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Abstract

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. We develop a three-country asymmetric tax competition model where, in addition to the conventional profit shifting to the tax haven, the high- and low-tax member (of an economic union) countries encourage MNEs to shift resources through the shifting of production activities and employment (activity shifting). We examine how the relative proportions of profit vs activity shifting are determined in the noncooperative equilibrium. We also examine the implications of the Global Minimum Tax (GMT).

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. 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-Bernardos and Jansky (2022) show that multinational corporations shifted USD 1 trillion of profits in 2016. Using new macroeconomic data, Tørsløv et al. (2023) 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. (2023)). Tørsløv et al. (2023) and Bustos et al. (2019) highlight the critical role of tax enforcement in understanding the persistence of profit shifting. Their empirical findings suggest that without strong enforcement mechanisms, efforts to curb profit shifting are unlikely to succeed. In this context, the OECD/G20 BEPS project places significant emphasis on strengthening international tax enforcement—particularly through the development of robust Controlled Foreign Company (CFC) rules, stricter transfer pricing regulations, and increased audit likelihood.

For instance, high-tax countries are particularly motivated to audit tax avoidance practices, often relying on the arm's length principle (ALP). Under the ALP, tax authorities must identify comparable market transactions to assess whether the pricing of intra-firm transactions is appropriate—making effective tax enforcement essential. However, as measures such as stricter transfer pricing regulations and other BEPS initiatives reduce the benefits of profit shifting, multinational enterprises (MNEs) have increasingly turned to a different strategy: relocating real economic activity across borders in response to tax rate differences (Agrawal and Wildasin (2020)). We refer to this legal form of avoidance as activity shifting.

We develop a three-country asymmetric tax competition model consisting of a high-tax country, a low-tax country, and a tax haven. The high- and low-tax countries are members of a larger economic union, but differ in their corporate tax bases. The low-tax country strategically encourages multinational enterprises (MNEs) to shift resources within the union. Crucially, even the low-tax member country remains vulnerable to profit shifting toward the third country—a tax haven that does not participate in international tax coordination efforts, including minimum tax agreements. Since the activity shifting involves real activities such as production and employment, it is limited to non-haven countries.

In 2020, the OECD/G20 Inclusive Framework on BEPS introduced blueprints for implementing a global minimum tax. A total of 131 countries and jurisdictions have since endorsed this initiative, which proposes a minimum corporate income tax rate of 15% (OECD (2021b)). Under this system, if a multinational enterprise (MNE) reports income in a jurisdiction with a tax rate below the minimum, the home country can impose a top-up tax to reach the 15% threshold. According to the OECD's latest assessment, a significant portion of the projected revenue gains from the reform is expected to result from this minimum tax provision.

We also discuss

- Trade liberalization and Foreign Direct Investment (FDI), in relation to Fajgelbaum et al. (2015) on Lindar hypothesis.
- This avoidance creates new features on the international tax competition and the use of the minimum tax.

2 Model

There are two (member) countries, denoted by 1 and 2, and a tax-haven country denoted by 0. Tax t_i and enforcement rate e_i are as follows. Tax haven would not tax profits and do not engage in enforcement: $t_0 = 0 = e_0$. Non-havens 1 and 2 will tax, typically $t_1 > t_2 > 0$. The level of tax enforcement is indicated by 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, which we typically have $e_1 > e_2 > 0$ in equilibrium.

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.[1] We often denote $\epsilon_1 = \epsilon$ and $\epsilon_2 = -\epsilon$.

Then, at some cost, the MNE shifts profits between branches to minimize its total tax liability. In other words, it decides how much profit actually accrued in Country i to divert to Country j, subject to quadratic and non fiscally-deductible shifting cost.[2]

$$C\left(s_{ij}\right) = \delta(e_1, e_2)\left(s_{ij}\right)^2.$$

δ is a reduced-form of the international tax capacity related to 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' sanctions 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.

In Hindriks and Nishimura (2021) and Hindriks and Nishimura (2025), δ is an increasing function of e_i and e_j, such that stricter enforcement implies a higher tax capacity $\delta(.)$. We consider the following enforcement technology. The tax haven does not participate in international enforcement.

We consider a three-stage game with the following sequence of events. In the first stage, countries 1 and 2 set their enforcements e_1 and e_2. In the second stage, both countries choose their taxes t_1 and t_2, with $t_0 = 0$ and we assume that tax haven is not affected by any

[1]Our basic specification of the profit tax competition resembles the basic setup of the commodity tax competition model in Nielsen (2001) with cross-border shopping. Agrawal and Wildasin (2020) use a 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 add a third country.

[2]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.

tax coordination scheme including the minimum tax. In the third stage, the multinational enterprise chooses the amount of profit to be shifted, from branches located countries 1 and 2 to the lower-tax affiliate, and also the profit shifting towards tax haven. In addition, the MNE also shifts the real resources in the form of activity shifting. They are subject to different costs as we introduce later. Our analysis seeks to show how enforcements can shape international taxes and profit allocation.[3] Our sequence of events fits well 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.

Each member country i chooses enforcement e_i and then tax rate t_i to maximize its revenue net of the enforcement cost anticipating declared profit $\tilde{\pi}_i$ and the addition of activity-shifting $\beta > 0$ from the high-tax affiliate to the low-tax affiliate. Assuming a quadratic cost of enforcement, $c(e_i) = \frac{e_i^2}{2}$, for simplicity, welfare in country i is, for $\beta_i = \beta$ if $t_i < t_j$ $(i, j = 1, 2)$ and $\beta_i = -\beta$ if $t_i > t_j$:

$$W_i = t_i(\tilde{\pi}_i + \beta_i) - \frac{e_i^2}{2}, \tag{2}$$

We do not include the welfare of the firm owners in the objective function as in Johannesen et al. (2020) or Hebous and Keen (2023) so as to voluntarily twist the model in favor of the minimum tax.[4]

3 Baseline model with $\epsilon = 0$

Following Agrawal and Wildasin (2020) (hereafter AW), we illustrate reallocation of production activities in response to a change of corporate tax rates and tax enforcement (see also Suarez Serrato (2019), Altshuler and Grubert (2016), Dharmapala (2020)). In practice,

[3] 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 would induce the low-tax member country to choose zero enforcement given that enforcement cannot affect equilibrium taxes. We distinguish the enforcement incentives between the low-tax member country and tax haven.

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

in addition to the profit-shifting, the firms conduct the shifting of the real allocation.

Suppose that, after the profit shifting the firm in the high-tax country has the tax base $\tilde{\pi}_1$, and by relocating some activity to the low-tax country the MNE can earn β with the cost of activity relocation to be a quadratic form $\Delta\beta^2$.[5] The activity shifting does not take place to tax haven. We also consider the case that activity shifting is a legal tax avoidance, and Δ is not affected by enforcement choice.

$$\begin{aligned} &\arg\max(1-t_1)(\tilde{\pi}_1-\beta)+(1-t_2)(\tilde{\pi}_2+\beta)-\Delta\beta^2 \\ &=\arg\max\sum_{i=1,2}(1-t_i)\tilde{\pi}_i+(t_1-t_2)\beta-\Delta\beta^2 \end{aligned}$$

The optimal amount of profit relocation via activity shifting is given by $\beta=\frac{t_1-t_2}{2\Delta}$.[6] With $s_{12}=\dfrac{t_1-t_2}{2\delta(e)}$ and $s_{i0}=\dfrac{t_i}{2\delta(e)}$ $(i=1,2)$ shown in the Appendix, we have

$$\tilde{\pi}_1-\beta=\frac{1+\epsilon}{2}-\frac{2t_1-t_2}{2\delta(e)}-\frac{t_1-t_2}{2\Delta},\ \ \tilde{\pi}_2+\beta=\frac{1-\epsilon}{2}+\frac{t_1-2t_2}{2\delta(e)}+\frac{t_1-t_2}{2\Delta}.$$
$$\tilde{\pi}_0=\frac{t_1+t_2}{2\delta(e)}$$

The threat of the activity-shifting (hereafter AS) relates to the tax gap t_i-t_j $(i,j=1,2\, j\neq i)$ and the level of t_i relates to the profit-shifting to tax haven (hereafer PSH or PS). In the pure activity-shifting model ($\frac{1}{\delta(e)}\to 0$), $\tilde{\pi}_0=0$. Otherwise, the tax haven receives the windfall gain even if the taxes are made out of activity-shifting motive.

The impacts of enforcement on the tax base can then be extended to both profit and activity shifting.

The first-order condition (FOC) of the tax stage without minimum tax is:

$$\frac{\partial TR_i}{\partial t_i}=\frac{1+\epsilon_i}{2}-2t_i\left(\frac{1}{2\Delta}+\frac{1}{\delta(e)}\right)+t_j\left(\frac{1}{2\Delta}+\frac{1}{2\delta(e)}\right)=0. \tag{3}$$

[5]AW considered the case of the activity-shifting cost to be $d\beta+\Delta\beta^2$, with $d\geq 0$ being the linear component. AW discussed that the increased "globalization", with the decrease of $\delta(e)$ and decrease of d having the different consequences in the equilibrium tax rate, in the analysis of the tax choice (where δ is exogenous and there is no minimum tax).

[6]AW sets the marginal cost a in footnote 5 for the activity shifting so that $\beta=0$ when a is sufficiently high. This is their "past" regime of in which activity shifting, a modern phenomenon of international tax avoidance, was not observed yet.

In the Appendix we show:

$$\begin{pmatrix} t_1^N \\ t_2^N \end{pmatrix} = \begin{pmatrix} (\frac{1}{\Delta} + \frac{3}{\delta(e)})^{-1} + (\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1}\epsilon \\ (\frac{1}{\Delta} + \frac{3}{\delta(e)})^{-1} - (\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1}\epsilon \end{pmatrix} \tag{4}$$

For exogenous Δ and $\frac{1}{\delta(e)} \to 0$, the above formula shows the equilibrium tax without tax haven ($t_i^N = \Delta\left(\frac{3+\epsilon_i}{3}\right)$ in the pure activity-shifting model). For $\frac{1}{\Delta} \to 0$, the above formula shows the case of Hindriks and Nishimura (2025) (hereafter HN), $t_i^N(e) = \delta(e)\left(\frac{1}{3} + \frac{\epsilon_i}{5}\right)$. The outflow to the tax haven is decreasing in the stringency of the anti-haven enforcement $\delta(e)$ and *increasing* with the difficulty of activity shifting Δ. This is because the increase of Δ increases *both* t_1^N and t_2^N, and in some sense Δ is a public bad to drain the MNE's profit to $\tilde{\pi}_0$.

$$\begin{aligned} \tilde{\pi}_2^N + \beta &= \frac{1-\epsilon}{2} - \frac{t_2^N}{2\delta(e)} + \{t_1^N - t_2^N\}(\frac{1}{2\delta} + \frac{1}{2\Delta}) \\ &= \frac{1}{2}[1 - (\frac{\delta(e)}{\Delta} + 3)^{-1} + \epsilon(-1 + (3\frac{\delta(e)}{\Delta} + 5)^{-1} + 2\frac{\frac{1}{\Delta} + \frac{1}{\delta(e)}}{\frac{3}{\Delta} + \frac{5}{\delta(e)}})] \end{aligned} \tag{5}$$

$$\text{So} \quad \tilde{\pi}_0 = (\frac{\delta(e)}{\Delta} + 3)^{-1}, \quad \tilde{\pi}_1^N - \beta = \frac{1}{2} - \frac{(\frac{\delta(e)}{\Delta} + 3)^{-1}}{2} + \frac{\epsilon}{2}\frac{\frac{1}{\Delta} + \frac{2}{\delta(e)}}{\frac{3}{\Delta} + \frac{5}{\delta(e)}} \tag{6}$$

Begin with the case when $\epsilon = 0$. With the pure PSH model à la HN so $\frac{1}{\Delta} = 0 = \epsilon$, $\tilde{\pi}_2^N = \frac{1}{3}$ since $\frac{1}{3}$ leaks to the tax haven. Next, in the pure activity-shifting model $\frac{1}{\delta(e)} \to 0$, the base amount (when $\epsilon = 0$) is $\tilde{\pi}_2^N = \frac{1}{2}$.

Continuing to assume $\epsilon = 0$, we have:

$$t_i^N \cdot (\tilde{\pi}_i^N + \beta) \equiv \delta(e)a \cdot \frac{1}{2}\{1 - a\} \tag{7}$$

$a \equiv (\frac{\delta(e)}{\Delta} + 3)^{-1} \leq \frac{1}{3}$, corresponding to $\frac{t_i^N}{\delta(e)}$, is decreasing in $\frac{\delta(e)}{\Delta}$ (increasing in Δ) since we factored out delta. The following term is $\tilde{\pi}_i^N + \beta_i = \frac{1}{2}\{1 - (\frac{\delta(e)}{\Delta} + 3)^{-1}\}$ includes the leak of the tax base from both member-countries to tax haven which is increasing in $\frac{\delta(e)}{\Delta}$ as we discussed above. $a(1-a)$ is increasing in a when $a \leq \frac{1}{3}$ so, given e, the above value is increasing in Δ.

Proposition 1. The tax stage without minimum tax under symmetric non-haven countries is characterized as follows:

- The tax rate t_i^N is a harmonic mean between a pure AS-model and i's tax-reaction against zero-rated tax haven.
- The member countries, country 1 and 2, need to mind the base erosion to tax haven.
- The outflow to the tax haven is decreasing in the stringency of the anti-haven enforcement $\delta(e)$ and increasing with the difficulty of activity shifting Δ.
- Even with the increasing leak of the tax base, the tax revenue of each member countries is increasing in the difficulties of activity shiftoing.

The inflow by the pure profit-shifting model is $\frac{1}{3}$ as we mention above, and in the pure activity-shifting, $\tilde{\pi}_0 = 0$. When both are present, the tax base $\tilde{\pi}_i^N + \beta_i$ is increasing in $\frac{\delta(e)}{\Delta}$, from $\frac{1}{3}$ ($\tilde{\pi}_0 = \frac{1}{3}$) to $\frac{1}{2}$ ($\tilde{\pi}_0 = 0$).

3.1 Minimum tax (along the 45-degree line)

We introduce the minimum tax as $t_i^M = \delta(e)(a + \lambda)$. This causes the tax base to decrease as $\frac{1}{2}(1 - a - \lambda)$. As $a \leq \frac{1}{3}$, *the introduction of the minimum tax along the 45-degree line increases* $\delta(e)(a + \lambda)\frac{1}{2}(1 - a - \lambda)$ *for any level of* e_i.

4 The Case of Asymmetric Member Countries $(\epsilon > 0)$

Now, we consider the case of $\epsilon > 0$ and begin the analysis with $\lambda = 0$. From (4) we have

$$t_1^N - t_2^N = 2(\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1}\epsilon, \quad \tilde{\pi}_0 = (\frac{\delta(e)}{\Delta} + 3)^{-1} \tag{8}$$

The tax gap is a harmonic mean between the profit-shifting with tax-haven model $\frac{\delta(e)}{5}\epsilon$ in HN (Section 5) and the activity-shifting model $\frac{\Delta}{3}\epsilon$.[7]

[7] The value of activity-shifting is an application of HN (Section 2.3). Since the modern option of tax avoidance would not go to tax haven, the tax rate is more responsive to Δ than to $\delta(e)$.

Let us turn to the equilibrium tax base (5), and begin with $\frac{1}{\Delta} = 0$ (no AS) under asymmetry. For the low-tax member country, the part of intrinsic asymmetry, $-\frac{1}{2}\epsilon$, will be partially made up of profit shifting from the high tax country. For another benchmark case, when $\frac{1}{\delta(e)} \to 0$ (no PS), intrinsic asymmetry is partially offset by AS by $\frac{1}{3}\epsilon$.

4.1 Minimum tax $\lambda > 0$, tax stage (below 45-degree line, $t_2^M < t_1^M$)

For the low-tax member country: since $a = (\frac{\delta(e)}{\Delta} + 3)^{-1} \leq \frac{1}{3}$,

$$t_2^M = \delta(e)a + \frac{2\lambda - 1}{3}\delta(e)((a)^{-1} - \frac{4}{3})^{-1}\epsilon \tag{4'.l}$$

From t_2^N above, which is a harmonic mean of $\Delta\left(\frac{3-\epsilon}{3}\right)$ of the pure activity-shifting model and $\delta(e)\left(\frac{1}{3} - \frac{\epsilon}{5}\right)$ of the profit-shifting-to-haven model, the addition is $2\lambda(\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1}\epsilon$.

$$\frac{\partial TR_1}{\partial t_1} = \frac{1+\epsilon}{2} - 2t_1\left(\frac{1}{2\Delta} + \frac{1}{\delta(e)}\right) + \underline{t}\left(\frac{1}{2\Delta} + \frac{1}{2\delta(e)}\right) = 0. \tag{9}$$

$$\begin{aligned} t_1^M &= \frac{1+\epsilon}{2}\frac{1}{\frac{1}{\Delta} + \frac{2}{\delta(e)}} + \frac{\underline{t}}{2}\frac{\frac{1}{2\Delta} + \frac{1}{2\delta(e)}}{\frac{1}{2\Delta} + \frac{1}{\delta(e)}} \\ &= \delta(e)a + \frac{\epsilon}{3}\delta(e)((a)^{-1} - \frac{4}{3})^{-1} + \frac{2\lambda}{3}\epsilon\delta(e)((a)^{-1} - \frac{4}{3})^{-1}\frac{\frac{1}{2\Delta} + \frac{1}{2\delta(e)}}{\frac{1}{\Delta} + \frac{2}{\delta(e)}}, \end{aligned} \tag{4'.h}$$

The addition of t_1^M to t_1^N is $2\lambda\epsilon(\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1}\frac{\frac{1}{2\Delta}+\frac{1}{2\delta(e)}}{\frac{1}{\Delta}+\frac{2}{\delta(e)}}$ where the slope of the tax reaction function is between $\frac{1}{2}$ (w/o tax-haven model) and $\frac{1}{4}$ (tax-haven model), with the weight by $\frac{\delta(e)}{\Delta}$.

$$t_1^M - t_2^M = 2\epsilon(\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1} - (2\lambda)(\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1}\epsilon\frac{\frac{1}{2\Delta} + \frac{3}{2\delta(e)}}{\frac{1}{\Delta} + \frac{2}{\delta(e)}}$$

$$\tilde{\pi}_2^M + \beta = \frac{1-\epsilon}{2} - \frac{t_2^M}{2\delta(e)} + \{t_1^M - t_2^M\}(\frac{1}{2\delta} + \frac{1}{2\Delta}) \tag{5'}$$

$$= \frac{1}{2}[1 - a - \epsilon\frac{\frac{\delta(e)}{\Delta}+2}{\frac{3\delta(e)}{\Delta}+5}] - \lambda((a)^{-1} - \frac{4}{3})^{-1}\frac{1}{3}\epsilon - \lambda((a)^{-1} - \frac{4}{3})^{-1}\frac{\epsilon}{3}\frac{\frac{\delta(e)}{2\Delta}+\frac{1}{2}}{\frac{\delta(e)}{\Delta}+2}(a)^{-1}$$

Notably, the impact of the minimal tax for low-tax country's tax base is *negative*, which is the increased PS to tax haven and the decreased activity shifting. The increase of λ causes the profit-shifting to tax haven (which is *increasing* with the difficulty of activity shifting Δ, from 0 to $\lambda\frac{1}{5}\epsilon$). The λ decreases tax gap which causes the reduction of the activity-shifting. When $\frac{1}{\delta(e)} \to 0$, the amount of the decreased activity-shifting is $-\lambda\epsilon\frac{1}{6}$. When $\frac{1}{\Delta} \to 0$, the amount of the decreased activity-shifting is $-\lambda\epsilon\frac{3}{20}$.

$$\tilde{\pi}_1^M - \beta = \frac{1}{2}[1 - a + \epsilon\frac{\frac{\delta(e)}{\Delta}+2}{\frac{3\delta(e)}{\Delta}+5}] - \lambda((a)^{-1} - \frac{4}{3})^{-1}\frac{\epsilon}{3}\frac{\frac{\delta(e)}{2\Delta}+\frac{1}{2}}{\frac{\delta(e)}{\Delta}+2} + \lambda((a)^{-1} - \frac{4}{3})^{-1}\frac{\epsilon}{3}\frac{\frac{\delta(e)}{2\Delta}+\frac{1}{2}}{\frac{\delta(e)}{\Delta}+2}(a)^{-1} \tag{6'}$$

The sum of the part related to λ for the high-tax country's tax base also relates to the increased PSH and the decreased AS, which is $\lambda(\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1}\epsilon\frac{\frac{1}{\Delta}+\frac{1}{\delta(e)}}{\frac{1}{\Delta}+\frac{2}{\delta(e)}}\{\frac{1}{2\Delta} + \frac{3}{2\delta(e)} - \frac{1}{2\delta(e)}\}$ and *positive*. The gain of reduced activity shifting from the minimum tax dominates the increased profit shifting to the tax haven.

$$\tilde{\pi}_0 = \frac{t_1^M + t_2^M}{2\delta(e)} = (\frac{\delta(e)}{\Delta} + 3)^{-1} + \lambda((a)^{-1} - \frac{4}{3})^{-1}\frac{\epsilon}{3}\{1 + \frac{\frac{\delta(e)}{2\Delta}+\frac{1}{2}}{\frac{\delta(e)}{\Delta}+2}\} \tag{8'}$$

To confirm (5') and (6') in the pure PSH's case, we have $\beta = 0$ and $\tilde{\pi}_1^M = \frac{1}{3} + \frac{\epsilon}{5} + \frac{2\lambda\epsilon}{20}$ and $\tilde{\pi}_2^M = \frac{1}{3} - \frac{\epsilon}{5} - \frac{7\lambda\epsilon}{20}$. The small member country experiences the outflow of money. For the high-tax country there is an inflow but the amount of inflow is lower than the amount of outflow.

On the top of (8), the outflow to the tax haven related to λ is *increasing* with the difficulty of activity shifting.

Proposition 2. (i) For the high-tax country's tax base $\tilde{\pi}_1^M - \beta$, the introduction and the increase of the minimum tax λ cause the gain of reduced activity shifting from the minimum tax that dominates the increased profit shifting to tax-haven.

(ii) For the low-tax country's tax base $\tilde{\pi}_2^M + \beta$, the the introduction and the increase of the minimum tax λ decreases tax gap $t_1^M - t_2^M$ which causes the reduction of the activity-shifting. Also, the profit-shifting to tax haven increases.

5 Equilibrium Enforcement

$\delta(e_i, e_j)$ is a reduced form of international tax capacity related to profit shifting. $\delta(e_i, e_j)$ is an increasing function of e_i and e_j, such that stricter enforcement implies a higher tax capacity $\delta(.)$. We consider the following enforcement technology:

$$\delta(e_1, e_2) = 0.5e_1 + 0.5e_2. \tag{10}$$

The tax haven does not participate to international enforcement.

5.1 Equilibrium e_i without minimum tax

With the quadratic enforcement cost $c_e' = e_i$, we have, for $a = (\frac{\delta(e)}{\Delta} + 3)^{-1}$ and $b = \frac{1}{2}\{1 - a\}$:

$$\begin{aligned}
&\frac{\partial}{\partial e_i}\left\{\delta(e)(\frac{\delta(e)}{\Delta} + 3)^{-1}\frac{1}{2}\{1 - (\frac{\delta(e)}{\Delta} + 3)^{-1}\}\right\} - e_i = \frac{1}{2}ab - \frac{\delta(e)}{\Delta}(a)^2 b + \frac{\delta(e)}{\Delta}\frac{1}{2}(a)^3 - e_i \\
&= \frac{1}{2}a\frac{1}{2}\{1 - a\} + \frac{1}{2}(a)^2(-\frac{\delta(e)}{\Delta} + 2a\frac{\delta(e)}{\Delta}) - e_i = 0.
\end{aligned} \tag{11}$$

Proposition 3.

- When $\frac{1}{\Delta} \to 0$ (no activity shifting), we have $a = \frac{1}{3}$ and $e_i = \frac{1}{2}a\frac{1}{2}(1 - a)$.
- When $\frac{\delta(e)}{\Delta} > 0$ (with both activity shifting and profit shifting), $a < \frac{1}{3}$. From (11), we have $e_i \in (0,\ \frac{1}{4}a(1 - a))$.
- As we see below, $\frac{\partial(0.5e_1 + 0.5e_2)/\delta}{\partial\Delta/\Delta} = \frac{\partial\delta(e)/\delta}{\partial\Delta/\Delta} \in (0,\ 0.5)$
- Then mobilization toward more activity shifting (a shift for lower Δ), for example, more FDI among member countries, à la "Linder hypothesis", brings $\frac{\partial}{\partial\Delta}[\delta(e)a\frac{1}{2}\{1 - a\} - c(e_i)] = \delta(e)\frac{\partial}{\partial\Delta}[a\frac{1}{2}\{1 - a\}] > 0$. Then this mobilization decreases the net tax revenue.

The result of *the decrease of* Δ, such as the mobilization of the Foreign Direct Investment as a result of globalization and the intense need of the international trade, results in the decrease of the outflow of money from the two member countries to tax haven in (6). But this comes as a result of the decrease of $\frac{t_i^N}{\delta(e)}$.

The *Linder hypothesis* in international trade posits that countries with similar per capita incomes tend to trade more intensely with each other.[8] Here we can treat the decrease of Δ as mobilization of resources towards Foreign Direct Investments (FDI) within member countries.

In the second term of the first-order condition (11), since $a < \frac{1}{2}$, the result of the decrease of Δ is a reduction of e_i which leads to the decrease of t_i^N.

5.2 $\epsilon > 0$

To see how it works, for $k_2 = 1$, and $k_1 \in [0.25, 0.5]$ is the slope of the tax-reaction function that is decreasing in $\frac{\delta(e)}{\Delta}$,

$$\frac{\partial W_i}{\partial e_i} - c'(e_i) \equiv FOC^{gr} - e_i = 0$$

$\frac{\partial k_1}{\partial(\delta/\Delta)} > 0$ and $\frac{\partial k_2}{\partial(\delta(e)/\Delta)} = 0$. When $\lambda = 0$, $a_i = (\frac{\delta(e)}{\Delta} + 3)^{-1} + (\frac{\delta(e)}{\Delta} + \frac{5}{3})^{-1}\frac{1}{3}(\epsilon_i)$ and $b_i = \frac{1}{2} - \frac{(\frac{\delta(e)}{\Delta} + 3)^{-1}}{2} + \frac{\epsilon_i}{6}(1 + (\frac{\delta(e)}{\Delta} + \frac{5}{3})^{-1}\frac{2}{3})$

- When $\frac{1}{\delta(e)} \to 0$, $t_i^N = \delta a_i = \Delta(\frac{3 + \epsilon_i}{3})$ and the tax base $b_i = \frac{1}{2} + \frac{\epsilon_i}{6}$. So the effort $e_i = 0$ for both member countries.
- When $\frac{1}{\Delta} \to 0$, $a_i = \frac{1}{3} + \frac{\epsilon_i}{5}$ and $b_i = \frac{1}{3} + \frac{\epsilon_i}{5}$. $e_i = \frac{1}{2}a_i b_i$.
- Therefore, $e_i \in (0,\ \frac{1}{2}a_i b_i)$.

With the subscript δ being a partial derivative w.r.t. δ and

Proposition 4. (i) When $FOC_\delta^{gr} < 0$,

$$\frac{\partial e_i}{\partial \Delta} = 0.5\frac{FOC_\delta^{gr}(\frac{\delta}{\Delta})}{FOC_\delta^{gr} - 1}, \quad \text{so} \quad \frac{\partial(0.5e_1 + 0.5e_2)/\delta}{\partial\Delta/\Delta} = \frac{\partial\delta(e)/\delta}{\partial\Delta/\Delta} \in (0,\ 0.5), \tag{12}$$

[8] This is because they have overlapping demand structures and produce similar goods and services.

Since $\tilde{\pi}_0 = (\frac{\delta(e)}{\Delta} + 3)^{-1} + \lambda \frac{\epsilon}{2} \frac{1}{\frac{\delta(e)}{\Delta}+2}$ in (8′), reducing the difficulty of the activity-shifting *reduces* the MNE's profit leaking to tax haven.

(ii) The decrease of Δ reduces $\delta(e)$ to the less extent, and the tax rates $t_2^M = (\frac{1}{\Delta} + \frac{3}{\delta(e)})^{-1} + (2\lambda - 1)(\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1}\epsilon$ and $t_1^M = (\frac{1}{\Delta} + \frac{3}{\delta(e)})^{-1} + \epsilon(\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1} + 2\lambda\epsilon(\frac{3}{\Delta} + \frac{5}{\delta(e)})^{-1} \frac{\frac{1}{2\Delta} + \frac{1}{2\delta(e)}}{\frac{1}{\Delta} + \frac{2}{\delta(e)}}$ decrease and becomes closer to the PSH model with relatively greater $\delta(e)$ than Δ. As in Proposition 3, mobilization of the FDI reduces the leak to tax haven $\tilde{\pi}_0$ in (8′).

5.3 Comparative Statics w.r.t. λ

$\frac{\partial a_i}{\partial \lambda} = (\frac{\delta(e)}{\Delta} + \frac{5}{3})^{-1} \frac{1}{3} 2|\epsilon_i|k_i$ for the tax rate, $\frac{\partial b_i}{\partial \lambda} = (\frac{\delta(e)}{\Delta} + \frac{5}{3})^{-1}(\frac{1}{3}\{3\epsilon_i(k_1) - |\epsilon_i|k_i\} + \frac{\epsilon_i}{3}k_1\{\frac{\delta(e)}{\Delta}\})\}$ for the tax base, which is positive for both countries. HN shows that in both the AS model and the PSH model, $\frac{\partial e_1}{\partial \lambda} > \frac{\partial e_2}{\partial \lambda}$ and the latter may be negative when λ is sufficiently high.

5.4 Comparative Statics w.r.t. ϵ

When the efforts e_i are perfect substitutes, the total efforts are increasing in ϵ since ϵ affects both the tax rates and the tax base in convex functions in ϵ. We have found this property in Hindriks and Nishimura (2021) in the two-country model corresponding to the current AS model without minimum tax, and the nature of the argument is invariant with the introduction of PSH with minimum tax.

Appendix

Profit-shifting in PSH model

The MNE set profit shifting so as to maximize its after-tax profit net of shifting cost. Recall that $t_0 = 0$.[9]

$$\arg\max(1-t_1)(\pi_1 - s_{10} - s_{12}) + (1-t_2)(\pi_2 - s_{10} + s_{12}) + \sum_{i=1,2} s_{i0} - \delta(e)\left(\sum_{i=1,2}(s_{i0})^2 + (s_{12})^2\right)$$
$$= \arg\max \sum_{i=1,2}(1-t_i)\pi_i + (t_1 - t_2)s_{12} + \sum_{i=1,2} t_i s_{i0} - \delta(e)\left(\sum_{i=1,2}(s_{i0})^2 + (s_{12})^2\right)$$

The equilibrium profit-shifting are:

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

Derivation of (4)

The matrix expression of (3) is:

$$\begin{pmatrix} t_1^N \\ t_2^N \end{pmatrix} = \gamma^{-1} \begin{pmatrix} \frac{1}{\Delta} + \frac{2}{\delta(e)} & \frac{1}{2\Delta} + \frac{1}{2\delta(e)} \\ \frac{1}{2\Delta} + \frac{1}{2\delta(e)} & \frac{1}{\Delta} + \frac{2}{\delta(e)} \end{pmatrix} \begin{pmatrix} \frac{1+\epsilon}{2} \\ \frac{1-\epsilon}{2} \end{pmatrix}$$

where $\gamma = (1.5\frac{1}{\Delta} + \frac{5}{2\delta(e)})(\frac{1}{2\Delta} + \frac{3}{2\delta(e)})$.

[9] 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.

FOC w.r.t. e_i

$$\begin{aligned}
&\frac{\partial TR_i}{\partial e_i} - c_e'(e_i) \\
&= 0.5[a_i b_i - \frac{\delta}{\Delta}\{(\frac{\delta}{\Delta}+3)^{-2} + (\frac{\delta}{\Delta}+\frac{5}{3})^{-2}\frac{1}{3}(\epsilon_i + 2\lambda|\epsilon_i|s_i)\}b_i + \frac{\delta}{\Delta}(\frac{\delta}{\Delta}+\frac{5}{3})^{-1}\frac{1}{3}2\lambda|\epsilon_i|\frac{\partial s_i}{\partial \delta}\Delta b_i\} \\
&-\frac{\delta}{\Delta}a_i\{-\frac{\epsilon_i}{2}\frac{\partial}{\partial\delta}\left(\frac{\frac{1}{\Delta}+\frac{2}{\delta(e)}}{\frac{3}{\Delta}+\frac{5}{\delta(e)}}\right)\Delta - \frac{(\frac{\delta(e)}{\Delta}+3)^{-2}}{2} + (\frac{\delta(e)}{\Delta}+\frac{5}{3})^{-2}(-\lambda|\epsilon_i|\frac{s_i}{3} + (\lambda)\frac{\epsilon_i}{3}s_1\{\frac{\delta(e)}{\Delta}+3\})\} \\
&+\frac{\delta}{\Delta}a_i(\frac{\delta(e)}{\Delta}+\frac{5}{3})^{-1}(-\lambda|\epsilon_i|\frac{1}{3}\frac{\partial s_i}{\partial\delta}\Delta + (\lambda)\frac{\epsilon_i}{3}\frac{\partial\{s_1\{\delta(e)/\Delta+3\}\}}{\partial\delta}\Delta)] - e_i \\
&\equiv FOC^{gr} - e_i = 0
\end{aligned}$$

Comparative Statics w.r.t. λ

The following matters for $\frac{\partial e_i}{\partial \lambda}$.

- $\frac{\partial^2 a_i}{\partial\lambda\partial\delta} = -\frac{1}{\Delta}\{(\frac{\delta}{\Delta}+\frac{5}{3})^{-2}\frac{1}{3}(2|\epsilon_i|s_i)\} + \frac{1}{\Delta}(\frac{\delta}{\Delta}+\frac{5}{3})^{-1}\frac{1}{3}2|\epsilon_i|\frac{\partial s_i}{\partial\delta}\Delta,$
- $\frac{\partial^2 b_i}{\partial\lambda\partial\delta} = \frac{1}{\Delta}\{(\frac{\delta(e)}{\Delta}+\frac{5}{3})^{-2}(-|\epsilon_i|\frac{s_i}{3}+\frac{\epsilon_i}{3}(s_1)\{\frac{\delta(e)}{\Delta}+3\})\} + \frac{1}{\Delta}(\frac{\delta(e)}{\Delta}+\frac{5}{3})^{-1}(-|\epsilon_i|\frac{1}{3}\frac{\partial s_i}{\partial\delta}\Delta + \frac{\epsilon_i}{3}\frac{\partial\{s_1\{\delta(e)/\Delta+3\}\}}{\partial\delta}\Delta)$

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