/2} \tag{20}$$

effective taxes which is the product of audit and tax rates. In their model, audit is a perfect substitute to tax rates, and there is no enforcement cooperation. They recognize explicitly in footnote 14 that they have been unable to perform tax and audit rates harmonization analysis in their framework.

In the Appendix, we illustrate the welfare of the low-tax country with cooperative and non cooperative enforcement for $\rho = 0$ (see figure 5). With these elements, the extension of proposition 3 to enforcement complementarity is straightforward. The key changes are that the minimum tax threshold as well as the country asymmetry thresholds are depending on ρ.

Proposition 4 *Enforcements are complements ($\rho > -1$). High-tax country benefits from enforcement cooperation for all $\lambda \in (0,1)$ and $\epsilon \in (0,1)$. As for low-tax country, there exist minimum tax threshold $\lambda^0(\epsilon, \rho) \in (0,1)$ and country asymmetry thresholds $0 < \underline{\epsilon}(\rho) < \overline{\epsilon}(\rho) < 1$ with similar properties as in Proposition 3. Moreover minimum tax threshold $\lambda^0(\epsilon, \rho)$ is decreasing with asymmetry rate ϵ and increasing with the enforcement complementarity rate ρ.*

Proposition 4 extends Proposition 3 to enforcement complementarity. The proof follows the same lines of argument as those in Proposition 3. The key change is that the participation threshold for the low-tax country has increased with the extent of enforcement complementarity. This is because enforcement complementarity increases the potential benefit of enforcement cooperation. Indeed, the effect of cooperation is to align enforcement choices, making them more effective and boosting taxes and tax revenues in both countries above what is attainable with uncoordinated enforcements. Except for this change in the gains of enforcement cooperation, the implications of the minimum tax on cooperation incentives are similar. There exists a critical minimum tax such that the low-tax country will defect of the enforcement agreement. This limit to the minimum tax is lower when country asymmetry increases, and it is higher when enforcement complementarity increases.

4 The breakup of cooperation

The final step of our argument about the welfare effect of global minimal taxation is to show that given the dynamic changes in the tax and enforcement policies, the high-tax country can lose, and the low-tax country gain with the minimum tax. We illustrate this graphically when enforcements are perfect substitutes.

[Insert Figure 2 about here]

Figure 2 illustrates the case of $\rho = -1$ and $\epsilon = 0.23$. Between $\lambda = 0$ corresponding to $\underline{t} = t_2^N$ (the unconstrained equilibrium) and $\lambda \approx 0.59$

with $\underline{t} = \lambda t_1^N(e) + (1-\lambda)t_2^N(e)$, enforcement cooperation Pareto dominates the non-cooperative equilibrium, and the minimum tax is Pareto improving. However, when λ is pushed beyond $\lambda \approx 0.59$, the low-tax country prefers to defect unilaterally of the international enforcement agreement causing a welfare loss for the high-tax country.[19] Interestingly, the minimum tax can harm the high-tax country because of the breakdown of enforcement cooperation, but it cannot harm the low-tax country which can freely opt out from the enforcement agreement when the minimum tax is set too high. We call this the enforcement dilemma of minimum taxation.

Increasing ϵ from 0.23 to 0.25 decreases the critical value of the minimum tax from 0.59 to 0.19. This suggests that there exists some upper bound of asymmetry $\overline{\epsilon}(\rho) \in (0,1)$ such that enforcement cooperation is no longer robust to the minimum tax when $\epsilon > \overline{\epsilon}(\rho)$. We can compute those upper-bound values for $\rho = -1, 0, \infty$. We obtain $\overline{\epsilon}(-1) = 0.26$, $\overline{\epsilon}(0) = 0.32$, $\overline{\epsilon}(\infty) = 0.33$ and $\overline{\epsilon}(\infty) = 0.41$. Hence there is no scope of mutually beneficial cooperation, even without minimum taxation, when the asymmetry is sufficiently high. Those upper bounds on asymmetry are increasing with ρ with a maximal value of 0.41 when $\rho = \infty$. Recall that $\epsilon = 0.41$ is equivalent to a pre-shifting profit share of 0.7 in the large country.

Similarly, there exists some lower bound of asymmetry $\underline{\epsilon}(\rho) \in (0,1)$ such that enforcement cooperation is always robust to the minimum tax when $\epsilon < \underline{\epsilon}(\rho)$. Those lower bounds of asymmetry are also increasing in ρ. To understand why both the lower and the upper bounds of asymmetry increase with enforcement complementarity, it is useful to see how the benefit of enforcement cooperation for the low-tax country changes when complementarity increases. Recall that the large country always benefits from enforcement cooperation.

[Insert Figure 3 about here]

Figure 3 illustrates the effect of increasing ρ. We assume $\epsilon = 0.23$ as in Figure 2 and ρ increases from $\rho = -1$ to $\rho = -0.8$. As W_2^C is independent of ρ, Figure 3 reveals that increasing ρ increases the critical level of the minimum tax $\lambda^0(\epsilon, \rho)$ because non-coordinated enforcement is more harmful when

[19]The welfare discontinuity should not cast doubt on the existence of equilibrium in our model. Both tax responses and enforcement responses are explicit and continuous in our model. There exists a specific equilibrium in taxes and enforcements for the cooperative and non-cooperative enforcements. Cooperation and non-cooperation are binary choice; this choice switches taxes and enforcements, but it does not cause welfare discontinuity for the defecting low-tax country (because its decision to cooperate is optimized). However, there is a downward jump of welfare in the high-tax country, which is powerless to prevent defection.

enforcements are complements. As a result enforcement cooperation is more robust to the minimum tax when enforcement complementarity increases. We summarize our results in Proposition 3.

Proposition 5 *Suppose that* $\rho = -1, 0, \infty$. *Then there exist minimum tax threshold* $\lambda^0(\epsilon, \rho) \in (0, 1)$ *and country asymmetry thresholds* $0 < \underline{\epsilon}(\rho) < \overline{\epsilon}(\rho) < 1$ *such that*
(i) enforcement cooperation is always robust to the minimum taxation when $\epsilon < \underline{\epsilon}(\rho)$ *and enforcement cooperation is never robust (even without the minimum taxation) when* $\epsilon > \overline{\epsilon}(\rho)$. *In both cases, the introduction of minimum taxation is Pareto improving.*
(ii) For any $\underline{\epsilon}(\rho) \leq \epsilon \leq \overline{\epsilon}(\rho)$, *there is an enforcement dilemma with a breakdown of enforcement cooperation when the minimum tax is* $\lambda \geq \lambda^0(\epsilon, \rho)$.

5 Model extension with tax haven

So far we have considered tax competition among two heterogenous countries that are non-havens. In this context the low-tax country agreed to exert effort to reduce profit shifting in order to increase the suboptimal tax rates and collect more tax revenue. There is no *direct* gain of enforcement for the low-tax country because it benefits from profit shifting, but we have argued there is *indirect* gain by limiting the harmful tax competition. That work horse model can easily be extended to include tax haven with zero profit tax and zero enforcement effort (i.e., non-participating jurisdiction). This extension does not change our key mechanism of cooperation breakdown among non-havens when the minimum tax is set too high. Consider country 0 with $t_0 = e_0 = 0$. Tax and enforcement rates in non-havens 1 and 2 are denoted as before $t_1 > t_2 > 0$ and $e_1 > e_2 > 0$. The shifted profit from country i to country j is given by s_{ij}. The reported profits across jurisdictions ($i = 0, 1, 2$) are

$$\tilde{\pi}_i = \pi_i - s_{ij} - s_{i0} \quad (i, j = 1, 2)$$

$$\tilde{\pi}_0 = \sum_{i=1,2} s_{i0}$$

where s_{ij} ($j \neq i$) is profit shifted from i to j. Reported profit in non-havens $\tilde{\pi}_i$ (with $i = 1, 2$) is initial profit π_i net of the shifted profits s_{ij} ($j \neq i$).

Reported profit in the tax haven, $\tilde{\pi}_0$ is the total profit shifted from non-havens. The MNE set profit shifting so as to maximize its after-tax profit net of shifting cost.[20]

$$\sum_{i=1,2}(1-t_i)\tilde{\pi}_i + \sum_{i=1,2} s_{i0} - \delta(e)\left(\sum_{i=1,2}(s_{i0})^2 + (s_{12})^2\right).$$

The equilibrium profit-shifting are :

$$s_{12} = \frac{t_1 - t_2}{2\delta(e)} \quad \text{and} \quad s_{i0} = \frac{t_i}{2\delta(e)} \quad (i = 1, 2)$$

Non-haven governments set tax rates anticipating how they shape profit shifting from the MNE. The equilibrium taxes in non-havens are

$$t_1^N(e) = \delta(e)\left(\frac{1}{3} + \frac{\epsilon}{5}\right) \quad \text{and} \quad t_2^N(e) = \delta(e)\left(\frac{1}{3} - \frac{\epsilon}{5}\right).$$

And reported profits are

$$\tilde{\pi}_1^N = \frac{1}{3} + \frac{\epsilon}{5}, \quad \tilde{\pi}_2^N = \frac{1}{3} - \frac{\epsilon}{5}, \quad \text{and} \quad \tilde{\pi}_0^N = \frac{1}{3}$$

Symmetric non-havens ($\epsilon = 0$) set the same tax rate $\tilde{t}_i^N = \delta/3$ (i=1,2) and attract each the same profit share of 1/3, whereas the tax haven gets the residual profit share of 1/3 with zero tax. When non-havens are asymmetric, they set different taxes with profit shifting from the high to the low-tax countries, but the equilibrium taxes still involve the same profit share of 1/3 in the haven. Non-havens have *direct* incentive to exert effort to reduce the amount of profit shifted to the haven.

We now introduce the minimum tax $\underline{t}$ as in (8), assuming that the haven is not subject to the minimum tax. One argument is that as a secrecy jurisdiction, some taxable profit can be hidden from the tax authorities into tax haven (i.e. Incomplete CBC reporting). Another argument is that as with "water's edge" regulation, the tax haven is not participating to the GMT union, which implies that untaxed shifting channels outside the non-havens will remain open (see Riedel and Runkel,2007). Given the minimum tax, the constrained equilibrium taxes are:

[20]We consider that shifting costs are separable across destinations so that the MNE shifts profit not only to the haven, but also to the low-tax non-haven, so as to equalize the marginal cost of profit shifting across destinations. In Hebous and Keen (2023), the shifting cost depends on the total amount shifted, so that profit is only shifted to the lowest tax destination.

$$t_2^M = \underline{t},\ t_1^M = \delta(e)\frac{1+\epsilon}{4} + \frac{\underline{t}}{4}$$

and the tax gap is

$$t_1^M - t_2^M = \frac{2\epsilon\delta(e)}{5}\left(1 - \frac{3\lambda}{4}\right) > 0.$$

Thus, the minimum tax λ increases the equilibrium taxes and decreases the tax gap in non-havens. The profit reported under minimum tax is

$$\tilde{\pi}_1^M = \frac{1}{3} + \frac{\epsilon}{5} + \frac{2\lambda\epsilon}{20}, \quad \tilde{\pi}_2^M = \frac{1}{3} - \frac{\epsilon}{5} - \frac{7\lambda\epsilon}{20}, \quad \text{and} \quad \tilde{\pi}_0^M = \frac{1}{3} + \frac{\lambda\epsilon}{4}$$

The minimum tax increases the profit shifted in the non-participating haven $\tilde{\pi}_0^M$, whereas it decreases the profit shifted in the low-tax country. Interestingly, the profit reported in the high-tax country increases with the minimum tax. This is because the high-tax country increases its rate to a lesser extent than the minimum tax, reducing the profit outflow to the low-tax country (but not to the haven). We now compute revenues in non-haven countries $R_i^M(e) = t_i^M(e)\tilde{\pi}_i^M$ $(i = 1, 2)$ under the minimum tax.

Proposition 6 *In the presence of (non-cooperative) tax haven, under minimum tax $\lambda \in [0, 1]$, country asymmetry $\epsilon \in [0, 1]$ and enforcement levels $e = (e_1, e_2)$, the equilibrium revenue satisfies.*

$$R_1^M(e) = a_1^0(\lambda, \epsilon)\delta(e) \geq R_2^M(e) = a_2^0(\lambda, \epsilon)\delta(e),$$

where

$$a_1^0(\lambda, \epsilon) = \left(\frac{1}{3} + \frac{\epsilon}{5} + \frac{\lambda\epsilon}{10}\right)^2 \geq a_2^0(\lambda, \epsilon) = \left(\frac{1}{3} - \frac{\epsilon}{5} + \frac{8\lambda\epsilon}{20}\right)\left(\frac{1}{3} - \frac{\epsilon}{5} - \frac{7\lambda\epsilon}{20}\right).$$

Thus, the minimum tax increases revenue in the high-tax country since $a_1^0(\lambda, \epsilon)$ is increasing with λ. However, in the low-tax country, revenue is first increasing then decreasing with the minimum tax as $a_2^0(\lambda, \epsilon)$ increases with λ for all $\lambda \leq \overline{\lambda}$ where $\overline{\lambda} = \left(\frac{1}{3} - \frac{\epsilon}{5}\right)\frac{10}{56\epsilon}$. Therefore, as in the model without tax haven, revenue in the low-tax country is a single-peaked function of the minimum tax. The implication of the tax haven is to scale down the equilibrium taxes and revenues for the non-havens without changing our enforcement dilemma mechanism. As in the previous section, if the minimum tax is pushed too far, the low-tax country will defect from the enforcement cooperation and the high-tax country will be worse off. The threshold levels for defecting from enforcement cooperation simply change in the presence of

a tax haven. Plugging the updated values a_1^0 and a_2^0 into cooperative welfare (15) and non-cooperative welfares (18) and (20) we can draw the welfare of the low-tax country with cooperative W_2^C and non-cooperative enforcements W_2^{NC} in the presence of tax haven, for $\rho = -1$ and $\rho = 0$. The corresponding figures, available upon request, are similar to figures 4 and 5 respectively.

6 Conclusion

This paper provides a novel argument on the effect of minimum taxation in the presence of profit shifting by studying the incentives faced by governments to coordinate their enforcement rates (via international enforcement agreement) to tackle more effectively profit shifting. We show theoretically that the fiscal authorities of low-tax countries, even though they may benefit from minimum tax to limit harmful tax competition, may lack the incentives to combat profit shifting.

In this paper, we show that low-tax countries may have incentive to defect from international enforcement agreement in response to the minimum tax. We formalize this argument and make precise the conditions under with international enforcement agreement will break down. Our main finding is that for intermediate (pre-tax profit) asymmetry between countries, the minimum tax can break down enforcement cooperation, making the high-tax countries (but not the low-tax countries) worse off. When the country asymmetry is sufficiently small, enforcement cooperation is always robust to the minimum tax. And when the coutry asymmetry is sufficiently high, the enforcement cooperation is impossible even without minimum tax. For these extreme cases, the minimum tax is Pareto improving. This finding is robust to the presence of tax havens that do not participate to the global minimum tax.

Our result suggests the importance of considering carefully tax enforcement incentives in the current policy reform on minimum tax. Tørsløv et al. (2020) also points out the crucial role of the (lack of adequate) tax enforcement incentives (albeit in a different context) to explain why profit shifting may persist. Another contribution is the joint enforcement technology that creates a non-trivial collective good problem in the fight against profit shifting.

We also illustrate how the interaction between taxes and enforcements can also address the recent findings of Dowd et al. (2017) suggesting that profit-shifting semi-elasticity with respect to tax rate differential may depend on tax levels. Given that enforcement incentives are weaker under low tax level,

our model can explain the higher profit shifting elasticity observed in less developed countries. Interestingly, the minimum tax increases enforcement incentives and reduces (ceteris paribus) the profit shifting elasticity.

As for future research, we find the extension of the analysis to a combination of profit shifting and activity shifting interesting. Suarez Serrato (2019) show the empirical relevance of both responses to tax changes. Interesting issues that arise when combining activity shifting and profit shifting are whether fiscal competition is taking place in taxes or subsidies (Janeba and Schjelderup, 2023), and whether the host countries can permit income to be shifted out to low-tax jurisdictions as a way of attracting (or retain) mobile companies (Dharmapala, 2020). Agrawal and Wildasin (2020) propose a simple modelling approach to extend our analysis in that direction, with two separate costs of shifting profit and shifting activities. Enforcement choices may affect differently these two shifting costs. Another avenue of research is to use the isomorphism between cross border shopping and profit shifting to extend our argument to tax harmonization and enforcement choices in a cross-border shopping context.

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Appendix

Proof of Proposition 3

Given $\rho = -1$, let $\underline{\epsilon}(\rho) = \underline{\epsilon}(-1)$ and $\overline{\epsilon}(\rho) = \overline{\epsilon}(-1)$. For country 1, comparing (15) with (18), we obtain that $W_1^C - W_1^{NC} > 0$ for all $\epsilon \in (0,1)$ and $\lambda \in (0,1)$. For country 2, using (15) and (18), define $\epsilon^0(\lambda)$ implicitly by $W_2^C - W_2^{NC} =$

0. From (15) and (18), it is readily seen to be equivalent to $\sqrt{2}a_2(\lambda,\epsilon) - a_2(\lambda,\epsilon) = 0$. Using $a_1(\lambda,\epsilon)$ and $a_2(\lambda,\epsilon)$ as defined in Proposition 1, we find that $W_2^C - W_2^{NC} = \sqrt{2}a_2(\lambda,\epsilon) - a_2(\lambda,\epsilon)$ is positive (negative) when $\epsilon < \epsilon^0(\lambda) \in (0,1)$ ($\epsilon > \epsilon^0(\lambda)$). Also, we find that $\epsilon^0(\lambda)$ is decreasing in λ. We have $\epsilon^0(0) \approx 0.26$ and $\epsilon^0(1) \approx 0.21$. Setting $\underline{\epsilon}(-1) \equiv \epsilon^0(1)$ and $\overline{\epsilon}(-1) \equiv \epsilon^0(0)$, we have $W_2^C - W_2^{NC} < 0$ for all $\lambda \in (0,1)$ when $\epsilon > \overline{\epsilon}(-1)$, and $W_2^C - W_2^{NC} > 0$ for all $\lambda \in (0,1)$ when $\epsilon < \underline{\epsilon}(-1)$. For $\epsilon \in (\underline{\epsilon}(-1), \overline{\epsilon}(-1))$, we invert $\epsilon^0(\lambda)$ to define $\lambda = \lambda^0(\epsilon)$ such that $W_2^C - W_2^{NC} \geq 0$ if and only if $\lambda \leq \lambda^0(\epsilon)$. Figure 4 depicts the welfare of country 2 with cooperative enforcement W_2^C and with non-cooperative enforcement W_2^{NC} when $\rho = -1$. The set of values of λ and ϵ such that $W_2^C = W_2^{NC}$ is represented by the intersection line $\lambda^0(\epsilon)$ in figure 4.

[Insert Figures 4]

Proof of Proposition 4

The proof is similar to Proposition 3, and we simply display in figure 5, the cooperative welfare and non cooperative welfare of country 2 for $\rho = 0$ in the space $\lambda \in (0,1)$ and $\epsilon \in (0,1)$. The set of values of λ and ϵ such that $W_2^C = W_2^{NC}$ is represented by the intersection line $\lambda^0(\epsilon)$ in Figure 5.

[Insert Figure 5]

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Figures

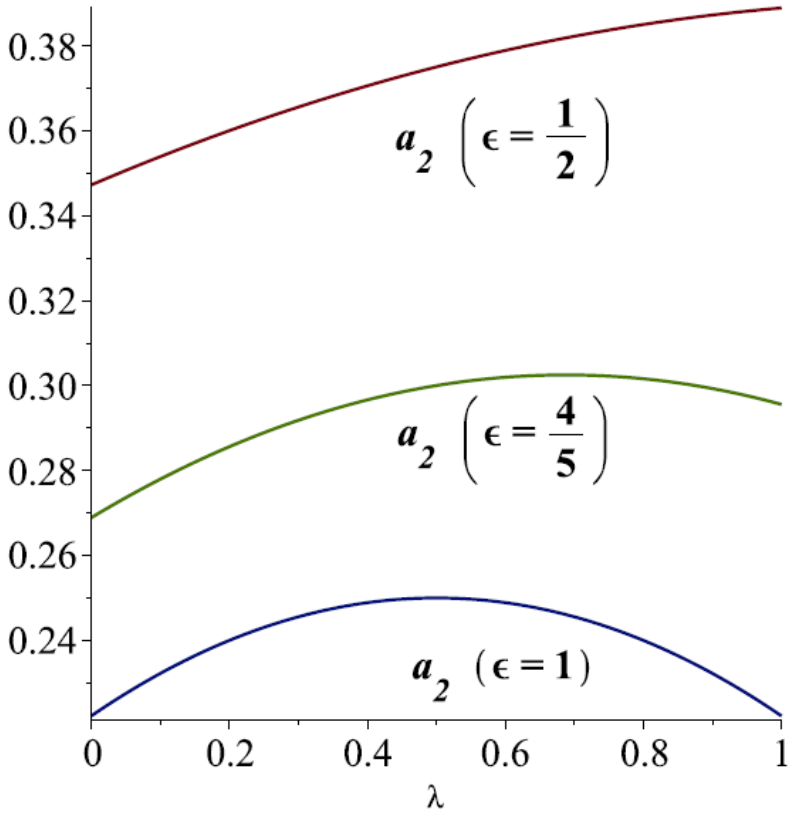


Figure 1: The low-tax country revenue as a function of the minimum tax λ and the market size asymmetry ϵ with exogenous enforcement

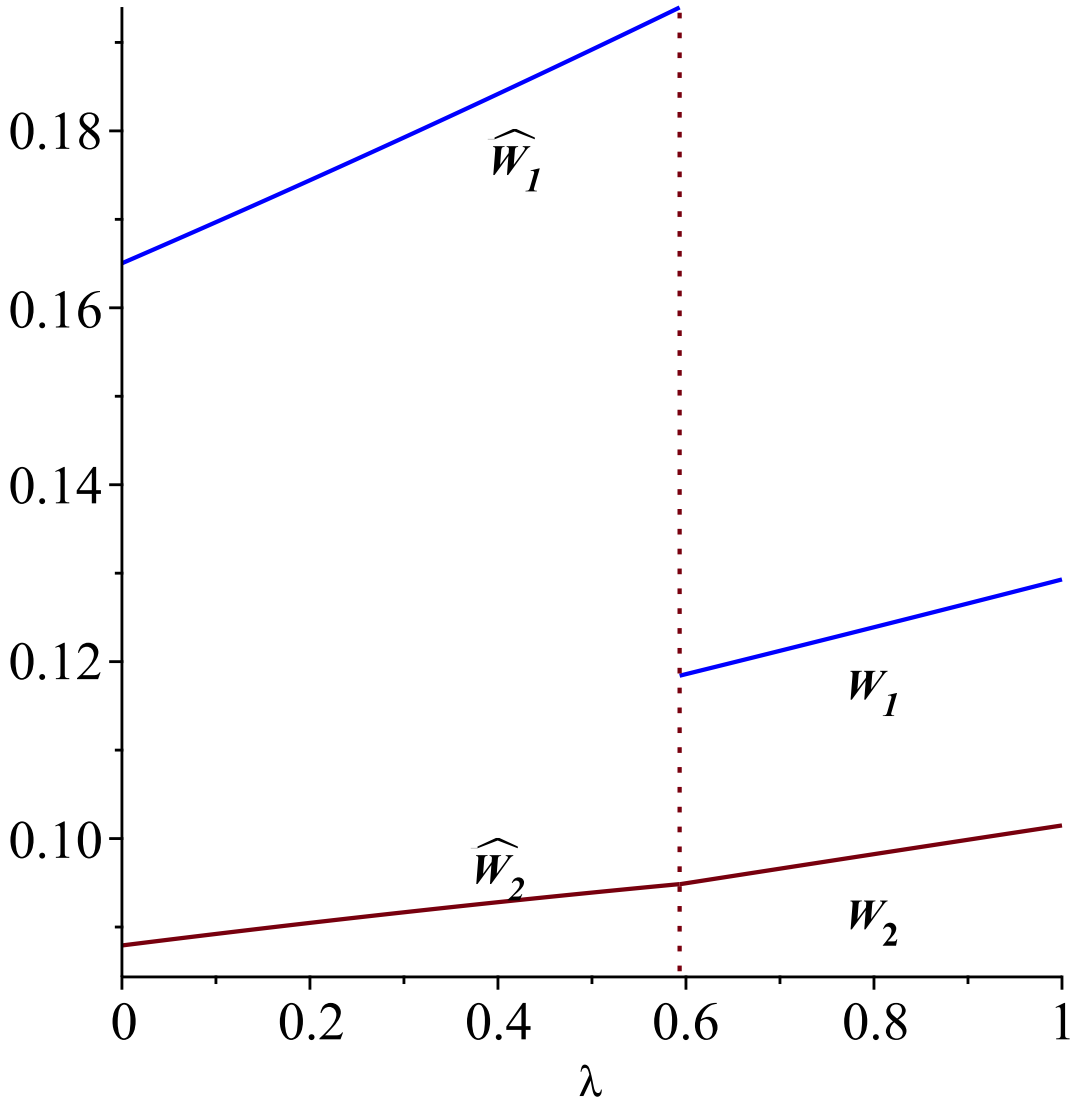


Figure 2: The minimum tax breaks the tax compliance agreement when the minimum tax is sufficiently high: $\rho = -1$, $\epsilon = 0.23$, $\hat{W}_i = W_i^C$ and $W_i = W_i^{NC}(\rho = -1)$.

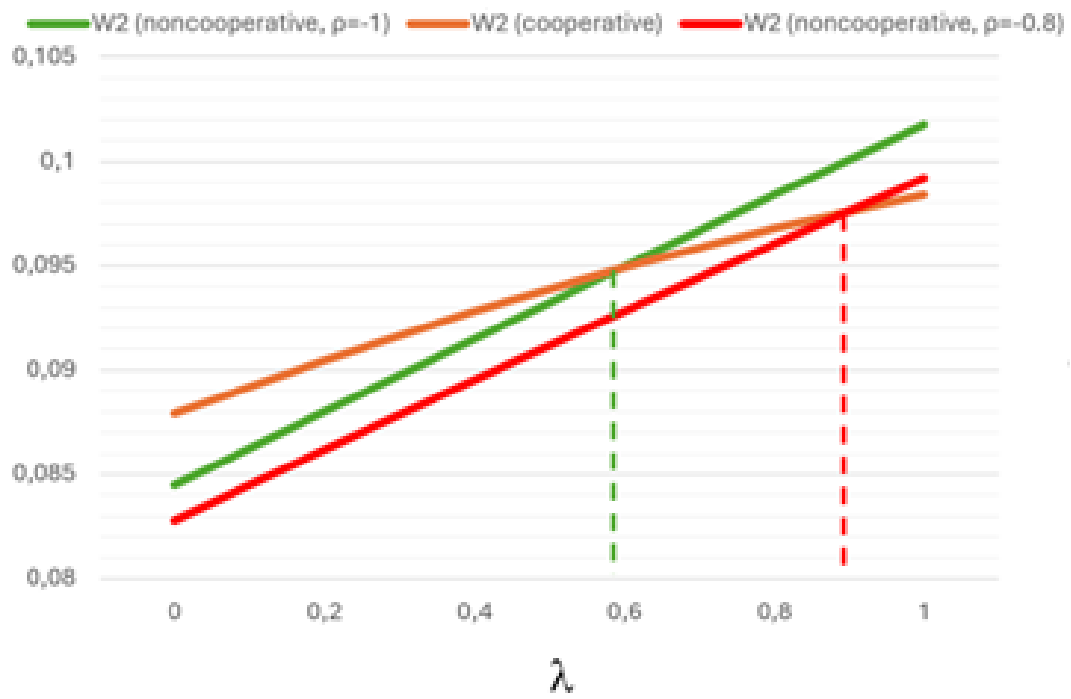


Figure 3: Cooperative W_2^C and non-cooperative welfare W_2^{NC} of the low-tax country when $\rho = -1$ (substitutes) and $\rho = -0.8$ (complements), with $\epsilon = 0.23$.

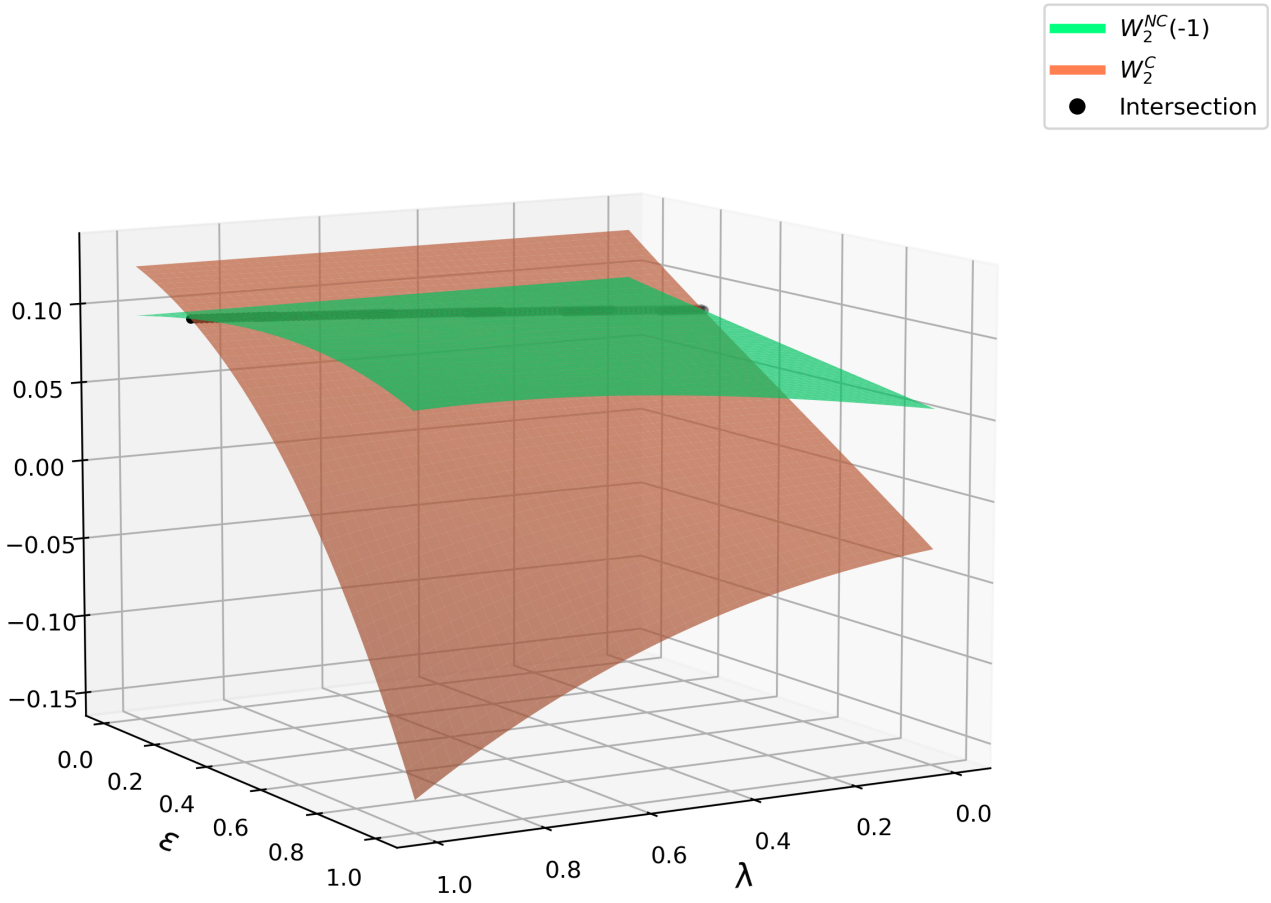


Figure 4: Cooperative W_2^C and non-cooperative welfare W_2^{NC} of the low-tax country when enforcements are substitutes ($\rho = -1$).

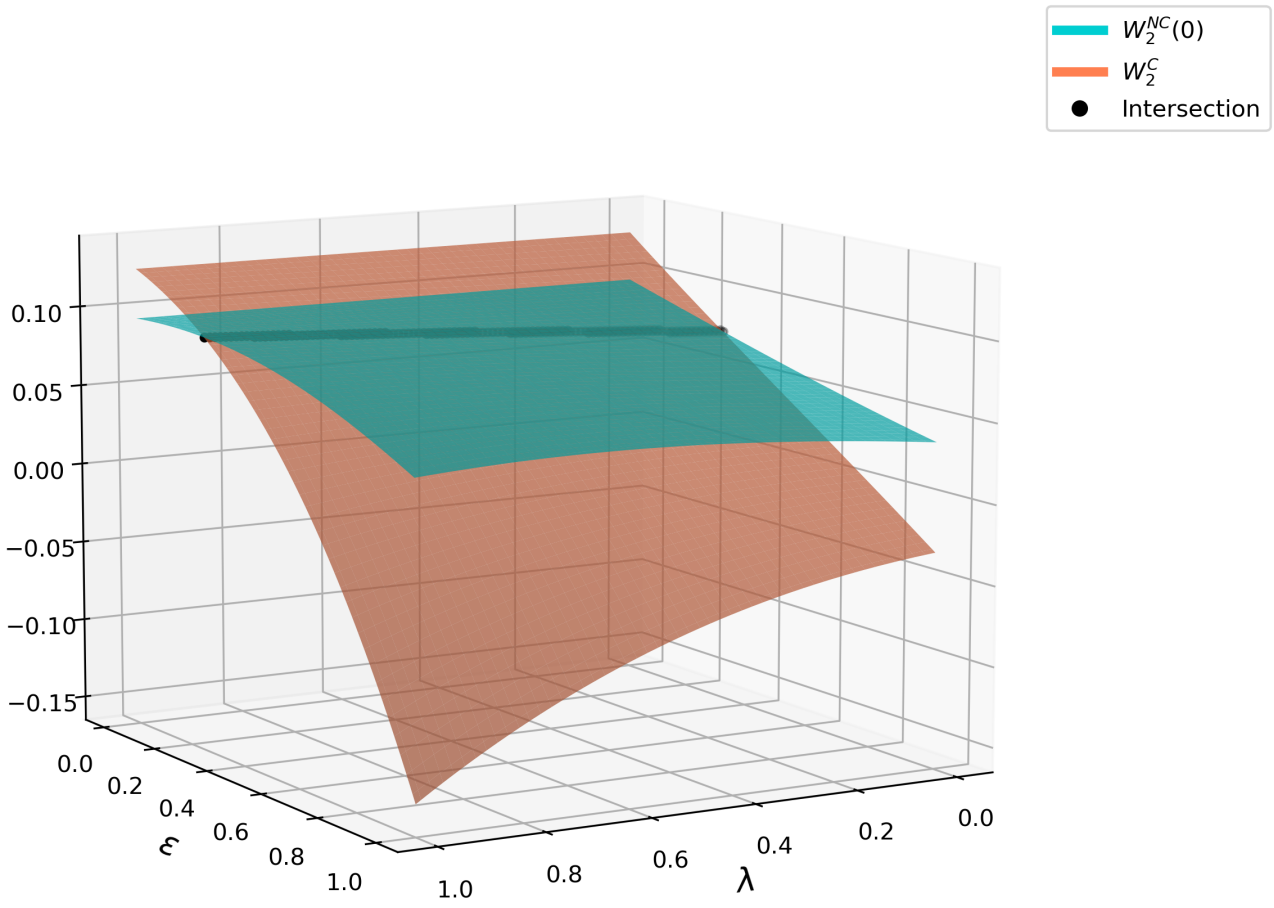


Figure 5: Cooperative W_2^C and non-cooperative welfare W_2^{NC} of the low-tax country when enforcements are complements ($\rho = 0$).