The Global Minimum Tax, Investment Incentives and Asymmetric Tax Competition

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The Global Minimum Tax, Investment Incentives and Asymmetric Tax Competition[1]

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Abstract

This paper investigates how the OECD's global minimum tax (GMT) affects multinational enterprises (MNEs) behavior and countries' corporate taxes. We consider both profit shifting and capital investment responses of the MNE in a formal model of tax competition between asymmetric countries. The GMT reduces the true tax rate differential and benefits the large country, while the revenue effect is generally ambiguous for the small country. In the short run where tax rates are fixed, due to tax deduction of the substance-based income exclusion (SBIE), a higher minimum rate exerts investment incentives but also incurs a larger revenue loss for the small country. We show that under high (low) profit shifting costs the former (latter) effect dominates so that the small country's revenue increases (decreases). In the long run where countries can adjust tax rates, the GMT reshapes the tax game and the competition pattern. In contrast to the existing literature, we reveal that the minimum rate binds the small country only if it is low. With the rise of the GMT rate, countries will undercut the minimum to boost real investments and collect top-up taxes. For small market-size asymmetry and intermediate profit shifting cost, the revenue loss from the elimination of profit shifting may dominate the revenue gain from taxing the true profits generated by substantive activities, so that even a marginal GMT reform may harm the small country. Otherwise, it can raise the small country's tax revenue.

JEL classification: F21, F23, H25, H73, H87

Keywords: Corporate taxes, Global minimum tax, Profit shifting, SBIE, Tax competition

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1. Introduction

Multinational enterprises (MNEs) can exploit loopholes in tax rules to shift profits to low-tax countries to avoid paying taxes. International profit shifting has caused considerable losses of tax revenue for both OECD and developing countries (see Crivelli, de Mooij and Keen, 2016; Davies et al., 2018; Bilicka, 2019; Wier and Zucman, 2022; Tørsløv et al., 2023). To relieve the pressure on the outdated international corporate tax system, over 135 jurisdictions in 2021 agreed on a 15% global minimum tax (GMT), which is a key part of Pillar Two of the two-pillar solution proposed by the OECD/G20 Inclusive Framework on base erosion and profit shifting (BEPS). The GMT ensures that large MNEs with revenues above EUR 750 million are subject to a 15% minimum tax rate in each jurisdiction where they operate.

It is expected that around 90% of in-scope MNEs will be subject to the GMT by 2025, based on the jurisdictions that have implemented or announced implementation (see Hugger et al., 2024). In practice, the GMT under Pillar Two works in a roundabout way. The first step is to determine the jurisdictional effective tax rate (ETR) of the MNE. It is computed by dividing the taxes (called covered taxes) of the affiliate in that jurisdiction by the income (called GloBE income) it has. If the jurisdictional ETR is below 15%, the MNE will be subject to a top-up tax. The top-up tax rate is the difference between the 15% minimum rate and the ETR. The top-up tax base (called excess profit) is calculated as the GloBE income in excess of the Substance-Based Income Exclusion (SBIE). The SBIE allows MNEs to tax-deduct a percentage of the carrying value of tangible assets and payroll expenses from the GloBE income of the low-tax affiliate. The current carve-out rate is 8% on tangible assets and 10% on payroll costs, while it will reduce to 5% on both tangibles and payroll over a transition period of ten years (see OECD, 2021; European Commission, 2021; Devereux et al., 2022). Hence, the SBIE benefits the low-tax affiliates that have real economic activity by reducing their top-up tax liability. A key question is which countries receive the additional tax revenue. In principle, the top-up tax can be collected either by the country where the headquarters of the MNE resides or by the host country where the MNE's affiliate records the profit. The first scenario corresponds to the income inclusion rule (IIR), while the latter corresponds to the qualified domestic minimum top-up tax (QDMTT). The Model Rules published by the OECD/G20 Inclusive Framework in December 2021 introduced the QDMTT, which gives the host country the priority to collect top-up taxes over the headquarters country (see OECD, 2021). While jurisdictions are not required to implement a QDMTT, there is a very strong incentive for countries affected by Pillar Two to do so. Notice that an MNE's tax liability is the same, no matter which country collects the top-up tax. So failure to adopt the QDMTT will cede tax revenue to other countries while conveying no tax benefit to the MNE. See IMF (2023) for detailed explanations of why countries should adopt the QDMTT.

In this paper, we investigate the OECD's GMT in a formal model of international tax competition with two *asymmetric* countries that differ in market size. First, two countries choose corporate tax rates noncooperatively to maximize their revenues. Then the MNE chooses capital investment in each country and profit shifting level to maximize total after-tax profits, taking as given the tax environments. Following the previous literature on minimum taxation (see Kanbur and Keen, 1993; Keen and Konrad, 2013), we focus on the situation where the minimum rate lies between two countries' initial tax rates without the GMT. Indeed, choosing a minimum that is above the higher of the initial tax rates is unappealing to policymakers of both countries and is politically infeasible. Our model captures the key features of Pillar Two (i.e., the SBIE and the QDMTT), and takes into account both profit shifting and real investment responses of the MNE. We analyze how the GMT affects the MNE's behavior and countries' taxes from a short-run perspective where corporate tax rates are fixed, and from a long-run perspective where governments engage in tax competition. This approach disentangles the tax incentive effect of the GMT due to the tax deduction of the SBIE from the behavioral adjustments by the governments. Similar treatment is used in the literature that compares two alternative tax principles – separate accounting (SA) and formula apportionment (FA) – in the taxation of MNEs (e.g., Riedel and Runkel, 2007; Mardan and Stimmelmayr, 2018). Different from SA under which profit is taxed in the country where the MNE declares it, under FA the MNE's taxable incomes are consolidated first and then assigned to each country based on a formula. Notably, Pillar One reallocates 25% of large MNEs' residual profits – which are the profits in excess of 10% of the revenues – to market jurisdictions through a sales-based formula (see OECD, 2023). In our paper, we restrict attention to SA, since it is the predominant tax principle at the international level.

A number of recent studies empirically analyze the tax revenue (or welfare) consequences of the GMT in the context of fixed corporate tax rates. UNCTAD (2022) shows that the GMT (with the SBIE) could lead to a growth in global tax revenues generated by FDI income between 15 per cent and 20 per cent, if all host countries apply the QDMTT. Baraké et al. (2022) document that G7 countries could collect around EUR 90 billion in the headquarters scenario, while it would fall to EUR 17 billion under host country collection. By contrast, developing countries would favor the QDMTT over the IIR. Ferrari et al. (2023) model and quantify the effects of the GMT, showing that it can improve welfare in most countries by inducing higher tax revenues. Hugger et al. (2024) find that the GMT would narrow the tax differential and raise global tax revenues by between USD 155-192 billion on average per year. Very few empirical works take into account the tax rate adjustments by countries in response to the minimum tax. IMF (2023) estimate that the average tax rate would rise from 22.2% to 24.3% in response to the GMT, which in turn could increase global tax revenues by 8.1%. Buettner and Poehnlein (2024) examine the effects of a minimum tax on the tax policy of German municipalities in a context of local tax competition. After introducing the minimum tax, only high-tax municipalities reduce their business tax rates. The minimum tax does not affect high-tax municipalities' revenues but harms the tax havens.

We start from the short-run analysis, in which only the MNE can adjust its behavior. Introducing the GMT does not change the investment level in the large country. With the top-up tax paid by the low-tax affiliate, the GMT reduces the difference between tax rates on two affiliates' GloBE incomes (referred to as the *true* tax rate differential). Consequently, profit shifting is reduced, and the large country's tax revenue definitely increases. However, the revenue effect of the GMT is generally ambiguous for the small country. Starting from the equilibrium without the GMT, a marginal increase in the minimum rate has two opposite effects. Firstly, due to the SBIE, a higher GMT rate exerts investment incentives for the low-tax affiliate and thus raises the small country's revenue. Secondly, a higher GMT rate increases the top-up tax rate and incurs a larger revenue loss from the deduction of SBIE. Which effect can dominate depends on the initial tax rate of the small country (or equivalently, on the profit shifting cost of the MNE).

Then we investigate the long-run situation where both the MNE and the governments react to the tax reform. Countries compete in corporate tax rates to maximize their revenues while taking as given the international tax architecture. At the equilibrium of the tax game, the GMT does not necessarily bind the small country. It is binding only if the minimum tax is low. Otherwise, the small country will set its tax rate below the minimum, even at zero (if the carve-out rate is very small). The key insight is that due to tax deduction of the SBIE, lowering one country's tax rate below the GMT rate can incentivize real investment but also incurs a larger revenue loss since the top-up tax rate increases. For a high GMT rate, the former effect can dominate. Moreover, when the GMT rate is sufficiently high and the carve-out is not very small, both countries undercut the minimum so that profit shifting ends. In this case, countries aim at attracting capital investments instead of competing for paper profits.

Our results can be related to the traditional minimum taxation literature, which treats the minimum tax as a lower bound imposed on countries' tax rates. Kanbur and Keen (1993) initiatively explore the minimum tax in a commodity tax competition model with cross-border shopping. They show that both large and small countries can benefit from the minimum tax. More recently, Hebous and Keen (2023) extend this framework to study international taxation of MNEs and derive the levels of maximal Pareto dominant minimum tax rate and Pareto-efficient minimum rate. In the two papers, the minimum tax binds the small country and induces the large country to set tax rate along the unconstrained best response curve. Wang (1999) extends Kanbur and Keen's (1993) model to the Stackelberg tax-setting, and presents that the minimum tax not only binds the follower (i.e., the small country) but also may bind the leader (i.e., the large country). Besides, imposing a minimum tax constraint definitely benefits the leader and harms the follower. In our paper, we restrict attention to simultaneous move of countries, as is widely accepted in the profit shifting literature. The binding minimum rate is also an implicit assumption in Janeba and Schjelderup (2023), who study the GMT in a model where two identical non-haven countries compete for firms via tax rates or subsidies, with profits shifted to the tax haven. They assume that the haven's tax rate adjusts to the minimum rate once the GMT is introduced, and show that the revenue effects of the GMT are ambiguous, depending on the fiscal instrument governments use. However, specifying the minimum tax as a constraint that no tax rate may be set below a minimum level somewhat deviates from the design of the GMT based on the OECD's Model Rules. The GMT under Pillar Two allows countries to collect additional revenue via top-up taxes when an affiliate's ETR falls below the minimum rate. Remarkably, Irish government has decided to keep its corporate tax rate at 12.5% and top up the rate to 15% for Irish affiliates of MNEs. It also states that Pillar Two will provide a sound and stable basis for inward investment into Ireland in the long-term (see Department of Finance, 2023). This is consistent with the argument in our paper that countries may undercut the GMT rate to promote real investments.

A few recent theoretical papers on the GMT go beyond "the minimum tax constraint assumption" and consider the case where countries' tax rates are below the GMT rate. Johannesen (2022) sets up a model of tax competition for paper profits among tax havens and non-haven countries, and assumes that the top-up taxes are collected by home countries (under the IIR). The GMT causes a loss of private consumption for the owners of the multinationals in non-haven countries, but also curbs profit shifting and boosts tax revenue. The net welfare effect is generally ambiguous for non-haven countries. Haufler and Kato (2024) develop a tax competition model, where a non-haven and a haven country are bound by the GMT rate for large MNEs, but can choose tax rates freely for small MNEs. They show that introducing a moderate minimum tax can raise tax revenues for both countries. As the GMT rate increases, each country has incentives to split the tax rate and set tax rate below the minimum for small MNEs. However, the SBIE is omitted in the two papers. Schjelderup and Stähler (2023) consider the SBIE in a standard MNE model where the host country's tax rate is below the GMT rate. They show that the SBIE works like a wage subsidy and investment subsidy for the low-tax affiliate, since it allows the firm to deduct payroll costs and user costs of tangible assets twice from the overall tax base. However, in their model countries' tax rates are assumed to be exogenously given, and the analysis of the revenue effect of the GMT is absent.

After characterizing the Nash equilibrium of the tax competition game, we examine the long-run revenue effects of the GMT. As in the short run, the GMT reduces the true tax rate differential between two countries and always benefits the large country. In contrast, the revenue effect for the small country is more subtle. We show that even a marginal GMT reform (with the minimum rate marginally above the small country's initial tax rate) may harm it. This may happen when the asymmetry between two countries is small and the profit shifting cost is intermediate. The key insight is that in this case the marginal reform induces both countries to undercut the minimum so that the profit shifted to the small country jumps *discontinuously* to zero. Since the small country attracts considerable paper profits absent the GMT, the revenue loss from eliminating profit shifting can outweigh the increased taxation on true profits generated by real economic activities. Furthermore, we provide conditions for the Pareto-improving non-marginal tax reform. When the carve-out rate is not too small, the GMT rate is not very high and profit shifting is not very sensitive to the minimum, the GMT can benefit the small country by increasing the taxation of both true profit and shifted profit.

Our paper tries to fill the gaps in the emerging theoretical works on the GMT. First, we take into account the real investment responses of the MNE. In most theoretical GMT literature, firms' profits are assumed to be fixed and independent of tax rates so that only profit shifting behavior is considered. This assumption implies the adoption of a pure profit tax with full tax deductibility of costs, which is at odds with most countries' corporate tax systems. In contrast, our model allows for the partial deductibility of capital costs such that countries' tax policies affect the MNE's decision on both profit shifting and real investment. As is discussed below, partial deductibility creates scope for countries to gain tax revenue by incentivizing affiliates to increase investments. In this regard, our paper can be related to Chen and Hindriks (2023), who analyze the effects of tax deductibility in a model of tax competition with two countries and a tax haven. They derive conditions under which pure profit tax is superior (inferior) to turnover tax and investigate the optimal deductibility rate in the profit shifting context. In our paper, the (partial) deductibility rate is fixed and our focus is on the effects of the GMT rate and carve-out rate. Second, we capture the SBIE and QDMTT in the tax competition game. The SBIE is a key feature of Pillar Two but is largely ignored in the existing theoretical literature. Only a few papers theoretically investigate the effects of the SBIE (see Devereux et al., 2021, 2022; Schjelderup and Stähler, 2023), whereas the strategic interactions between countries' tax rates are overlooked in these works. Due to the SBIE, either increasing the minimum rate in the short run or setting tax rate below the minimum in the long run can exert investment incentives, while doing so also increases the top-up tax rate and incurs a larger revenue loss (see Sections 3 and 4 for details). This is the key trade-off in our analysis, which determines the short-run revenue effect of the GMT and reshapes the tax competition game in the long run. Moreover, our results are comparable with traditional minimum taxation literature. When all costs are tax deductible (which is equivalent to the assumption of fixed profits), investments in each country are undistorted at the initial equilibrium. The aforementioned tax policies fail to raise the affiliate's GloBE income through investment incentives, but only causes a larger revenue loss. Consequently, the GMT always harms the small country in the short run. In the long run, undercutting the minimum is a strictly dominated strategy for each country. Therefore, the GMT under Pillar Two works in the same way as "a constraint that no tax rate may be set below the minimum level". In this sense, the traditional minimum taxation model can be regarded as a special case in our paper.

The rest of the paper proceeds as follows. In Section 2, we present the model and analyze the equilibrium before the GMT is introduced. Section 3 analyzes the short-run effect of introducing the GMT. In Section 4, we characterize the Nash equilibrium of the tax competition game and investigate the long-run effects of the GMT. Section 5 summarizes our results.

2. The model

Consider two asymmetric countries, labelled by 1 and 2, that form a small part of the world. Each country hosts an affiliate of a representative multinational enterprise (MNE). Each affiliate produces a homogenous good according to a decreasing returns to scale technology $f_i(k_i)$, where k_i is the capital employed by affiliate i. Decreasing returns to scale in production imply the existence of a fixed factor (e.g., entrepreneurial services) that generates economic rents. In Appendix E, we briefly present the extended model that includes labor. Output is sold at the world market at a price normalized to unity. The two affiliates pay the (exogenously given) world interest rate r for per unit of capital use. For most corporate tax systems, the capital cost may not be fully tax deductible, since countries only allow the MNE to deduct the cost financed by debt but not by equity. Denote by $\mu \in [0,1)$ the fraction of capital cost that can be deducted from the corporate tax base. Although we mainly focus on the case of partial deductibility, our results also hold true for $\mu = 1$. As we will present in Sections 3 and 4, a pure profit tax with full deductibility – which is the underlying assumption in the existing minimum tax literature – can be regarded as a special case of our model. Since the main purpose of the paper is to investigate the effects of GMT, we impose a few structure on the production technology by specifying a quadratic production function:

$f_i(k_i) := \alpha_i k_i - \frac{k_i^2}{2}$ with $\alpha_1 > \alpha_2 > r$. With this set-up, country 1 (country 2) is the large country (small country) in the sense that country 1 has a lager marker size and a less elastic tax base.

The MNE can shift profits between two affiliates in order to minimize its tax liability. We abstract from the specific channels through which the MNE reallocates profits and denote the profit shifting level by g. If $g > 0$ ($g < 0$), then the MNE shifts profit to (from) country 2 and so the tax base in country 2 goes up (down). Profit shifting is costly for the MNE and involves a non-deductible concealment cost with the form $h(g) := \frac{\delta}{2} g^2$, $\delta > 0$. The concealment cost approach is widely used in the profit shifting literature (e.g., Kind et al., 2005; Devereux et al., 2008; Mardan and Stimmelmayr, 2018; Janeba and Schjelderup, 2023). The tax rate of country i ($i = 1, 2$) is denoted by t_i. The GloBE income (i.e., taxable profit) of affiliate i is $\pi_i = f_i(k_i) - \mu r k_i + (-1)^i g$.

We consider a two-stage tax competition game. In the first stage, two countries choose tax rates simultaneously and non-cooperatively to maximize their own tax revenues. In the second stage, the MNE chooses real investment and profit shifting level to maximize total after-tax profits. The assumption of revenue-maximizing governments is frequently used in the international taxation literature (e.g., Johannesen, 2010; Mardan and Stimmelmayr, 2018; Koethenbuerger et al., 2019; Janeba and Schjelderup, 2023; Haufler and Kato, 2024). It reflects the desire to increase tax payments from MNEs and is line with the objective of the OECD/G20 Inclusive Framework on BEPS. Tax revenue considerations play a very important role in the taxation of MNEs, due to the low taxes that many large MNEs are paying. In reality, profit shifting causes severe revenue shortfalls and raises equality-of-treatment concerns in many countries, which motivates politicians to stabilize the revenue from corporate taxes.

Without the GMT, the MNE's after-tax profit is:

$$\Pi = \sum_{i=1}^{2} \left[(1 - t_i)\left(f_i - \mu r k_i + (-1)^i g\right) - (1 - \mu) r k_i \right] - \frac{\delta}{2} g^2 .$$

Solving the MNE's profit maximization leads to:

$$k_i = \max\left\{ \frac{\alpha_i (1 - t_i) - (1 - \mu t_i) r}{1 - t_i}, 0 \right\}, \quad i = 1, 2, \tag{1}$$

$$g = (-1)^i \min\left\{ \frac{t_j - t_i}{\delta}, f(k_j) - \mu r k_j \right\} \quad if \quad t_j \geq t_i . \tag{2}$$

From (1), for interior solution with $k_i > 0$, $\frac{\partial k_i}{\partial t_i} < 0$. Intuitively, a higher tax rate increases the tax burden of the affiliate and so discourages real investment. From (2), the MNE shifts profit from high-tax country to low-tax country. In particular, the high-tax affiliate reports zero taxable profit if the tax differential is sufficiently large. (1) and (2) replicate the standard results in the profit shifting literature.

The tax revenue function of country i reads:

$$R_i(t_i,t_j)=t_i\pi_i=t_i\left(f_i-\mu rk_i+(-1)^i g\right). \tag{3}$$

Due to the complexity inherent in partial tax deductibility and asymmetry settings, the model has no closed-form solution for all $\mu\in[0,1)$. In what follows, we assume that $\frac{\alpha_1-r}{\alpha_1-\mu r}\le 2\frac{\alpha_2-r}{\alpha_2-\mu r}$ (or equivalently, $\underline{\alpha}_2:=\frac{r\left[\alpha_1(2-\mu)-\mu r\right]}{\alpha_1+r-2\mu r}\le\alpha_2<\alpha_1$). It means that country 2 is not "too small" relative to country 1. As shown in Appendix A1, under this assumption country 2 has no incentive to become a tax haven with shifted profits being its only tax base. Denote by t_i^N country i's equilibrium tax rate absent the GMT. Then we can present the following:

Lemma 1. *Before the introduction of the GMT,*

(i) *there exists a unique Nash equilibrium with* $t_i^N\in\left(0,\frac{\alpha_i-r}{\alpha_i-\mu r}\right)$, $i=1,2$;

(ii) *at equilibrium, the small country always undercuts the large country, i.e.,* $t_1^N>t_2^N$.

Proof. See Appendices A1 and A3.

The lemma establishes the existence and uniqueness of the Nash equilibrium absent the GMT. There are capital investments in both countries at equilibrium, while the small country sets a lower tax rate to attract profits from the large country. Intuitively, under equal tax rates $t_1=t_2$ the small country has a higher tax base elasticity (in absolute value) than the large country (i.e., $-\frac{\partial\pi_2}{\partial t_2}\frac{t_2}{\pi_2}>-\frac{\partial\pi_1}{\partial t_1}\frac{t_1}{\pi_1}$). Hence, the small country's tax base is more sensitive to tax rate changes, which forces it to tax less.

Remark 1. Using (A4) and Lemma 1(ii) leads to $\frac{\partial t_1^N}{\partial\delta}>0$, i.e., the equilibrium tax rate of country 1 strictly increases with the profit shifting cost. Denote by $\bar{t}_1:=\lim_{\delta\to+\infty}t_1^N(\delta)$ the (least) upper bound for t_1^N. In contrast, the effect of profit shifting cost on country 2's equilibrium tax rate is ambiguous. Numerical simulations indicate that t_2^N may *decrease* with δ when δ is large.

Remark 2. When $\delta \to +\infty$, the profit shifting is eliminated so that the positive tax externality vanishes. In this limiting case, by setting the efficient tax rate $\overline{t}_1$, country 1 can achieve the first-best solution $\overline{R}_1 := \lim_{\delta \to +\infty} R_1^N(t_1^N(\delta), t_2^N(\delta))$ absent the GMT. Formally, we have the following:

$$R_1(t_1^N, t_2^N) = \varphi_1(t_1^N) - \frac{t_1^N\left(t_1^N - t_2^N\right)}{\delta} < \varphi_1(t_1^N) < \varphi_1(\overline{t}_1) = \overline{R}_1, \tag{4}$$

where $\varphi_1(t_1^N) := t_1^N\left(f_1(k_1^N) - \mu r k_1^N\right)$ denotes the revenue from taxing affiliate 1's true profit generated by substantive activities.

(4) indicates that $\overline{R}_1$ is the upper bound for country 1's equilibrium revenue without the GMT. Nevertheless, after introducing the GMT, country 1 can receive an equilibrium revenue larger than $\overline{R}_1$ when the minimum is sufficiently high and the carve-out is not very small (see Section 4 and Appendix 7.4).

3. Short-run analysis of the GMT: fixed tax rates

After introducing the GMT, affiliate i's GloBE income π_i is targeted for additional taxation (i.e., top-up tax) when country i's tax rate falls below the GMT rate t_m. As in the previous minimum taxation literature (e.g., Kanbur and Keen, 1993; Wang, 1999; Keen and Konrad, 2013), we assume throughout the paper that the GMT rate lies between the initial tax rates of two countries, i.e., $t_m \in \left(t_2^N, t_1^N\right)$. The top-up tax rate for affiliate i is $\max\{t_m - t_i, 0\}$, which is the difference between the minimum rate and the host country's tax rate. The SBIE allows the MNE to tax-deduct a fraction of the capital stock from the GloBE income, which reduces the top-up tax liability of the affiliate with substantive activity. The GloBE income after the deduction of the SBIE is the excess profit $E_i = \pi_i - \sigma k_i$, where σ denotes the carve-out rate and σk_i is the SBIE. The excess profit constitutes the tax base for the top-up tax. So the top-up tax owed by affiliate i is $\max\{t_m - t_i, 0\} \cdot (\pi_i - \sigma k_i)$. As mentioned in Section 1, an MNE's tax liability is the same, whether the top-up tax is collected by the headquarters country (under the IIR) or by the host country (under the QDMTT). The low-tax country has very strong incentives to implement the QDMTT, because otherwise it would leave "money on the table" for other countries without changing the MNE's tax burden (see also Perry, 2023). In light of this, we assume throughout the paper that each country adopts the QDMTT to collect top-up taxes from the affiliate that is recording undertaxed profits in its territory.

In the short run, two countries' tax rates remain unchanged, while the MNE is able to adjust the decisions on investment and profit shifting. This reflects the fact that governments usually need some time to adjust tax rates in response to the tax reform.

The after-tax profit of the MNE reads:

$$\begin{aligned}\Pi^m &= \sum_{i=1}^{2}\left[(1-t_i^N)(\underbrace{f_i-\mu rk_i+(-1)^i g}_{GloBE\ income})-(1-\mu)rk_i\right]-\underbrace{(t_m-t_2^N)(f_2-\mu rk_2+g-\sigma k_2)}_{top-up\ tax}-\frac{\delta}{2}g^2 \\ &=(1-t_1^N)(f_1-\mu rk_1-g)-(1-\mu)rk_1+(1-t_m)(f_2-\mu rk_2+g)-(1-\mu)rk_2 \\ &\quad+\underbrace{(t_m-t_2^N)\sigma k_2}_{tax\ saved\ from\ the\ SBIE}-\frac{\delta}{2}g^2\end{aligned}, \qquad (5)$$

where superscripts m represents the introduction of the GMT.

As shown by (5), with the additional GloBE top-up tax, affiliate 2's GloBE income is now taxed at the minimum rate t_m. On the other hand, the SBIE reduces the exposure to the minimum tax so that the tax amount of $(t_m-t_2^N)\sigma k_2$ can be saved by affiliate 2.

The first-order conditions of the profit maximization are:

$$\frac{\partial\Pi^m}{\partial k_1}=(1-t_1^N)(f_1'-\mu r)-(1-\mu)r=0 \Rightarrow k_1^m=\frac{\alpha_1\left(1-t_1^N\right)-(1-\mu t_1^N)r}{1-t_1^N}=k_1^N, \qquad (6)$$

$$\frac{\partial\Pi^m}{\partial k_2}=(1-t_m)(f_2'-\mu r)-(1-\mu)r+\sigma(t_m-t_2^N)\le 0 \Rightarrow$$

$$k_2^m=\max\left\{\frac{\alpha_2(1-t_m)-(1-\mu t_m)r+(t_m-t_2^N)\sigma}{1-t_m},0\right\}, \qquad (7)$$

$$\frac{\partial\Pi^m}{\partial g}=t_1^N-t_m-\delta g=0 \Rightarrow g^m=\frac{t_1^N-t_m}{\delta}. \qquad (8)$$

Notably, for a high carve-out rate, affiliate 2's excess profit E_2 will be negative so that the GMT is immaterial. Since the main focus of this paper is the effects of the GMT, we restrict attention to positive excess profit and assume that the short-run carve-out rate satisfies $\sigma\le\frac{\alpha_2\left(1-t_m\right)+r\left(1-\left(2-t_m\right)\mu\right)}{2-t_2^N-t_m}=:\bar{\sigma}^S(t_m)$, where superscript S represents the short-run analysis. As shown in Appendix B.1, this assumption ensures that $E_2>0$.

The GMT is inactive for affiliate 1, since country 1's tax rate is above the minimum. As shown by (6), the capital investment in country 1 is unaffected. In contrast, increasing the GMT rate has two opposite effects on the capital investment of affiliate 2. Specifically, for interior solution with $k_2^m>0$, differentiating (7) with respect to t_m yields:

$$\frac{\partial k_2^m}{\partial t_m}=\underbrace{\frac{\partial}{\partial t_m}\left[\frac{\alpha_2(1-t_m)-(1-\mu t_m)r}{1-t_m}\right]}_{tax\ burden\ effect}+\underbrace{\frac{\partial}{\partial t_m}\left[\frac{(t_m-t_2^N)\sigma}{1-t_m}\right]}_{tax\ incentive\ effect}=\frac{\sigma\left(1-t_2^N\right)-r\left(1-\mu\right)}{\left(1-t_m\right)^2}.$$

The first team on the right-hand side is negative. A higher GMT rate increases the taxation on affiliate 2's GloBE income and tends to reduces the real investment in country 2. We refer to it as the "tax burden effect". The second term is positive and captures the "tax incentive effect". A higher GMT rate means that more taxes can be saved due to the deduction of the SBIE (cf. (5)), which incentivizes affiliate 2 to employ more capital. Moreover, a higher carve-out rate makes the tax incentive effect stronger, since it leads to a larger SBIE. When $\sigma>\frac{r(1-\mu)}{1-t_2^N}$ ($\sigma<\frac{r(1-\mu)}{1-t_2^N}$), the second (first) effect dominates such that country 2's investment level increases (decreases) with the minimum rate.

(8) indicates that the GMT reduces the profit shifting of the MNE. From (5), the MNE's profit shifting decision depends on the difference between the tax rates on two affiliates' GloBE incomes (taking into account the top-up tax paid by the low-tax affiliate). Henceforth, we refer to it as the *true* tax rate differential between two countries. After introducing the GMT, the tax rate on affiliate 2's GloBE income increases from t_2^N to t_m. So the true tax differential narrows down and profit shifting decreases.

The short-run tax revenues of two countries are:

$$R_1^m=t_1^N(f_1-\mu rk_1-g), \tag{9}$$

$$\begin{aligned}R_2^m&=t_2^N(f_2-\mu rk_2+g)+(t_m-t_2^N)(f_2-\mu rk_2+g-\sigma k_2)\\&=t_m(f_2-\mu rk_2+g)-\underbrace{(t_m-t_2^N)\sigma k_2}_{loss\ from\ the\ deduction\ of\ SBIE}.\end{aligned} \tag{10}$$

As shown by (10), the introduction of the GMT does not bring country 2's total taxes to the minimum rate t_m. The tax amount (i.e., $(t_m-t_2^N)\sigma k_2$ in (5)) saved by affiliate 2 due to the SBIE corresponds to a revenue loss for country 2.

The following proposition presents the revenue effect of the GMT when countries' tax rates are fixed.

Proposition 1. *In the short run where countries' tax rates are fixed,*

(i) *the large country benefits from the GMT;*

(ii) *introducing a GMT with minimum rate marginally higher than the small country's equilibrium tax without the GMT increases (reduces) the small country's tax revenue if $t_2^N>t_2^*$ ($t_2^N<t_2^*$);*

(iii) *(the non-marginal reform) assuming that the small country's revenue function is quasiconcave in* t_m*, then the GMT always reduces its tax revenue if* $t_2^N < t_2^*$*,*

where $t_2^* := 1 - \sqrt{\dfrac{r(1-\mu)}{\alpha_2 - \mu r}}$.

Proof. See Appendix A4.

Intuitively, the introduction of GMT does not change the investment level in country 1 but reduces the outward profit shifting. So the GMT raises the large country's tax revenue. In contrast, the revenue effect of the GMT is ambiguous for the small country. Increasing the minimum rate marginally above the initial tax rate of country 2 affects its tax revenue in the following way:

$$\left.\frac{\partial R_2^m}{\partial t_m}\right|_{t_m = t_2^N} = \underbrace{\frac{t_2^N (f_2' - \mu r)\sigma}{-(1-t_2^N) f_2''}}_{\text{gain from tax incentive}} - \underbrace{\sigma k_2^N}_{\text{loss from SBIE}} .$$

The first term is positive and captures the revenue gain from investment incentives. Recall that due to the SBIE, a higher GMT rate has a tax incentive effect, which exerts investment incentives for affiliate 2, increases its GloBE income and thus raises country 2's revenue. The second term is negative. All else equal, a higher GMT rate increases the top-up tax rate and incurs a larger revenue loss for country 2 due to the deduction of SBIE (cf. (10)). Moreover, for a higher initial tax rate t_2^N, the tax incentive effect arising from the marginal rise of the minimum is stronger, while country 2's capital stock and the revenue loss from the SBIE are smaller. Therefore, the revenue gain generated by the marginal tax reform can dominate if and only if country 2's initial tax rate is high.

In the special case of pure profit tax ($\mu = 1$), the threshold $t_2^* = 1$. Then by the proposition, the marginal tax reform always harms the small country. For a pure profit tax, all costs are deductible and investment in each country is undistorted at the initial equilibrium, with the marginal product of capital equaling the exogenous interest rate. Consequently, a higher GMT rate fails to raise affiliate 2's GloBE income through the investment incentives. The marginal reform only causes a larger revenue loss from the deduction of SBIE and thus reduces the small country's revenue.

Part (iii) further shows the global property of the GMT for any minimum rate on the interval $\left(t_2^N, t_1^N\right)$, and is more relevant to practical policies. It states that the GMT generally reduces the short-run revenue of the small country if its initial tax rate is low. In Appendix C, we provide sufficient conditions for the quasiconcavity of $R_2^m(t_m)$. Specifically, if $\sigma \le \frac{r(1-\mu)}{1-t_2^N}$ or if $\frac{r(1-\mu)(2+t_2^N)}{(1-t_2^N)(2-t_2^N)} \le \sigma \le \bar{\sigma}^S(t_1^N)$, then $R_2^m(t_m)$ is quasiconcave in t_m for all $t_m \in (t_2^N, t_1^N)$,.

Lastly, the following lemma reveals how the profit shifting cost affects the comparison of t_2^N and t_2^*.

Lemma 2. *There exists a threshold of the concealment cost parameter δ^* such that $t_2^N > t_2^*$ ($t_2^N \le t_2^*$) if $\delta > \delta^*$ ($\delta \le \delta^*$).*

Proof. See Appendix A5.

Unlike country 1, country 2's equilibrium tax rate does not necessarily monotonically increase with the concealment cost (see Remark 1). However, t_2^* must intersect $t_2^N(\delta)$ at the upward-sloping part of $t_2^N(\delta)$ (see Appendix A5). This property directly leads to the lemma.

It immediately follows from Proposition 1 and Lemma 2 that a marginal reform of the GMT will raise (reduce) the small country's short-run revenue under high (low) profit shifting cost. Moreover, assuming the quasiconcavity of the small country's revenue function, then introducing a GMT with minimum rate lying between two countries' initial tax rates always harms the small country in low concealment cost environments.

4. Long-run analysis: tax competition

In the long run, both the MNE and the governments adjust their strategies in response to the GMT. In the first stage, two countries simultaneously choose their tax rates, while taking the minimum and carve-out rate as given and anticipating the MNE's responses to their tax choices. In the second stage, the MNE chooses capital investment in each country and the profit shifting level. In the long-run analysis, we assume that the carve-out rate $\sigma \in (\underline{\sigma}, \bar{\sigma}]$, where $\underline{\sigma} := \frac{(1-\mu t_m)r - \alpha_2(1-t_m)}{t_m}$ and $\bar{\sigma} := \frac{\alpha_2(1-t_m) + r[1+(t_m-2)\mu]}{2-t_m}$. As is shown below, the lower bound on the carve-out rate ensures that the small country can attract some investment by setting a low tax rate. It rules out the case where country 2 becomes a tax haven with $k_2 \equiv 0$, $\forall t_2 \in [0,1]$. In Appendix D, we analyze $\sigma \le \underline{\sigma}$ (which corresponds to a high minimum together with an overly small carve-out) and show that there exists a continuum of Nash equilibria in this case. The upper bound on the carve-out ensures that the excess profit is positive when each country sets its tax below the GMT rate, i.e., $E_i := \pi_i - \sigma k_i \geq 0$, $\forall t_i \in [0, t_m)$, $\forall i \in \{1,2\}$ (see Appendix B.2). It rules out the case where the minimum tax is inconsequential for country i due to negative excess profit.

4.1. The equilibrium analysis

We first investigate the situation where one country's tax rate is below the GMT rate. Suppose that country i's tax rate $t_i < t_m$. Then the after-tax profit of the MNE reads:

$$\begin{aligned}\Pi^m =& \left(1-t_m\right)\left(f_i - \mu r k_i + (-1)^i g\right) - (1-\mu) r k_i + \underbrace{(t_m - t_i)\sigma k_i}_{\text{tax saved from the SBIE}} + \left(1-t_j\right)\left(f_j - \mu r k_j + (-1)^j g\right) \\ & - (1-\mu) r k_j - \mathbf{1}_j \left(t_m - t_j\right)\left(f_j - \mu r k_j + (-1)^j g - \sigma k_j\right) - \frac{\delta}{2} g^2\end{aligned}, \quad (11)$$

where indicator variable $\mathbf{1}_j$ equals unity if $t_j < t_m$ and zero otherwise.

Solving the profit maximization of the MNE yields:

$$k_i^m = \max\left\{\frac{\alpha_i(1-t_m) - (1-\mu t_m) r + (t_m - t_i)\sigma}{1-t_m}, 0\right\}, \quad (12)$$

$$k_j^m = \begin{cases} \max\left\{\dfrac{\alpha_j\left(1-t_j\right) - (1-\mu t_j) r}{1-t_j}, 0\right\} & if \quad t_j \geq t_m \\ \max\left\{\dfrac{\alpha_i(1-t_m) - (1-\mu t_m) r + (t_m - t_i)\sigma}{1-t_m}, 0\right\} & if \quad t_j < t_m \end{cases}, \quad (13)$$

$$g^m = \begin{cases} (-1)^i \min\left\{\dfrac{t_j - t_m}{\delta}, f_j(k_j^m) - \mu r k_j^m\right\} & if \quad t_j \geq t_m \\ 0 & if \quad t_j < t_m \end{cases}. \quad (14)$$

From (12), for interior solution with $k_i^m > 0$, we have $\frac{\partial k_i^m}{\partial t_i} < 0$ and $\frac{\partial k_i^m}{\partial \sigma} > 0$. The intuition is straightforward. Due to the deduction of SBIE, affiliate i can reduce its tax payments by $(t_m - t_i)\sigma k_i$, as presented by (11). Hence, either a lower tax rate of country i or a higher carve-out rate increases the tax incentives and raises the capital affiliate i employs. In particular, by reducing its tax rate down to zero, country i can gain a maximum level of investment with $\bar{k}_i := \frac{\alpha_i(1-t_m) - (1-\mu t_m) r + t_m \sigma}{1-t_m}$. Under the assumption $\sigma > \underline{\sigma}$, we have $\bar{k}_2 > 0$, which means that the small country is able to attract inward investment by setting a low corporate tax rate. Combining (13) and (14) indicates that for all $t_i < t_m$, the profit shifting of the MNE is *independent* of country i's tax choice. Whenever country i sets its tax rate below the minimum, the top-up tax is triggered so that affiliate i's GloBE income is always taxed at t_m (cf. (11)). Country i cannot attract more paper profits from country j by further lowering its tax rate. So the GMT places a floor on the taxation of GloBE incomes. It reduces countries' incentives to compete for paper profits and mitigates the corporate tax competition. Moreover, when both countries' tax rates are below the GMT rate, two affiliates' GloBE incomes are taxed at the same rate of t_m, so that the true tax differential vanishes. In this case, profit shifting is irrelevant to the MNE's total tax liability and can be eliminated.

Under the QDMTT, Country i's tax revenue function is:

$$\begin{aligned} R_i^m(t_i,t_j) &= t_i\left(f_i - \mu r k_i + (-1)^i g\right) + \left(t_m - t_i\right)\left(f_i - \mu r k_i + (-1)^i g - \sigma k_i\right) \\ &= t_m\left(f_i - \mu r k_i + (-1)^i g\right) - \underbrace{\left(t_m - t_i\right)\sigma k_i}_{\text{loss from the deduction of SBIE}} \end{aligned} . \tag{15}$$

The following lemma presents the effect of one country's tax rate when it is below the minimum rate.

Lemma 3. *Suppose that country i's tax rate is below the GMT rate, i.e., $t_i < t_m$. Then country i's tax rate affects its tax revenue in the following way:*

(i) *For $t_m \le t_i^*$, country i's revenue strictly increases with t_i for all $t_i \in [0, t_m)$;*

(ii) *For $t_m > t_i^*$ and $\underline{\sigma} < \sigma \le \sigma_i^m$, country i's revenue decreases with t_i for all $t_i \in [0, t_m)$;*

(iii) *For $t_m > t_i^*$ and $\max\left\{\underline{\sigma}, \sigma_i^m\right\} < \sigma \le \bar{\sigma}$, country i's revenue increases (decreases) with t_i when $t_i \in \left[0, \left(1 - \frac{\sigma_i^m}{\sigma}\right) t_m\right)$ ($t_i \in \left(\left(1 - \frac{\sigma_i^m}{\sigma}\right) t_m, t_m\right)$),*

where $t_i^* := 1 - \sqrt{\dfrac{r(1-\mu)}{\alpha_i - \mu r}}$ *and* $\sigma_i^m := \dfrac{r\left(1 - 2\mu t_m + \mu t_m^2\right) - \alpha_i\left(1 - t_m\right)^2}{t_m\left(2 - t_m\right)}$.

Proof. See Appendix A6.

Part (i) of Lemma 3 implies that one country will never set its tax rate below the minimum when the minimum rate is low. Otherwise, as shown by part (ii) and (iii), it still has incentives to keep a tax rate below the minimum, even possibly at zero. The intuition is as follows. Given (15), starting from the minimum rate, a marginal decrease in one country's tax rate affects its revenue in the following way:

$$-\left.\frac{\partial R_i^m}{\partial t_i}\right|_{t_i=t_m}=\underbrace{-t_m(f_i'-\mu r)\frac{\partial k_i}{\partial t_i}}_{>0}-\sigma k_i\,. \tag{16}$$

The first effect in (16) is positive. From (12), a lower tax rate of country i incentivizes affiliate i to employ more capital. This increases affiliate i's GloBE income and tends to raise country i's tax revenue. The second effect in (16) is negative. Reducing country i's tax rate increases the top-up tax rate and thus causes a larger revenue loss for country i due to the deduction of SBIE. Furthermore, a higher t_m renders real investment more sensitive to the tax rate change (i.e., $\frac{\partial}{\partial t_m}\left|\frac{\partial k_i}{\partial t_i}\right|>0$) and so makes the first effect stronger. Therefore, when t_m is high, the first effect prevails so that one country can increases its tax revenue by undercutting the minimum. For a low t_m, the second effect dominates so that any tax choice below the minimum is a strictly dominated strategy.

We now analyze the role of carve-out rate. For $t_m > t_i^*$, assume that country i sets its tax rate below the minimum. Recall from (12) that either a higher carve-out rate or a lower tax rate promotes the investment. So when the carve-out rate decreases, country i has to reduce its tax rate to offset the negative effect on capital investment in order to maintain the revenue-maximizing capital level with $k_i^m=\frac{\alpha_i-r}{2-t_m}$ (see Appendix A6). In particular, for a very small carve-out rate with $\sigma\le\sigma_i^m$, country i has to reduce its tax rate down to zero to maximize its revenue.

Notably, it directly follows from Lemma 3(ii) and (iii) that: for $t_m > t_i^*$ and $t_j\in[0,1]$, $\arg\max_{t_i\in[0,t_m]} R_i^m(t_i,t_j)=\max\left\{0,\left(1-\frac{\sigma_i^m}{\sigma}\right)t_m\right\}=:\tilde{t}_i$. Denote by t_i^m the Nash equilibrium tax rate of country i after the GMT is introduced. We can establish the following:

Proposition 2. *After the introduction of the GMT, two countries set equilibrium tax rates in the following way:*

- *(i)* *For $t_m\le t_2^*$, $t_1^m=t_1(t_m)$, $t_2^m=t_m$;*
- *(ii)* *For $t_2^*<t_m\le t_1^*$, $t_1^m=t_1(t_m)$, $t_2^m=\tilde{t}_2$;*
- *(iii)* *For $t_m>t_1^*$, two countries' equilibrium taxes are ($t_1^m=t_1(t_m)$, $t_2^m=\tilde{t}_2$) when $R_1(t_1(t_m),t_m)>R_1^m(\tilde{t}_1,\tilde{t}_2)$, and ($t_1^m=\tilde{t}_1$, $t_2^m=\tilde{t}_2$) when $R_1(t_1(t_m),t_m)<R_1^m(\tilde{t}_1,\tilde{t}_2)$; both ($t_1(t_m)$, $\tilde{t}_2$) and ($\tilde{t}_1$, $\tilde{t}_2$) are equilibrium tax rates when $R_1(t_1(t_m),t_m)=R_1^m(\tilde{t}_1,\tilde{t}_2)$.*
- *(iv)* *A sufficient condition for ($\tilde{t}_1$, $\tilde{t}_2$) to be Nash equilibrium is: $t_m>t^{**}$ and $\max\{\underline{\sigma},\sigma_1^m\}<\sigma\le\bar{\sigma}$,*

where $R_1(t_1(t_m),t_m)=\varphi_1(t_1(t_m))-\dfrac{t_1(t_m)[t_1(t_m)-t_m]}{\delta}$,

$$R_1^m(\tilde{t}_1,\tilde{t}_2)=\begin{cases}\dfrac{(\alpha_1-r)^2}{2(2-t_m)} & if\quad \sigma>\sigma_1^m\\ \dfrac{(\alpha_1-r)^2}{2(2-t_m)}-\dfrac{(\sigma_1^m-\sigma)^2(2-t_m)t_m^2}{2(1-t_m)^2} & if\quad \sigma\le\sigma_1^m\end{cases}$$ *, and* t^{**} *is determined by* $\dfrac{(\alpha_1-r)^2}{2(2-t^{**})}=\overline{R}_1$

with $t^{**}\in(t_1^*,\overline{t}_1)$.

Proof. See Appendix A7.

Remark 3. When $t_m>t_1^*$ and $R_1(t_1(t_m),t_m)=R_1^m(\tilde{t}_1,\tilde{t}_2)$, the two Nash equilibria are Pareto-rankable. Specifically, ($t_1(t_m)$, $\tilde{t}_2$) Pareto-dominates ($\tilde{t}_1$, $\tilde{t}_2$). The two equilibria involve the same investment level in country 2. However, country 2 has additional revenue at the former equilibrium by taxing the profit shifted from country 1, since the two affiliates' GloBE incomes are taxed at different rates. By contrast, the profit shifting is eliminated at the latter equilibrium. So we have: $R_2^m(\tilde{t}_2,t_1(t_m))>R_2^m(\tilde{t}_2,\tilde{t}_1)$.

Remark 4. An immediate consequence of Proposition 2 is that the GMT reduces the MNE's profit shifting at equilibrium. When $t_m\le t_2^*$, the GMT binds country 2 and the tax rate differential is $t_1(t_m)-t_m$. When $t_m>t_2^*$, country 2 undercuts the minimum and triggers the top-up tax so that affiliate 2's GloBE income is still taxed at t_m (cf. (11)). The true tax rate differential is $t_1(t_m)-t_m$ if country 1 sets the tax rate $t_1(t_m)$, and zero if country 1 also undercuts the minimum. Furthermore, $t_1(t_m)-t_m$ strictly decreases with the minimum rate, since $t_1'(t_m)<1$ by (A1). So the GMT always narrows the true tax differential at equilibrium and curbs profit shifting.

Our results are substantially different from the traditional minimum taxation literature which treats minimum tax as a lower bound imposed on each country's tax rate. In such settings, the minimum tax always binds the low-tax country, inducing the high-tax country to set tax rate along the unconstrained best response curve (see Kanbur and Keen, 1993; Keen and Konrad, 2013; Hebous and Keen, 2023). The binding minimum rate is also an implicit assumption in Janeba and Schjelderup (2023), who model the GMT as an increase in the tax haven's tax rate. In our paper, for a pure profit tax ($\mu=1$), the threshold $t_i^*=1$. Then by Proposition 2(i), the GMT is binding for the small country. For each country, the capital investment is undistorted whenever its pure profit tax rate is above the minimum. Then lowering the tax rate marginally below the minimum is unable to alter the affiliate's GloBE income through investment incentives, but only causes a larger revenue loss (cf. (16)). So neither country has incentives to undercut the minimum. In this special case, the GMT under Pillar Two works in the same way as "a constraint that no tax rate may be set below the minimum level".

However, for the general case of partial deductibility ($\mu < 1$), the GMT does not necessarily bind the small country. It is binding only if the minimum rate is low. Otherwise, the small country will set its tax rate below the minimum. The intuition is the following. Starting from a high minimum rate with $t_m > t_2^*$, country 2 can be better off by undercutting the minimum, since the revenue gain from larger real investments outweighs the revenue loss from the deduction of SBIE (see the discussion below Lemma 3). On the other hand, recall that absent the GMT, country 2's tax base is very sensitive to tax rate changes due to the small market size. Consequently, given country 1's equilibrium tax rate, the tax revenue curve of country 2 is downward-sloping for all $t_2 \geq t_m$. Starting from the minimum rate, choosing a higher tax rate always reduces country 2's revenue. So when the minimum rate is above the threshold t_2^*, country 2's best response is to undercut the minimum.

In contrast, the GMT shapes the large country's revenue function in a different way. Since country 1 has a larger market size, its tax base is less sensitive to tax rate changes absent the GMT. Therefore, given country 2's equilibrium tax, country 1's revenue curve is upward-sloping for all $t_1 \in [t_m, t_1(t_m)]$. Starting from the minimum rate, it can be better off by choosing a higher rate $t_1(t_m)$. On the other hand, for a high minimum rate with $t_m > t_1^*$, undercutting the minimum is also beneficial for country 1 due to larger inward investments. This sheds new light on the "conventional wisdom" that countries' revenue functions (i.e., the Laffer curves) are unimodal and quasiconcave. In our paper, when $t_m > t_1^*$, country 1's revenue function $R_1^m(t_1, t_2^m)$ becomes *bimodal* with two peaks and is *non-quasiconcave* in t_1. In this case, country 1 chooses between undercutting the minimum (with the GloBE income taxed at the minimum rate and more inward investments) and setting a high tax rate $t_1(t_m)$ on the GloBE income (at the cost of smaller investment and outward profit shifting), depending on which tax revenue is larger. In particular, when the GMT rate is sufficiently high and the carve-out is not very small, the benefit of attracting larger investments dominates that of levying a higher tax rate so that country 1 will also undercut the minimum and collect top-up taxes (see Proposition 2(iv)).

Notably, one country's equilibrium tax rate is *decreasing* in the GMT rate, whenever it is below the minimum, i.e., $\frac{\partial}{\partial t_m}\left[\left(1-\frac{\sigma_i^m}{\sigma}\right)t_m\right] < 0$. Recall that a higher GMT rate makes capital investment more sensitive to tax rate changes (i.e., $\frac{\partial}{\partial t_m}\left|\frac{\partial k_i}{\partial t_i}\right| > 0$). This increases the benefit of undercutting the minimum and incentivizes the country to reduce its tax rate, even down to zero (if the carve-out rate is small). While country 2's tax rate is continuous in the minimum, gradually increasing the GMT rate may trigger country 1's tax rate to jump *discontinuously* below the minimum rate. In this case, both countries aim at attracting real investment instead of competing for paper profits. In summary, the GMT under Pillar Two will reshape the underlying tax game and the competition pattern between two countries.

4.2. The revenue effects of the GMT

In this subsection, we investigate how the GMT affects countries' tax revenues in the long run. First, we show how the comparison of t_2^N and t_1^* is related to the market-size asymmetry and profit shifting cost.

Lemma 4. *(i) For $\alpha_2 > \alpha_2^*$, there exists a threshold of the concealment cost parameter δ^{**} with $\delta^{**} > \delta^*$ such that $t_2^N > t_1^*$ ($t_2^N \le t_1^*$) if $\delta > \delta^{**}$ ($\delta \le \delta^{**}$); (ii) For $\alpha_2 \le \alpha_2^*$, $t_2^N < t_1^*$ always holds, where $\alpha_2^* := \sqrt{(\alpha_1 - \mu r)\left[2\sqrt{r(1-\mu)(\alpha_1 - \mu r)} - r(1-\mu)\right]} + \mu r \in (\underline{\alpha}_2, \alpha_1)$.*

Proof. See Appendix A8.

Absent the GMT, a reduction in country 2's market size increases the elasticity of its tax base (in absolute value) and thus imposes a downward pressure on its tax rate. When country 2 is sufficiently small (i.e., the market-size asymmetry is sufficiently large), this pressure is so high that country 2's equilibrium tax rate is always below t_1^*. Otherwise, t_1^* intersects $t_2^N(\delta)$ at the upward-sloping part of $t_2^N(\delta)$, which directly leads to part (i) of the lemma.

The following proposition reveals how the GMT affects equilibrium tax revenues after the behavioral adjustments of the MNE and two countries in response to the tax reform.

Proposition 3. *In the long run where countries' tax rates are endogenously determined,*

- *(i) the GMT always increases the large country's tax revenue.*
- *(ii) introducing a GMT with minimum rate marginally higher than the small country's equilibrium tax without the GMT increases the small country's tax revenue when $\alpha_2 \in [\underline{\alpha}_2, \alpha_2^*]$, or when $\alpha_2 \in (\alpha_2^*, \alpha_1)$ and $\delta \le \delta^{**}$. Otherwise, it may reduce the small country's tax revenue.*
- *(iii) (the non-marginal reform) the GMT can raise the small country's tax revenue whenever the carve-out and minimum rate satisfy $\sigma \in [\sigma_2^m, \bar{\sigma}]$, $t_m \le t_1^*$ and $\varepsilon_g(t_m) \in (0,1]$, where $\varepsilon_g(t_m) := -\dfrac{\partial g^m / g^m}{\partial t_m / t_m}$ is the elasticity of profit shifting with respect to the GMT rate (in absolute value).*

Proof. See Appendix A9.

Remark 5. If the small country loses from a marginal GMT reform in the short run, it can be better off in the long run. This result directly follows from Proposition 1(ii), Lemma 2 and Proposition 3(ii). Introducing the marginal reform in an international tax environment with low concealment cost, the small country will experience a transition period of revenue loss. Its tax revenue will be higher than the initial level after countries adjust their tax rates. This implies that it has to take some time until the benefits of the GMT realize for all countries.

The rationale of part (i) is the following. Consider an increase in the GMT rate from t_2^N. When $t_m \leq t_1^*$, country 1 chooses its tax rate along the initial best-response function. Thus, the revenue effect of the GMT rate for country 1 via the adjustment of its equilibrium tax rate cancels out (by the envelope theorem). On the other hand, a higher GMT rate creates a positive externality on country 1, since it raises the tax rate on affiliate 2' GloBE income and reduces the outward profit shifting in country 1. When $t_m > t_1^*$, country 1 chooses between undercutting the minimum and setting a higher rate $t_1(t_m)$, depending on which tax revenue is larger. In this case, the revenue effect of increasing the minimum rate is no less than that in the case $t_m \leq t_1^*$. So introducing the GMT always benefits country 1.

In contrast, the revenue effect for country 2 is more delicate. Part (ii) states that a marginal reform of the GMT increases country 2's long-run revenue either when the market-size asymmetry is *large* or when the profit shifting cost is *low*. The rationale is the following. Consider a marginal increase in the GMT rate from country 2's initial tax rate. For $t_2^N < t_2^*$, the GMT binds country 2 and induces country 1 to set tax rate along the initial best response curve. In this case, our result is the same as the traditional minimum taxation literature which treats the minimum tax as a lower bound imposed on countries' tax rates (see Kanbur and Keen, 1993; Keen and Konrad, 2013; Hebous and Keen, 2023). Absent the GMT country 2's revenue is maximized at t_2^N, which means that the marginal reform has a zero first-order effect on its equilibrium revenue (i.e., $\left.\frac{\partial R_2(t_m, t_1(t_m))}{\partial t_2}\right|_{t_m = t_2^N} = 0$). But it induces country 1 to increase tax rate due to the strategic complementarity (i.e., $t_1'(t_m) > 0$ by (A1)), which in turn imposes a positive externality on country 2's revenue. For $t_2^* \leq t_2^N \leq t_1^*$, country 2 undercuts the minimum and promotes the real investment to gain a higher tax revenue, while country 1 still chooses its best response $t_1(t_m)$. Consequently, the revenue effect of the marginal reform for country 2 is no less than that in the case $t_2^N < t_2^*$. In summary, the marginal GMT reform benefits country 2 when $t_2^N \leq t_1^*$ (or equivalently, by Lemma 4, when $\alpha_2 \leq \alpha_2^*$ or when $\alpha_2 > \alpha_2^*$ and $\delta \leq \delta^{**}$).

However, the above argument does not necessarily hold for $t_2^N > t_1^*$ (or equivalently, by Lemma 4, for $\alpha_2 > \alpha_2^*$ and $\delta > \delta^{**}$). Indeed, when the asymmetry between two countries is *small* and the profit shifting cost is *intermediate*, even a marginal reform of the GMT under Pillar Two may harm the low-tax country. This is substantially different from the previous minimum taxation literature. To explain the underlying intuition, we rewrite country 2's equilibrium revenue as follows:

$$R_2^m(t_2^m, t_1^m) = \underbrace{t_m\left(f_2 - \mu r k_2\right) - \left(t_m - t_2^m\right)\sigma k_2}_{\text{taxation on true profit}} + \underbrace{t_m g^m(t_m)}_{\text{taxation on shifted profit}} .$$

When $t_2^N > t_1^*$ and $R_1^m(\tilde{t}_1, \tilde{t}_2)\big|_{t_m = t_2^N} > R_1(t_1^N, t_2^N)$, a marginal increase in the GMT rate from t_2^N induces both countries to undercut the minimum. The marginal reform increases the taxation on the true profit generated by substantive activities. However, the true tax rate differential vanishes so that the profit shifted to country 2 jumps *discontinuously* from $\frac{t_1^N - t_2^N}{\delta}$ to zero. This is distinct from the traditional minimum taxation literature in which the minimum rate binds the small country so that the profit shifting level changes continuously with the minimum rate. When the concealment cost δ is not very large, country 2 attracts considerable paper profits absent the GMT. Then the revenue loss from eliminating profit shifting can dominate the increased taxation on true profits, so that country 2's revenue decreases after introducing the marginal tax reform.

Part (iii) provides (sufficient) conditions for the Pareto-improving non-marginal reform. The intuition is straightforward. For $\sigma \geq \sigma_2^m$, the equilibrium investment level is interior such that country 2's revenue from taxing the true profit is larger than that without the GMT. For $t_m \leq t_1^*$, the GloBE incomes of affiliate 1 and 2 are taxed at $t_1(t_m)$ and t_m, respectively. It rules out the case where both countries undercut the minimum so that profit shifting jumps discretely to zero. When the profit shifting is not sensitive to the minimum rate changes (i.e., $\varepsilon_g(t_m) < 1$), the increase in the minimum rate outweighs the decrease in the inward profit shifting so that country 2's revenue from taxing the shifted profit also increases.

5. Conclusion

This paper has studied how the global minimum tax under Pillar Two of the OECD/G20 Inclusive Framework affects MNEs' behavior and countries' corporate taxes. We take into account partial tax deductibility, the SBIE and the QDMTT in a formal model of tax competition between asymmetric countries. In response to the tax policies, the MNE chooses capital investments and profit shifting to maximize total after-tax profits. Under the QDMTT, the country with tax rate below the minimum will collect top-up taxes from the MNE's affiliate operating in its territory.

Introducing a GMT with minimum rate lying between two countries' initial tax rates can reduce the true tax differentials, curb profit shifting and always raise the large country's tax revenue. The revenue effect for the small country, however, is generally ambiguous. In the short run where countries' tax rates are fixed, due to tax deduction of the SBIE, a higher minimum rate has two opposite effects. On one hand, it means that more taxes can be saved by the low-tax affiliate, which incentivizes the capital investment. On the other hand, it raises the top-up tax rate and thus incurs a larger revenue loss for the small country. We show that the former (latter) effect dominates under high (low) profit shifting cost so that the small country's tax revenue increases (decreases). In the long run where countries can adjust their tax rates, the GMT reshapes the underlying tax game and the competition pattern. At the equilibrium, the minimum rate binds the small country only if it is low. Otherwise, the small country will set its tax rate below the minimum, even at zero (if the carve-out rate is very small), in order to promote real investments in its territory. When the GMT rate is sufficiently high and the carve-out is not very small, both countries undercut the minimum and so profit shifting vanishes. In this case, countries aim at attracting capital investments instead of competing for paper profits. Moreover, we show that countries' equilibrium tax rates are decreasing in the minimum rate whenever they are below the minimum. While the equilibrium tax rate of the small country changes continuously with the minimum, gradual increases in the GMT rate may trigger the large country's tax rate to drop discontinuously below the minimum. As for the long-run revenue effect, under small market-size asymmetry and intermediate profit shifting cost, the revenue loss from eliminating inward profit shifting may outweigh the revenue gain from taxing the true profits generated by genuine economic activities, so that even a marginal GMT reform may harm the small country. Otherwise, a marginal reform can raise the small country's tax revenue. Our results are substantially different from the traditional minimum taxation literature which specifies the minimum tax as a lower bound imposed on countries' tax rates. We also investigate the Pareto-improving non-marginal tax reform. When the carve-out rate is not too small, the GMT rate is not very high and profit shifting is not very sensitive to the minimum rate, the GMT can benefit the small country by increasing the taxation of both true profit and shifted profit.

Our findings suggest that the introduction of the GMT may not bring all countries' tax rates above the minimum rate of 15%. Small countries may still set their taxes below the minimum to attract inward investments and collect top-taxes. Indeed, Ireland has decided to keep the corporate tax rate of 12.5% and top up the rate to 15% for Irish affiliates of MNEs (see Department of Finance, 2023). Moreover, introducing the GMT in low concealment cost environments – which might be the current situation due to cross-border tax loopholes – will cause a short period of revenue losses for small countries. But they can benefit from a moderate GMT rate in the long run where countries' tax rates are reset. This implies that it has to take some time until the benefits of the GMT realize for all countries.

Appendix A. Proofs and Derivations

A1. Proof of Lemma 1(i)

Recall from (1) that one country's capital investment is zero when it sets a very high tax rate. From (2), the high-tax affiliate will report zero profit when the tax rate differential is large or profit shifting cost is very small. The possible corner solutions undermine the smoothness of tax revenue function and complicate the analysis. Our proof will handle this issue and show that the Nash equilibrium must be interior. We proceed in five steps.

Step 1. We show that $\pi_i(t_i^N, t_j^N) > 0$, $i = 1,2$.

Given country j's tax rate, country i can set its tax rate marginally above zero to earn a positive tax revenue. This implies that at equilibrium each country's revenue is positive. So the GloBE income (i.e., taxable profit) of affiliate i is $\pi_i(t_i^N, t_j^N) = f_i(k_i^N) - \mu r k_i^N - \dfrac{t_i^N - t_j^N}{\delta} > 0$.

Step 2. We claim that $t_1^N < \dfrac{\alpha_1 - r}{\alpha_1 - \mu r}$.

If $t_1^N \geq \dfrac{\alpha_1 - r}{\alpha_1 - \mu r}$, then the capital investment in country 1 is $k_1 = 0$. Besides, in this case no profit is shifted to country 1, irrespective of country 2's tax rate. So country 1's tax base is 0, which contradicts $\pi_1(t_1^N, t_2^N) > 0$. Hence, it must be that $t_1^N < \dfrac{\alpha_1 - r}{\alpha_1 - \mu r}$.

Step 3. We claim that $t_2^N \leq \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$.

To prove this claim, we analyze the following two cases, respectively. Case (i): $t_1^N \leq \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$. In this case, $\forall t_2 \geq \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$, $\pi_2(t_2, t_1^N) = 0 \Rightarrow t_2^N < \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$. Case (ii): $t_1^N > \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$. In this case, $\forall t_2 \geq t_1^N$, $\pi_2(t_2, t_1^N) = 0 \Rightarrow t_2^N < t_1^N$. On the other hand, if $\dfrac{\alpha_2 - r}{\alpha_2 - \mu r} < t_2^N < t_1^N$, then country 2's equilibrium revenue is $R_2(t_2^N, t_1^N) = \dfrac{t_2^N\left(t_1^N - t_2^N\right)}{\delta}$. Using $\dfrac{\alpha_1 - r}{\alpha_1 - \mu r} \leq 2\dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$ and $t_1^N < \dfrac{\alpha_1 - r}{\alpha_1 - \mu r}$, we can derive: $\dfrac{t_1^N}{2} < \dfrac{\alpha_1 - r}{2(\alpha_1 - \mu r)} \leq \dfrac{\alpha_2 - r}{\alpha_2 - \mu r} \quad \Rightarrow \quad \dfrac{t_2(t_1^N - t_2)}{\delta}$ strictly decreases with t_2 for all $t_2 \geq \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$. Consider a tax rate t_2' that is marginally below t_2^N. By the continuity of π_1 in t_2, we get: $\pi_1(t_1^N, t_2') > 0$ and $k_2(t_1') = 0$. Then $R_2(t_2', t_1^N) = \frac{t_2'\left(t_1^N - t_2'\right)}{\delta} > R_2(t_2^N, t_1^N)$, which contradicts the definition of Nash equilibrium. So it must be that $t_2^N \le \frac{\alpha_2 - r}{\alpha_2 - \mu r}$.

Step 4. We derive country i's best response to t_j^N.

Using (1) – (3), we obtain that: $\forall \left(t_i, t_j\right) \in A_{ij} := \left\{ \left(t_i, t_j\right) \in \left[0, \frac{\alpha_i - r}{\alpha_i - \mu r}\right] \times \left[0, \frac{\alpha_j - r}{\alpha_j - \mu r}\right] : \pi_i(t_i, t_j) > 0 \text{ and } \pi_j(t_j, t_i) > 0 \right\}$, country i's tax revenue $R_i(t_i, t_j) = \varphi_i(t_i) + \frac{t_i(t_j - t_i)}{\delta}$, where $\varphi_i(t_i) := t_i\left(f_i - \mu r k_i\right) = t_i\left[\frac{\alpha_i^2}{2} - \alpha_i \mu r - \frac{r^2\left(1 - \mu t_i\right)\left(1 - 2\mu + \mu t_i\right)}{2\left(1 - t_i\right)^2}\right]$ is the revenue from taxing affiliate i's true profit and $\frac{t_i(t_j - t_i)}{\delta}$ is the revenue gain (loss) from the MNE's profit shifting if $t_j > t_i$ ($t_j < t_i$). From the results shown in Steps 1-3, we have $\left(t_i^N, t_j^N\right) \in A_{ij}$. Besides, it is straightforward to show that: for all $t_j \in \left[0, \frac{\alpha_1 - r}{\alpha_1 - \mu r}\right]$,

$$\frac{\partial}{\partial t_i}\left[\varphi_i(t_i) + \frac{t_i(t_j - t_i)}{\delta}\right]\Bigg|_{t_i = 0} = \frac{\left(\alpha_i - r\right)\left(\alpha_i + r - 2\mu r\right)}{2} + \frac{t_j}{\delta} > 0,$$

$$\frac{\partial}{\partial t_i}\left[\varphi_i(t_i) + \frac{t_i(t_j - t_i)}{\delta}\right]\Bigg|_{t_i = \frac{\alpha_i - r}{\alpha_i - \mu r}} = -\frac{\left(\alpha_i - r\right)\left(\alpha_i - \mu r\right)^2}{\left(1 - \mu\right) r} - \frac{\frac{2\left(\alpha_i - r\right)}{\alpha_i - \mu r} - t_j}{\delta} < 0, \quad \text{and}$$

$$\frac{\partial^2}{\partial t_i^2}\left[\varphi_i(t_i) + \frac{t_i(t_j - t_i)}{\delta}\right] = -\frac{r^2\left(1 - \mu\right)^2\left(2 + t_i\right)}{\left(1 - t_i\right)^4} - \frac{2}{\delta} < 0,$$ which leads to the following:

(i) $\forall t_j \in \left[0, \frac{\alpha_1 - r}{\alpha_1 - \mu r}\right]$, $\frac{\partial}{\partial t_i}\left[\varphi_i(t_i) + \frac{t_i(t_j - t_i)}{\delta}\right] = 0$ has a unique solution denoted by $t_i(t_j)$ with $t_i(t_j) \in \left(0, \frac{\alpha_i - r}{\alpha_i - \mu r}\right)$; and (ii) $\varphi_i(t_i) + \frac{t_i(t_j - t_i)}{\delta}$ strictly increases (decreases) with t_i if $t_i < t_i(t_j)$ ($t_i > t_i(t_j)$).

Now we argue by contradiction that $t_i^N = t_i(t_j^N)$. If $t_i^N < t_i(t_j^N)$ ($t_i^N > t_i(t_j^N)$), then consider a tax rate t_i' that is marginally above (below) t_i^N. By the continuity of π_i and π_j in t_i, we would get: $\pi_i(t_i', t_j^N) > 0$ and $\pi_j(t_j^N, t_i') > 0$. Together with $t_i' \in \left(0, \dfrac{\alpha_i - r}{\alpha_i - \mu r}\right)$, it would be that: $\left(t_i', t_j^N\right) \in A_{ij} \Rightarrow R_i(t_i', t_j^N) > R_i(t_i^N, t_j^N)$, which contradicts the definition of Nash equilibrium. Therefore, it must be that $t_i^N = t_i(t_j^N)$.

Step 5. We establish the existence and uniqueness of the Nash equilibrium.

Given $\dfrac{\partial}{\partial t_i}\left[\varphi_i(t_i) + \dfrac{t_i(t_j - t_i)}{\delta}\right] = \varphi_i'(t_i) + \dfrac{t_j - 2t_i}{\delta} = 0$, using the implicit function theorem yields:

$$\frac{dt_i(t_j)}{dt_j} = \frac{1}{2 - \delta\varphi_i''(t_i)} \in \left(0, \frac{1}{2}\right), \tag{A1}$$

where $\varphi_i''(t_i) = -\dfrac{r^2(1-\mu)^2(2+t_i)}{(1-t_i)^4} < 0$.

(A1) shows that for interior solutions two countries' tax rates are strategic complements. Moreover, it implies that function $T(t_1, t_2) := (t_1(t_2), t_2(t_1))$ is a contraction on the space $\left[0, \dfrac{\alpha_1 - r}{\alpha_1 - \mu r}\right] \times \left[0, \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}\right]$. Then by the contraction mapping theorem, there exists a unique fixed point of $T(t_1, t_2)$, that is, a unique Nash equilibrium with $t_i^N = t_i(t_j^N) \in \left(0, \dfrac{\alpha_i - r}{\alpha_i - \mu r}\right)$, $i = 1, 2$.

Q.E.D.

A2. The comparative static results

By the continuity of π_i and π_j, together with $t_i^N \in \left(0, \dfrac{\alpha_i - r}{\alpha_i - \mu r}\right)$, we can show that: in a small neighborhood of $\left(t_i^N, t_j^N\right)$, $\left(t_i, t_j\right) \in A_{ij}$ and $R_i(t_i, t_j) = \varphi_i(t_i) + \dfrac{t_i(t_j - t_i)}{\delta}$. Then totally differentiating $\left.\dfrac{\partial R_i}{\partial t_i}\right|_{\left(t_i^N, t_j^N\right)} = 0$ yields the comparative statics without the GMT:

$$\frac{\partial t_i^N}{\partial \alpha_i} = \frac{\alpha_i - \mu r}{|J|} \cdot \left[\frac{r^2 (1-\mu)^2 \left(2 + t_j^N\right)}{\left(1 - t_j^N\right)^4} + \frac{2}{\delta} \right] > 0, \tag{A2}$$

$$\frac{\partial t_j^N}{\partial \alpha_i} = \frac{\alpha_i - \mu r}{\delta |J|} > 0, \tag{A3}$$

$$\frac{\partial t_i^N}{\partial \delta} = \frac{1}{|J|} \cdot \left[\frac{(1-\mu)^2 r^2 (2t_i^N - t_j^N)(2 + t_j^N)}{(1 - t_j^N)^4 \delta^2} + \frac{3t_i^N}{\delta^3} \right], \tag{A4}$$

where $|J| := \frac{\partial^2 R_1}{\partial t_1^2} \cdot \frac{\partial^2 R_2}{\partial t_2^2} - \frac{\partial^2 R_1}{\partial t_1 \partial t_2} \cdot \frac{\partial^2 R_2}{\partial t_1 \partial t_2} = \prod_{i=1}^{2} \left[\frac{r^2 (1-\mu)^2 \left(2 + t_i^N\right)}{\left(1 - t_i^N\right)^4} + \frac{2}{\delta} \right] - \frac{1}{\delta^2} > 0$ is the Jacobian determinant of the system $\frac{\partial R_i}{\partial t_i}$ ($i = 1, 2$) evaluated at $\left(t_1^N, t_2^N\right)$.

A3. Proof of Lemma 1(ii)

For identical countries with $\alpha_1 = \alpha_2$, it must be that $t_1^N = t_2^N$. On the other hand, using (A2) and (A3) we can get: $\frac{\partial (t_1^N - t_2^N)}{\partial \alpha_1} = \frac{\alpha_1 - \mu r}{|J|} \cdot \left[\frac{r^2 (1-\mu)^2 (2 + t_2)}{(1 - t_2)^4} + \frac{1}{\delta} \right] > 0$, which means that $t_1^N(\alpha_1, \alpha_2) - t_2^N(\alpha_1, \alpha_2)$ is strictly increasing in α_1. Hence, we can derive that: $\forall \alpha_1 > \alpha_2$, $t_1^N(\alpha_1, \alpha_2) - t_2^N(\alpha_1, \alpha_2) > t_1^N(\alpha_2, \alpha_2) - t_2^N(\alpha_2, \alpha_2) = 0 \;\Rightarrow\; \forall \alpha_1 > \alpha_2$, $t_1^N > t_2^N$. **Q.E.D.**

A4. Proof of Proposition 1

It follows from (8) that $g^m = \frac{t_1^N - t_m}{\delta} < \frac{t_1^N - t_2^N}{\delta} = g^N$. Together with (3), (6) and (9), we have $R_1^m > R_1^N$.

Now we prove (ii). Differentiating (7) with respect to t_m and evaluating it at t_2^N gives:

$$\left. \frac{\partial k_2^m}{\partial t_m} \right|_{t_m = t_2^N} = \frac{\partial k_2^N}{\partial t_2^N} + \underbrace{\frac{\sigma}{-(1 - t_2^N) f_2''}}_{tax\ incentive\ effect}, \tag{A5}$$

where $\frac{\partial k_2^N}{\partial t_2^N} = \frac{f_2' - \mu r}{(1 - t_2^N) f_2''}$ is the derivative of k_2 evaluated at t_2^N in the absence of the GMT.

Differentiating (10) with respect to t_m and using (A5) yields:

$$\left.\frac{\partial R_2^m}{\partial t_m}\right|_{t_m=t_2^N} = \left[f_2(k_2^m) - \mu r k_2^m + g^m + t_m\left((f_2' - \mu r)\frac{\partial k_2^m}{\partial t_m} + \frac{\partial g^m}{\partial t_m} \right) - \sigma k_2^m - (t_m - t_2^N)\sigma \frac{\partial k_2^m}{\partial t_m} \right]\Bigg|_{t_m=t_2^N}$$

$$= \underbrace{f_2(k_2^N) - \mu r k_2^N + \frac{t_1^N - t_2^N}{\delta} + t_2^N\left((f_2' - \mu r)\frac{\partial k_2^N}{\partial t_2^N} - \frac{1}{\delta} \right)}_{\frac{\partial R_2^N}{\partial t_2^N}=0} + \underbrace{\frac{t_2^N (f_2' - \mu r)\sigma}{-(1-t_2^N) f_2''}}_{gain\ from\ tax\ incentive} - \underbrace{\sigma k_2^N}_{loss\ from\ SBIE} . \quad \text{(A6)}$$

$$= -\frac{\sigma\left[\alpha_2 \left(1-t_2^N\right)^2 - r\left(1 - 2\mu t_2^N + \mu\left(t_2^N\right)^2\right) \right]}{\left(1-t_2^N\right)^2}$$

Using (A6), it is straightforward to show:

$$\left.\frac{\partial R_2^m}{\partial t_m}\right|_{t_m=t_2^N} \gtreqless 0 \iff t_2^N \gtreqless 1 - \sqrt{\frac{r(1-\mu)}{\alpha_2 - \mu r}} =: t_2^*. \quad \text{(A7)}$$

It immediately follows from (A7) that: for $t_2^N > t_2^*$ ($t_2^N < t_2^*$), $R_2^m(t_m) > R_2^m(t_2^N) = R_2^N$ ($R_2^m(t_m) < R_2^m(t_2^N) = R_2^N$) when t_m is marginally higher than t_2^N.

Lastly, we prove part (iii). Notice that for the continuous function $R_2^m(t_m)$, it is quasiconcave in t_m if and only if one of the following conditions holds: (i) $R_2^m(t_m)$ is increasing; (ii) $R_2^m(t_m)$ is decreasing; or (iii) there is some $t_m' \in \left(t_2^N, t_1^N\right)$ such that $R_2^m(t_m)$ is increasing for all $t_m \in \left(t_2^N, t_m'\right)$ and is decreasing for all $t_m \in \left(t_m', t_1^N\right)$. On the other hand, recall from (A7) that $\left.\frac{\partial R_2^m}{\partial t_m}\right|_{t_m=t_2^N} < 0$ if $t_2^N < t_2^*$. Assuming that $R_2^m(t_m)$ is quasiconcave in t_m for all $t_m \in \left(t_2^N, t_1^N\right)$, we can derive that: $R_2^m(t_m)$ must be decreasing in t_m if $t_2^N < t_2^* \Rightarrow R_2^m(t_m) < R_2^m(t_2^N) = R_2^N$ holds for all $t_m \in \left(t_2^N, t_1^N\right)$, if $t_2^N < t_2^*$. **Q.E.D.**

A5. Proof of Lemma 2

One might hope to prove the lemma by comparing $t_2^N(\delta)$ and t_2^* as $\delta \to 0$ and $\delta \to +\infty$, and then by resorting to the monotonicity of $t_2^N(\delta)$. However, unlike $t_1^N(\delta)$, $t_2^N(\delta)$ is not necessarily increasing in δ. To surmount this difficulty, we will invoke the Poincaré-Hopf index theorem (see Vives, 2000), which only requires information on $\frac{dt_2^N(\delta)}{d\delta}$ at δ that satisfies $t_2^N(\delta) = t_2^*$.

Define $\xi(\delta) := t_2^N(\delta) - t_2^*$. Recall from Appendix A1 that the equilibrium tax rates have to satisfy $\varphi_i'(t_i^N) - \dfrac{2t_i^N - t_j^N}{\delta} = 0$ ($i, j \in \{1,2\}$ and $i \neq j$). Then it is straightforward to show the following:

$$\lim_{\delta \to 0} t_i^N(\delta) = 0,\ i = 1,2 \ \Rightarrow\ \lim_{\delta \to 0} \xi(\delta) < 0. \tag{A8}$$

$$\varphi_2'(t_2^*) = \frac{1}{2}(\alpha_2 - \mu r)\left[(\alpha_2 - \mu r) + (1-\mu)r - 2\sqrt{(\alpha_2 - \mu r)(1-\mu)r}\right] > 0 = \varphi_2'(\lim_{\delta \to +\infty} t_2^N(\delta)) \ \Rightarrow$$

$$\lim_{\delta \to +\infty} t_2^N(\delta) > t_2^* \ \Rightarrow\ \lim_{\delta \to +\infty} \xi(\delta) > 0. \tag{A9}$$

For all δ satisfying $t_2^N(\delta) = t_2^*$, using (A4) we can derive that:

$$\frac{2t_2^N(\delta) - t_1^N(\delta)}{\delta} = \varphi_2'(t_2^N(\delta)) = \varphi_2'(t_2^*) > 0 \ \Rightarrow\ \frac{dt_2^N(\delta)}{d\delta} > 0 \ \Rightarrow\ \xi'(\delta) > 0. \tag{A10}$$

(A10) indicates that $\xi'(\delta)$ is positive whenever $\xi(\delta) = 0$. Together with (A8) and (A9) (the boundary conditions), it follows from the Poincaré-Hopf index theorem that there exists a unique δ^* such that $\xi(\delta^*) = 0$. Furthermore, given (A8), (A9) and the uniqueness of δ^*, it is straightforward to show $t_2^N \gtreqless t_2^* \Leftrightarrow \delta \gtreqless \delta^*$. **Q.E.D.**

A6. Proof of Lemma 3

Denote $\widehat{t}_i := \min\left\{\dfrac{\alpha_i(1-t_m) - (1-\mu t_m)r + \sigma t_m}{\sigma}, t_m\right\}$. Given (12), (14) and (15), for $t_i \in [\widehat{t}_i, t_m)$, there is no investment in country i, and its revenue is $R_i^m = t_m(-1)^i g^m$, which is independent of t_i. For $t_i \in [0, \widehat{t}_i)$, inserting (12) and (14) into (15) and differentiating the revenue function with respect to t_i yields:

$$\frac{\partial R_i^m}{\partial t_i} = t_m(f_i' - \mu r)\frac{\partial k_i}{\partial t_i} + \sigma k_i - (t_m - t_i)\sigma\frac{\partial k_i}{\partial t_i} = \frac{\sigma\left[\alpha_i(1-t_m)^2 - r(1 - 2\mu t_m + \mu t_m^2) + (t_m - t_i)(2-t_m)\sigma\right]}{(1-t_m)^2}.$$

Moreover, it is readily verified that $\forall t_i \in [0, \widehat{t}_i)$, $\dfrac{\partial^2 R_i^m}{\partial t_i^2} = -\dfrac{(2-t_m)\sigma^2}{(1-t_m)^2} < 0$. Then it is straightforward to show the following:

(i) For $t_m \le 1-\sqrt{\dfrac{(1-\mu)r}{\alpha_i-\mu r}} =: t_i^*$, $\dfrac{\partial R_i^m}{\partial t_i}>0$, $\forall t_i \in [0,t_m)$. That is, country i's revenue strictly increases with its tax rate. Besides, we have $R_i^m(t_m,t_j)=\varphi_i(t_m)+t_m(-1)^i g^m$.

(ii) For $t_m > t_i^*$ and $\underline{\sigma} < \sigma \le \dfrac{r\left(1-2\mu t_m+\mu t_m^2\right)-\alpha_i\left(1-t_m\right)^2}{t_m\left(2-t_m\right)} =: \sigma_i^m$, $\forall t_i \in [0,\widehat{t}_i)$, $\dfrac{\partial R_i^m}{\partial t_i}<0$. That is, country i's revenue strictly decreases with t_i when $t_i \in [0,\widehat{t}_i)$ and remains unchanged when $t_i \in [\widehat{t}_i,t_m)$. So the revenue-maximizing tax rate is zero, with $R_i^m(0,t_j)=\dfrac{(\alpha_i-r)^2}{2(2-t_m)}-\dfrac{(\sigma_i^m-\sigma)^2(2-t_m)t_m^2}{2(1-t_m)^2}+t_m(-1)^i g^m$.

(iii) For $t_m > t_i^*$ and $\max\left\{\underline{\sigma},\sigma_i^m\right\}<\sigma\le\overline{\sigma}$, solving $\dfrac{\partial R_i^m}{\partial t_i}=0$ yields $t_i=\left(1-\dfrac{\sigma_i^m}{\sigma}\right)t_m \in \left(0,\widehat{t}_i\right)$. Country i 's revenue strictly increases (decreases) with t_i when $t_i \in \left[0,\left(1-\dfrac{\sigma_i^m}{\sigma}\right)t_m\right)$ ($t_i \in \left(\left(1-\dfrac{\sigma_i^m}{\sigma}\right)t_m,\widehat{t}_i\right)$) and remains unchanged when $t_i \in [\widehat{t}_i,t_m)$. So the revenue-maximizing tax rate is $\left(1-\dfrac{\sigma_i^m}{\sigma}\right)t_m$, with $k_i^m\Big|_{t_i=(1-\frac{\sigma_i^m}{\sigma})t_m}=\dfrac{\alpha_i-r}{2-t_m}$ and $R_i^m((1-\dfrac{\sigma_i^m}{\sigma})t_m,t_j)=\dfrac{(\alpha_i-r)^2}{2(2-t_m)}+t_m(-1)^i g^m$. **Q.E.D.**

A7. Proof of Proposition 2

As shown in the proof of Lemma 3, given country j's tax rate, country i can choose $t_i=\min\left\{\tilde{t}_i,t_m\right\}$ to earn a positive tax revenue, where $\tilde{t}_i := \max\left\{0,\left(1-\dfrac{\sigma_i^m}{\sigma}\right)t_m\right\}$. This implies that each country's equilibrium revenue is positive $\Rightarrow$ the GloBE income $\pi_i^m(t_i^m,t_j^m)>0$, $i=1,2$. Notice that $t_m<t_1^N<\dfrac{\alpha_1-r}{\alpha_1-\mu r}$, which means that the GMT is inactive for affiliate 1 when country 1's tax rate $t_1\ge\dfrac{\alpha_1-r}{\alpha_1-\mu r}$. Then repeating Step 2 in the proof of Lemma 1 with superscript N replaced by m, we can show $t_1^m<\dfrac{\alpha_1-r}{\alpha_1-\mu r}$. In the following, we prove the four parts of Proposition 2, separately.

A7.1. Proof of Proposition 2(i)

Given $t_m \le t_2^* < t_1^*$, it follows from Lemma 3(i) that: for each country, any tax choice below the GMT rate is strictly dominated by t_m such that its equilibrium tax must meet $t_i^m \ge t_m$. This means that at equilibrium the GMT is inactive for both affiliates. Each country's equilibrium tax base (GloBE income) is: $\pi_i^m(t_i^m, t_j^m) = f_i(k_i^m) - \mu r k_i^m - \dfrac{t_i^m - t_j^m}{\delta} > 0$.

Step 1. We claim that $t_2^m \le \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$.

Notice that $t_m \le t_2^* \;\Rightarrow\; t_m < \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$ and that $R_i^m(t_i, t_j) = R_i(t_i, t_j)$ when $t_i \ge t_m$ and $t_j \ge t_m$. Then repeating Step 3 in the proof of Lemma 1 with superscript N replaced by m, we have: $t_2^m \le \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$.

Step 2. We claim that $t_i^m = \max\{t_m, t_i(t_j^m)\}$.

We analyze two cases, respectively. Case (i): $t_m \ge t_i(t_j^m)$. We argue by contradiction that $t_i^m = t_m$. If $t_i^m > t_m \ge t_i(t_j^m)$, then consider a tax rate t_i' that is marginally below t_i^m. Notice that $(t_i^m, t_j^m) \in A_{ij}$. Then by the continuity of π_i and π_j in t_i, we have: $\pi_i(t_i', t_j^m) > 0$ and $\pi_j(t_j^m, t_i') > 0 \;\Rightarrow\; (t_i', t_j^m) \in A_{ij} \;\Rightarrow\; R_i^m(t_i', t_j^m) = R_i(t_i', t_j^m) > R_i(t_i^m, t_j^m) = R_i^m(t_i^m, t_j^m)$, which contradicts the definition of Nash equilibrium. So it must be that $t_i^m = t_m$. Case (ii): $t_m < t_i(t_j^m)$. By similar reasoning as in Case (i), we can show $t_i^m = t_i(t_j^m)$. Combining the two cases, we have proved the claim.

Step 3. The Nash equilibrium taxes are $t_1^m = t_1(t_m)$, $t_2^m = t_m$.

Using (A1) and $t_i^m = \max\{t_m, t_i(t_j^m)\}$, we can derive: $t_1(t_2^m) \ge t_1(t_m) > t_1(t_2^N) = t_1^N > t_m \;\Rightarrow\; t_1^m = t_1(t_2^m)$. Now we argue that $t_2^m \ne t_2(t_1^m)$. If $t_2^m = t_2(t_1^m)$, then together with $t_1^m = t_1(t_2^m)$ we would obtain $t_2^m = t_2^N$, which contradicts $t_2^m \ge t_m > t_2^N$. So given $t_2^m = \max\{t_m, t_2(t_1^m)\}$, it must be that $t_2^m = t_m$. So the equilibrium taxes have to satisfy $t_1^m = t_1(t_m)$, $t_2^m = t_m$. On the other hand, it follows from (A1) that the function $t_2(t_1(x)) - x$ strictly decreases with x for all $x \in \left[0, \dfrac{\alpha_1 - r}{\alpha_1 - \mu r}\right]$. Then we can derive:

$$t_2(t_1^m) - t_m = t_2(t_1(t_m)) - t_m < t_2(t_1(t_2^N)) - t_2^N = 0 \;\Rightarrow\; t_2(t_1^m) < t_m \;\Rightarrow\; \max\{t_m, t_2(t_1^m)\} = t_m. \qquad \text{(A11)}$$

So country 2's best response to country 1's tax choice $t_1(t_m)$ is choosing t_m. Hence, ($t_1(t_m)$, t_m) satisfies the definition of Nash equilibrium. **Q.E.D.**

A7.2. Proof of Proposition 2(ii)

Firstly, it follows from Lemma 3 (i) that: for country 1, any tax choice below the GMT rate is strictly dominated by t_m such that its equilibrium tax must meet $t_1^m \geq t_m$.

Step 1. We claim that $t_2^m = \tilde{t}_2$.

We analyze two cases: (i) $t_m \geq \frac{\alpha_2 - r}{\alpha_2 - \mu r}$, and (ii) $t_m < \frac{\alpha_2 - r}{\alpha_2 - \mu r}$, separately.

Case (i): $t_m \geq \frac{\alpha_2 - r}{\alpha_2 - \mu r}$. In this case, we prove by contradiction that $t_2^m \leq t_m$. If $t_2^m > t_m$ and $t_1^m \leq t_2^m$, then we would have $\pi_2(t_2^m, t_1^m) = 0$, which contradicts $\pi_2^m(t_2^m, t_1^m) > 0$. If $t_2^m > t_m$ and $t_1^m > t_2^m$, then country 2's equilibrium revenue would be $R_2^m(t_2^m, t_1^m) = \frac{t_2^m\left(t_1^m - t_2^m\right)}{\delta}$. Then by the same reasoning as in Step 3 in the proof of Lemma 1, for a tax rate t_2' that is marginally below t_2^m, we would get: $R_2^m(t_2', t_1^m) > R_2^m(t_2^m, t_1^m)$, which contradicts the definition of Nash equilibrium. So we have shown $t_2^m \leq t_m$. Then it follows from Lemma 3 that $t_2^m = \tilde{t}_2$.

Case (ii): $t_m < \frac{\alpha_2 - r}{\alpha_2 - \mu r}$. We argue by contradiction that $t_2^m < t_m$. If $t_2^m \geq t_m$, then repeating Steps 1 – 3 in the proof of Proposition 2(i) would lead to $t_1^m = t_1(t_m)$ and $t_2^m = t_m$. However, it follows from Lemma 3 that $R_2^m(\tilde{t}_2, t_1^m) > R_2^m(t_m, t_1^m)$, which contradicts the definition of the Nash equilibrium. So country 2's equilibrium tax must satisfy $t_2^m < t_m$. Then using Lemma 3 again, it must be that $t_2^m = \tilde{t}_2$.

Step 2. Given $t_2^m = \tilde{t}_2$, country 1's best response is choosing $t_1(t_m)$.

Given $t_2^m = \tilde{t}_2$, country 1's revenue function is: $R_1^m(t_1, t_2^m) = \begin{cases} R_1(t_1, t_m) & if \;\; t_m \leq t_1 < \hat{t}_1 \\ 0 & if \;\; t_1 \geq \hat{t}_1 \end{cases}$, where $\hat{t}_1 \in \left(t_1(t_m), \frac{\alpha_1 - r}{\alpha_1 - \mu r}\right)$ is the unique value of t_1 such that $\pi_1^m(\hat{t}_1, t_2^m) = \left[f_1(k_1) - \mu r k_1 - \frac{t_1 - t_m}{\delta}\right]\Big|_{t_1 = \hat{t}_1} = 0$

(noticing that the expression for $R_1^m(t_1,t_2^m)$ holds for all $t_2^m \in [0,t_m]$). Besides, using (A1) and $t_2^N < t_m < t_1^N$ yields $t_1(t_m) > t_1(t_2^N) = t_1^N > t_m$. Hence, $R_1^m(t_1,t_2^m)$ increases (decreases) with t_1 if $t_m \le t_1 < t_1(t_m)$ ($t_1 > t_1(t_m)$), such that country 1's best response is setting a tax rate of $t_1(t_m)$.

Step 3. We show that ($t_1(t_m)$, $\tilde{t}_2$) are Nash equilibrium tax rates.

Given the result shown in Step 2, we only need to analyze country 2's best response to $t_1^m = t_1(t_m)$. Given country 1's tax choice $t_1^m = t_1(t_m)$, country 2's revenue function depends on the relationship between t_m, t_1^m and $\dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$ in the following way:

When $\dfrac{\alpha_2 - r}{\alpha_2 - \mu r} \le t_m < t_1^m$, $R_2^m(t_2,t_1^m) = \begin{cases} \dfrac{t_2(t_1^m - t_2)}{\delta} & if \;\; t_m \le t_2 \le t_1^m \\ 0 & if \;\; t_2 > t_1^m \end{cases}$; When $t_m < \dfrac{\alpha_2 - r}{\alpha_2 - \mu r} < t_1^m$,

$$R_2^m(t_2,t_1^m) = \begin{cases} R_2(t_2,t_1^m) & if \;\; t_m \le t_2 < \dfrac{\alpha_2 - r}{\alpha_2 - \mu r} \\ \dfrac{t_2(t_1^m - t_2)}{\delta} & if \;\; \dfrac{\alpha_2 - r}{\alpha_2 - \mu r} \le t_2 < t_1^m \\ 0 & if \;\; t_2 \ge t_1^m \end{cases}$$

; When $t_m < t_1^m \le \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$,

$R_2^m(t_2,t_1^m) = \begin{cases} R_2(t_2,t_1^m) & if \;\; t_m \le t_2 < \hat{t}_2 \\ 0 & if \;\; t_2 \ge \hat{t}_2 \end{cases}$, where $\hat{t}_2 \in \left[t_1^m, \dfrac{\alpha_2 - r}{\alpha_2 - \mu r} \right]$ is the unique value of t_2 such that $\pi_2^m(\hat{t}_2,t_1^m) = \left[f_2(k_2) - \mu r k_2 - \dfrac{t_2 - t_1^m}{\delta} \right] \Bigg|_{t_2 = \hat{t}_2} = 0$. Note that $\dfrac{t_1^m}{2} < \dfrac{\alpha_1 - r}{2(\alpha_1 - \mu r)} \le \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$, and recall from (A11) that $t_2(t_1^m) < t_m$. It is straightforward to show that $R_2^m(t_2,t_1^m)$ always decreases with t_2 for all $t_2 \ge t_m$. Together with Lemma 3, country 2's best response is choosing $\tilde{t}_2$. **Q.E.D.**

A7.3. Proof of Proposition 2(iii)

We proceed in two steps.

Step 1. We claim that $t_2^m = \tilde{t}_2$.

If country 1's equilibrium tax rate $t_1^m \ge t_m$, then by repeating Step 1 in the proof of Proposition 2(ii), it must be that $t_2^m = \tilde{t}_2$.

If country 1's equilibrium tax $t_1^m < t_m$, then it follows from Lemma 3 that $t_1^m = \tilde{t}_1$. In what follows, we analyze two cases. Case (i): $t_m \geq \frac{\alpha_2 - r}{\alpha_2 - \mu r}$. It is obvious that $R_2^m(t_2, t_1^m) = 0$ for all $t_2 \geq t_m$. Then using Lemma 3, we have $t_2^m = \tilde{t}_2$. Case (ii): $t_m < \frac{\alpha_2 - r}{\alpha_2 - \mu r}$. For $t_2 \geq t_m$, country 2's tax revenue function is $R_2^m(t_2, t_1^m) = \begin{cases} R_2(t_2, t_m) & if \quad t_m \leq t_2 < \hat{t}_2 \\ 0 & if \quad t_2 \geq \hat{t}_2 \end{cases}$, where $\hat{t}_2 \in \left(t_m, \frac{\alpha_2 - r}{\alpha_2 - \mu r} \right)$ is the unique value of t_2 such that $\pi_2^m(\hat{t}_2, t_1^m) = \left[f_2(k_2) - \mu r k_2 - \frac{t_2 - t_m}{\delta} \right] \Big|_{t_2 = \hat{t}_2} = 0$. Besides, it follows from (A1) and $t_2^N < t_m < t_1^N$ that: $t_2(t_m) < t_2(t_1^N) = t_2^N < t_m$, which implies that $R_2^m(t_2, t_1^m)$ decreases with t_2 for all $t_2 \geq t_m$. Together with Lemma 3, country 2's best response to $t_1^m = \tilde{t}_1$ is choosing $\tilde{t}_2$.

Step 2. We derive country 1's best response to $t_2^m = \tilde{t}_2$.

Using Lemma 3 and repeating Step 2 in the proof of Proposition 2(ii), we can obtain: $\arg\max_{t_1 \in [0, t_m]} R_1^m(t_1, t_2^m) = \tilde{t}_1$ and $\arg\max_{t_1 \in [t_m, 1]} R_1^m(t_1, t_2^m) = t_1(t_m)$. Therefore, country 1's best response is choosing $t_1(t_m)$ when $R_1^m(t_1(t_m), t_2^m) = R_1(t_1(t_m), t_m) > R_1^m(\tilde{t}_1, t_2^m)$, and $\tilde{t}_1$ when $R_1^m(t_1(t_m), t_2^m) = R_1(t_1(t_m), t_m) < R_1^m(\tilde{t}_1, t_2^m)$. It is indifferent between choosing $t_1(t_m)$ and $\tilde{t}_1$ when $R_1^m(t_1(t_m), t_2^m) = R_1(t_1(t_m), t_m) = R_1^m(\tilde{t}_1, t_2^m)$. **Q.E.D.**

A7.4. Proof of Proposition 2(iv)

We first prove $t^{**} \in (t_1^*, \overline{t}_1)$. Using $\frac{(\alpha_1 - r)^2}{2(2 - t^{**})} = \overline{R}_1 = \varphi_1(\overline{t}_1)$, we can show:

$$\frac{(\alpha_1 - r)^2}{2(2 - \overline{t}_1)} - \frac{(\alpha_1 - r)^2}{2(2 - t^{**})} = \frac{(\alpha_1 - r)^2}{2(2 - \overline{t}_1)} - \varphi_1(\overline{t}_1) = \frac{\left[\alpha_1 (1 - \overline{t}_1)^2 - r\left(1 - 2\mu \overline{t}_1 + \mu \overline{t}_1^2\right) \right]^2}{2(2 - \overline{t}_1)(1 - \overline{t}_1)^2} > 0 \Rightarrow t^{**} < \overline{t}_1. \quad \text{(A12)}$$

On the other hand, using $\varphi_1'(\overline{t}_1) = 0$ we can obtain:

$$\frac{\alpha_1}{r} = \sqrt{\frac{1 + \overline{t}_1}{(1 - \overline{t}_1)^3}} (1 - \mu) + \mu. \quad \text{(A13)}$$

Using (A13), we have:

$$\overline{R}_1 = \varphi_1(\overline{t}_1) = r^2 \overline{t}_1 \left[\frac{\alpha_1^2}{2r^2} - \mu \frac{\alpha_1}{r} - \frac{(1 - \mu \overline{t}_1)(1 - 2\mu + \mu \overline{t}_1)}{2(1 - \overline{t}_1)^2} \right] = \frac{r^2 (1 - \mu)^2 \overline{t}_1^2}{(1 - \overline{t}_1)^3}.$$

Then solving $\frac{(\alpha_1-r)^2}{2(2-t^{**})}=\overline{R}_1=\frac{r^2(1-\mu)^2\,\overline{t}_1^2}{(1-\overline{t}_1)^3}$ for t^{**} and using (A-13), we can get:

$$t^{**}=2-\frac{(1-\overline{t}_1)^3\left(\frac{\alpha_1}{r}-1\right)^2}{2(1-\mu)^2\,\overline{t}_1^2}=2-\frac{(1-\overline{t}_1)^3}{2\overline{t}_1^2}\cdot\left(\sqrt{\frac{1+\overline{t}_1}{(1-\overline{t}_1)^3}}-1\right)^2. \tag{A14}$$

Define $H(t):=\frac{\alpha_1}{r}(1-t)^2-(1-2\mu t+\mu t^2)$. It is readily verified that $H(t)<0$ if and only if $t\in\left(t_1^*,1+\sqrt{\frac{r(1-\mu)}{\alpha_1-\mu r}}\right)$. Plugging (A13) and (A14) into $H(t)$ yields:

$$H(t^{**})=-\frac{(1-\mu)\left(1-\sqrt{1-\overline{t}_1^2}\right)^3\left(5+3\sqrt{1-\overline{t}_1^2}-t_1^2\right)}{4\overline{t}_1^4}<0\ \Rightarrow\ t^{**}>t_1^*. \tag{A15}$$

Combining (A12) and (A15) leads to $t^{**}\in(t_1^*,\overline{t}_1)$.

Notice that $\forall t_m\in\left(t_2^N,t_1^N\right)$, $\overline{t}_1>t_1(t_m)>t_m$. Then replacing t_1^N with $t_1(t_m)$ and t_2^N with t_m in (4), we have:

$$R_1(t_1(t_m),t_m)<\overline{R}_1. \tag{A16}$$

Let δ be an arbitrary element of set $\left\{\delta>0:t_1^N(\delta)>t^{**}\right\}$, which is nonempty according to (A12). When $\max\left\{t_2^N(\delta),t^{**}\right\}<t_m<t_1^N(\delta)$ and $\max\left\{\underline{\sigma},\sigma_1^m\right\}<\sigma\le\overline{\sigma}$, by (A15) and (A16) we can show that:

$$t_m>t_1^* \text{ and } R_1^m(\tilde{t}_1,\tilde{t}_2)=\frac{(\alpha_1-r)^2}{2(2-t_m)}>\frac{(\alpha_1-r)^2}{2(2-t^{**})}=\overline{R}_1>R_1(t_1(t_m),t_m).$$

Then by Proposition 2(iii), the Nash equilibrium rates are $t_1^m=\tilde{t}_1$, $t_2^m=\tilde{t}_2$. **Q.E.D.**

A8. Proof of Lemma 4

As in the proof of Lemma 2, we will again appeal to the Poincaré-Hopf index theorem, which only requires information on $\frac{dt_2^N(\delta)}{d\delta}$ at δ that satisfies $t_2^N(\delta)=t_1^*$. We proceed in two steps.

Step 1. We claim that: for all δ satisfying $t_2^N(\delta)=t_1^*$, $\frac{dt_2^N(\delta)}{d\delta}>0$.

First, we prove by contradiction that $2t_2^N > t_1^N$ when $t_2^N = t_1^*$. Recall that equilibrium taxes without the GMT are determined by $\varphi_i'(t_i^N) - \dfrac{2t_i^N - t_j^N}{\delta} = 0$. If $2t_2^N \le t_1^N$, then we would get:

$$\varphi_1'(2t_2^N) \ge \varphi_1'(t_1^N) = \frac{2t_1^N - t_2^N}{\delta} > 0 \ge \frac{2t_2^N - t_1^N}{\delta} = \varphi_2'(t_2^N), \tag{A17}$$

where the first inequality holds since $\varphi_1'(t_1)$ strictly decreases with t_1 for all $t_1 \in [0,1)$.

On the other hand, we could derive the following:

$$\begin{aligned}
\varphi_1'(2t_2^N) - \varphi_2'(t_2^N) &= \frac{1}{2}\left(\left(\alpha_1^2 - 2\mu r\alpha_1\right) - \left(\alpha_2^2 - 2\mu r\alpha_2\right) - \frac{r^2 t_2^N (1-\mu)^2 \left[4 - 9t_2^N + \left(t_2^N\right)^2 + \left(6t_2^N\right)^3\right]}{\left(1-t_2^N\right)^3\left(1-2t_2^N\right)^3} \right) \\
&\le \frac{1}{2}\left(\left(\alpha_1^2 - 2\mu r\alpha_1\right) - \left(\underline{\alpha}_2^2 - 2\mu r\underline{\alpha}_2\right) - \frac{r^2 t_2^N (1-\mu)^2 \left[4 - 9t_2^N + \left(t_2^N\right)^2 + \left(6t_2^N\right)^3\right]}{\left(1-t_2^N\right)^3\left(1-2t_2^N\right)^3} \right), \\
&= \frac{r^2(1-\mu)^2 t_2^N \Omega}{2\left(1-t_2^N\right)^4\left(1-2t_2^N\right)^3\left[2 - 2t_2^N + \left(t_2^N\right)^2\right]^2} < 0
\end{aligned}$$

where the inequality in line 2 holds since $\alpha_2^2 - 2\mu r\alpha_2$ strictly increases with α_2 for all $\alpha_2 \ge \mu r$, the equality in line 3 is obtained by substitution $\alpha_1 = \dfrac{r\left[1 - 2\mu t_2^N + \mu\left(t_2^N\right)^2\right]}{\left(1-t_2^N\right)^2}$ into line 2, and $\Omega := 20t_2^N + 28\left(t_2^N\right)^2 - 151\left(t_2^N\right)^3 + 218\left(t_2^N\right)^4 - 167\left(t_2^N\right)^5 + 82\left(t_2^N\right)^6 - 29\left(t_2^N\right)^7 + 6\left(t_2^N\right)^8 - 8 < 0$, $\forall t_2^N \in (0,1)$.

This contradicts (A17). So we have proved that $2t_2^N > t_1^N$ when $t_2^N = t_1^*$. Then using (A4), the claim directly follows.

Step 2. We prove Lemma 4.

Recall that $\varphi_2'(t_2)$ strictly decreases with t_2 for all $t_2 \in [0,1)$. Then we can derive the following:

$$t_1^* \gtreqless \lim_{\delta\to+\infty} t_2^N(\delta) \iff \varphi_2'(t_1^*) \lesseqgtr \varphi_2'(\lim_{\delta\to+\infty} t_2^N(\delta)) = 0 \iff \alpha_2 \lesseqgtr \alpha_2^*,$$

where $\alpha_2^* := \sqrt{(\alpha_1 - \mu r)\left[2\sqrt{r(1-\mu)(\alpha_1 - \mu r)} - r(1-\mu)\right]} + \mu r \in (\underline{\alpha}_2, \alpha_1)$.

Define $\eta(\delta) := t_2^N(\delta) - t_1^*$. Then it follows from the claim shown in Step 1 that:

$\eta'(\delta) > 0$, whenever $\eta(\delta) = 0$. (A18)

In what follows, we analyze three cases, respectively.

Case (i): $\alpha_2 > \alpha_2^*$. In this case, $\lim_{\delta \to +\infty} t_2^N(\delta) > t_1^*$. Recall that $\lim_{\delta \to 0} t_2^N(\delta) = 0 < t_1^*$. Together with (A18), by the same reasoning as in the proof of Lemma 2, we can show there exists a threshold δ^{**} such that $t_2^N \gtreqqless t_1^* \Leftrightarrow \delta \gtreqqless \delta^{**}$. In addition, by Lemma 2, we can derive that: $t_2^N(\delta^{**}) = t_1^* > t_2^*$ $\Rightarrow \delta^{**} > \delta^*$.

Case (ii): $\alpha_2 < \alpha_2^*$. We prove by contradiction that $\forall \delta$, $t_2^N < t_1^*$. Assume that there were some $\delta_0 > 0$ such that $t_2^N(\delta_0) \geq t_1^*$. Notice that $\lim_{\delta \to +\infty} t_2^N(\delta) < t_1^*$. Then together with (A18), there would exist some δ' and δ'' with $\delta_0 \leq \delta' < \delta''$ such that $t_2^N(\delta') > t_1^*$ and $t_2^N(\delta'') < t_1^*$. So we would get: $-\eta(\delta') < 0$ and $-\eta(\delta'') > 0$ (the boundary conditions). By the Poincaré-Hopf index theorem, we would have: $\sum_{\delta \in \{\delta : \eta(\delta) = 0 \text{ and } \delta' \leq \delta \leq \delta''\}} sign\{-\eta'(\delta)\} = +1$, which contradicts (A18).

Case (iii): $\alpha_2 = \alpha_2^*$. Using the result shown in Case (ii), we get:

$$\forall \delta,\ t_2^N(\delta, \alpha_2^*) = \lim_{\alpha_2 \to (\alpha_2^*)^-} t_2^N(\delta, \alpha_2) \leq \lim_{\alpha_2 \to (\alpha_2^*)^-} t_1^* = t_1^*. \tag{A19}$$

Moreover, note that $t_2^N(\delta, \alpha_2^*) \neq t_1^*$. Otherwise, using the claim shown in Step 1 we would get: $t_2^N(\delta', \alpha_2^*) > t_1^*$ when δ' is marginally larger than δ, which contradicts (A19). So it must be that $\forall \delta$, $t_2^N(\delta, \alpha_2^*) < t_1^*$. **Q.E.D.**

A9. Proof of Proposition 3

By Proposition 2, we have: $R_1^m(t_1^m, t_2^m) = R_1(t_1(t_m), t_m)$ when $t_m \leq t_1^*$; and $R_1^m(t_1^m, t_2^m) = \max\{R_1(t_1(t_m), t_m), R_1^m(\tilde{t}_1, \tilde{t}_2)\} \geq R_1(t_1(t_m), t_m)$ when $t_m > t_1^*$. Besides, it is straightforward to show that: $\forall t_m \in \left(t_2^N, t_1^N\right)$, $\frac{dR_1(t_1(t_m), t_m)}{dt_m} = \frac{\partial R_1}{\partial t_2} = \frac{t_1(t_m)}{\delta} > 0$ $\Rightarrow$ $R_1(t_1(t_m), t_m) > R_1(t_1(t_2^N), t_2^N) = R_1(t_1^N, t_2^N)$. Hence, the GMT always increases the large country's tax revenue.

Now we prove (ii). Firstly, we analyze the case of $t_2^N = t_1^*$. It is straightforward to show:

$$R_1(t_1(t_2^N), t_2^N) = R_1(t_1^N, t_2^N) > R_1(t_2^N, t_2^N) = \varphi_1(t_2^N) = \frac{(\alpha_1 - r)^2}{2(2 - t_2^N)}, \tag{A20}$$

where the inequality holds by the definition of the Nash equilibrium and the last equality is obtained by using $t_2^N = t_1^*$.

Using (A20) and the continuity of $R_1(t_1(t_m), t_m)$ and $\frac{(\alpha_1 - r)^2}{2(2 - t_m)}$, together with Proposition 2(iii), we can derive:

$\left[R_1(t_1(t_m), t_m) - \frac{(\alpha_1 - r)^2}{2(2 - t_m)} \right]\Bigg|_{t_m = t_2^N} > 0 \quad \Rightarrow$ when t_m is marginally above t_2^N,

$$R_1(t_1(t_m), t_m) > \frac{(\alpha_1 - r)^2}{2(2 - t_m)} \geq R_1^m(\tilde{t}_1, \tilde{t}_2) \text{ and thus } \left(t_1^m, t_2^m\right) = \left(t_1(t_m), \tilde{t}_2\right). \tag{A21}$$

Now consider introducing a GMT with minimum rate t_m marginally above t_2^N. It immediately follows from Proposition 2(i), (ii) and (A21) that: $R_2^m(t_2^m, t_1^m) = R_2(t_m, t_1(t_m))$ if $t_2^N < t_2^*$; and $R_2^m(t_2^m, t_1^m) = R_2^m(\tilde{t}_2, t_1(t_m)) > R_2(t_m, t_1(t_m))$ if $t_2^* \leq t_2^N \leq t_1^*$. Besides, using (A1) we can derive: $\frac{dR_2(t_m, t_1(t_m))}{dt_m}\bigg|_{t_m = t_2^N} = \left[\frac{\partial R_2}{\partial t_1} \cdot \frac{dt_1(t_m)}{dt_m} \right]\bigg|_{t_m = t_2^N} = \frac{t_2^N}{\delta} \cdot \frac{1}{2 - \delta \varphi_1''(t_1^N)} > 0 \Rightarrow$ when t_m is marginally above t_2^N, $R_2(t_m, t_1(t_m)) > R_2(t_2^N, t_1(t_2^N)) = R_2(t_2^N, t_1^N)$. So the marginal reform increases country 2's long-run revenue if $t_2^N \leq t_1^*$ (or equivalently, by Lemma 4, if $\alpha_2 \leq \alpha_2^*$, or if $\alpha_2 > \alpha_2^*$ and $\delta \leq \delta^{**}$).

On the other hand, there exist parameters $\left(\alpha_1, \alpha_2, \mu, r, \delta, \sigma\right)$ such that (i) $t_2^N > t_1^*$, (ii) $\sigma_2^m(t_2^N) < \sigma < \bar{\sigma}(t_2^N)$, (iii) $\left[\frac{(\alpha_1 - r)^2}{2(2 - t_m)} - R_1(t_1(t_m), t_m) \right]\bigg|_{t_m = t_2^N} = \frac{(\alpha_1 - r)^2}{2(2 - t_2^N)} - R_1(t_1^N, t_2^N) > 0$, and (iv) $\left[\frac{(\alpha_2 - r)^2}{2(2 - t_m)} - R_2(t_1^N, t_2^N) \right]\bigg|_{t_m = t_2^N} = \frac{(\alpha_2 - r)^2}{2(2 - t_2^N)} - R_2(t_1^N, t_2^N) < 0$. Then by the continuity of $\sigma_2^m(t_m)$, $\bar{\sigma}(t_m)$, $R_1(t_1(t_m), t_m)$ and $\frac{(\alpha_i - r)^2}{2(2 - t_m)}$ ($i = 1, 2$) and using Proposition 2(iii), we can show the following:

When t_m is marginally above t_2^N, (i) $\sigma_2^m(t_m) < \sigma < \bar{\sigma}(t_m) \Rightarrow \tilde{t}_i = \left(1 - \frac{\sigma_i^m(t_m)}{\sigma}\right) t_m$, $i = 1,2$; (ii) $R_1^m(\tilde{t}_1, \tilde{t}_2) = \frac{(\alpha_1 - r)^2}{2(2 - t_m)} > R_1(t_1(t_m), t_m) \Rightarrow t_1^m = \tilde{t}_1$, $t_2^m = \tilde{t}_2$; and (iii) $R_2^m(\tilde{t}_2, \tilde{t}_1) = \frac{(\alpha_2 - r)^2}{2(2 - t_m)} < R_2(t_1^N, t_2^N)$.

Thus, for such parameters $(\alpha_1, \alpha_2, \mu, r, \delta, \sigma)$, introducing a marginal GMT reform induces both countries to undercut the minimum and reduces country 2's long-run revenue.

Lastly, we prove (iii). By Proposition 2, country 2's equilibrium tax revenue can be decomposed as follows:

$$R_2^m(t_2^m, t_1^m) = \underbrace{t_m\left(f_2 - \mu r k_2\right) - \left(t_m - t_2^m\right)\sigma k_2}_{taxation\ on\ true\ profit} + \underbrace{t_m g^m(t_m)}_{taxation\ on\ shifted\ profit},$$

where $t_2^m = \begin{cases} t_m & if \quad t_m \le t_2^* \\ \tilde{t}_2 & if \quad t_m > t_2^* \end{cases}$ and $g^m(t_m) = \begin{cases} 0 & if \quad t_m > t_1^* \text{ and } R_1^m(\tilde{t}_1, \tilde{t}_2) > R_1(t_1(t_m), t_m) \\ \frac{t_1(t_m) - t_m}{\delta} & \text{otherwise} \end{cases}$.

For $t_2^N < t_m \le t_2^*$, recall that $\varphi_2'(t_2^*) > 0$ and $\varphi_2''(t_2) < 0$, which leads to: $t_m\left(f_2 - \mu r k_2\right) - \left(t_m - t_2^m\right)\sigma k_2 = \varphi_2(t_m) > \varphi_2(t_2^N)$. For $\sigma \in \left[\sigma_2^m, \bar{\sigma}\right]$ and $t_m > \max\left\{t_2^N, t_2^*\right\}$, it is straightforward to show: $t_m\left(f_2 - \mu r k_2\right) - \left(t_m - t_2^m\right)\sigma k_2 = \frac{(\alpha_2 - r)^2}{2(2 - t_m)} > \frac{(\alpha_2 - r)^2}{2(2 - t_2^N)} > \varphi_2(t_2^N)$. Therefore, given that $\sigma \in \left[\sigma_2^m, \bar{\sigma}\right]$, the revenue from taxing the true profit is higher than that without the GMT.

On the other hand, when $t_m \le t_1^*$, $\frac{\partial\left(t_m g^m\right)}{\partial t_m} = g^m(t_m)\left(1 - \varepsilon_g(t_m)\right)$, where $\varepsilon_g(t_m) := -\frac{\partial g^m / g^m}{\partial t_m / t_m} = \frac{t_m\left(1 - t_1'(t_m)\right)}{t_1(t_m) - t_m} > 0$ is the elasticity of profit shifting with respect to the minimum rate (measured positively). Besides, using (A1) we can show that: $\frac{d\varepsilon_g(t_m)}{dt_m} = \frac{\left(1 - t_1'(t_m) - t_m t_1''(t_m)\right)\left(t_1(t_m) - t_m\right) + t_m\left(1 - t_1'(t_m)\right)^2}{\left(t_1(t_m) - t_m\right)^2} > 0$, where $t_1''(t_m) = \frac{\delta\varphi_1'''(t_1)}{\left[2 - \delta\varphi_1''(t_1)\right]^3} < 0$ since $\varphi_1'''(t_1) = -\frac{3r^2\left(3 + t_1\right)\left(1 - \mu\right)^2}{\left(1 - t_1\right)^5} < 0$. That is, $\varepsilon_g(t_m)$ strictly increases with t_m. Then for any minimum t_m satisfying $t_m \le t_1^*$ and $\varepsilon_g(t_m) \le 1$, by the mean value theorem we have: $t_m g^m - t_2^N g_2^N = \left(t_m - t_2^N\right) \cdot g^m(\omega)\left(1-\varepsilon_g(\omega)\right) > 0$, where $\omega \in \left(t_2^N, t_m\right)$. So the revenue from taxing the shifted profit is higher than that without the GMT.

In summary, the conditions for the GMT to increase the small country's revenue are: $\sigma \in \left[\sigma_2^m, \bar{\sigma}\right]$, $t_m \le t_1^*$ and $\varepsilon_g(t_m) \in (0,1]$. **Q.E.D.**

Appendix B. Conditions for excess profits to be positive

B1. The condition for short-run excess profit $E_2 > 0$

In the short run, the excess profit of affiliate 2 is: $E_2 = f_2(k_2^m) - \mu r k_2^m + g^m - \sigma k_2^m$, where k_2^m and g^m are given by (7) and (8), respectively. In what follows, we analyze two cases:

Case (i): $\sigma \le \dfrac{(1-\mu t_m)r - \alpha_2(1-t_m)}{t_m - t_2^N}$. In this case, there is no investment in country 2, i.e., $k_2^m = 0 \;\Rightarrow\; E_2 = g^m = \dfrac{t_1^N - t_m}{\delta} > 0$.

Case (ii): $\sigma > \dfrac{(1-\mu t_m)r - \alpha_2(1-t_m)}{t_m - t_2^N}$. In this case, $k_2^m = \dfrac{\alpha_2(1-t_m) - (1-\mu t_m)r + (t_m - t_2^N)\sigma}{1-t_m} > 0$

$\Rightarrow$

$$E_2 = f_2(k_2^m) - \mu r k_2^m + g^m - \sigma k_2^m > f_2(k_2^m) - \mu r k_2^m - \sigma k_2^m = k_2^m \cdot \frac{\alpha_2\left(1-t_m\right) + r\left(1-\left(2-t_m\right)\mu\right) - \left(2-t_2^N-t_m\right)\sigma}{2\left(1-t_m\right)}$$

$$\Rightarrow\; E_2 > 0 \text{ if } \sigma \le \frac{\alpha_2\left(1-t_m\right) + r\left(1-\left(2-t_m\right)\mu\right)}{2-t_2^N-t_m} =: \bar{\sigma}^S(t_m).$$

Combining Cases (i) and (ii), a sufficient condition for $E_2 > 0$ is: $\sigma \le \bar{\sigma}^S(t_m)$.

B2. The condition for long-run excess profit $E_i \ge 0$, $\forall t_i \in [0, t_m)$, $\forall i \in \{1,2\}$.

Suppose that country i sets its tax rate below the minimum, i.e., $t_i < t_m$. Then we have: $E_i = f_i(k_i^m) - \mu r k_i^m + (-1)^i g^m - \sigma k_i^m \ge f_i(k_i^m) - \mu r k_i^m - \sigma k_i^m = \left(\alpha_i - \dfrac{k_i^m}{2} - \mu r - \sigma\right) k_i^m$, where k_i^m and g^m are given by (12) and (14), respectively.

Given (12), k_i^m is decreasing in t_i with $k_i^m \geq 0$. So for all $t_i \in [0, t_m)$, $E_i \geq 0$ if $\alpha_i - \frac{k_i^m}{2}\bigg|_{t_i=0} - \mu r - \sigma \geq 0$ (or equivalently, if $\sigma \leq \frac{\alpha_i(1-t_m)+(1+\mu t_m - 2\mu)r}{2-t_m} =: \bar{\sigma}_i$).

Therefore, $\forall t_i \in [0, t_m)$, $\forall i \in \{1,2\}$, $E_i \geq 0$ if and only if $\sigma \leq \min\{\bar{\sigma}_1, \bar{\sigma}_2\} = \bar{\sigma}_2 =: \bar{\sigma}$.

Appendix C. Sufficient conditions for the quasiconcavity of $R_2^m(t_m)$, $\forall t_m \in \left(t_2^N, t_1^N\right)$

Firstly, to ensure that the short-run excess profit $E_2 > 0$ for all $t_m \in \left(t_2^N, t_1^N\right)$, we impose an upper bound on the carve-out, i.e., $\sigma \leq \inf_{t_m \in \left(t_2^N, t_1^N\right)} \bar{\sigma}^S(t_m) = \bar{\sigma}^S(t_1^N)$. In what follows, we analyze two cases, separately.

Case (a): $\alpha_2(1-t_1^N) - (1-\mu t_1^N)r + (t_1^N - t_2^N)\sigma < 0$ (i.e., $\sigma < \frac{(\alpha_2 - \mu r)t_1^N - (\alpha_2 - r)}{t_1^N - t_2^N}$). Given (7), we distinguish the following two subcases.

Subcase (a1): $t_m \in \left(t_2^N, \frac{\alpha_2 - r - \sigma t_2^N}{\alpha_2 - \mu r - \sigma}\right)$. We have $k_2^m = \frac{\alpha_2(1-t_m) - (1-\mu t_m)r + (t_m - t_2^N)\sigma}{1-t_m}$. Together with (8) and (10), we can obtain:

$$\frac{d^2 R_2^m}{dt_m^2} = -\frac{\left[\left(1-t_2^N\right)\sigma - r(1-\mu)\right]\left[\left(2 - t_2^N(4-t_m) + t_m\right)\sigma - r(2+t_m)(1-\mu)\right]}{(1-t_m)^4} - \frac{2}{\delta}. \tag{C1}$$

Besides, it is readily verified that $\frac{(\alpha_2 - \mu r)t_1^N - (\alpha_2 - r)}{t_1^N - t_2^N} < \frac{r(1-\mu)}{1-t_2^N} < \min\left\{\frac{r(2+t_m)(1-\mu)}{2 - t_2^N(4-t_m) + t_m}, \bar{\sigma}^S(t_1^N)\right\}$. Then it immediately follows from (C1) that: $\forall t_m \in \left(t_2^N, \frac{\alpha_2 - r - \sigma t_2^N}{\alpha_2 - \mu r - \sigma}\right)$, $\frac{d^2 R_2^m}{dt_m^2} < 0$.

Subcase (a2): $t_m \in \left[\frac{\alpha_2 - r - \sigma t_2^N}{\alpha_2 - \mu r - \sigma}, t_1^N\right)$. We have $k_2^m = 0$ and $R_2^m = \frac{t_m\left(t_1^N - t_m\right)}{\delta}$. Besides, we can derive: $\frac{t_1^N}{2} < \frac{\alpha_1 - r}{2(\alpha_1 - \mu r)} \leq \frac{\alpha_2 - r}{\alpha_2 - \mu r} < \frac{\alpha_2 - r - \sigma t_2^N}{\alpha_2 - \mu r - \sigma} \Rightarrow R_2^m$ strictly decreases with t_m for all $t_m \in \left[\frac{\alpha_2 - r - \sigma t_2^N}{\alpha_2 - \mu r - \sigma}, t_1^N\right)$.

Combining Subcases (a1) and (a2) indicates that: $R_2^m(t_m)$ is quasiconcave for $t_m \in \left(t_2^N, t_1^N\right)$ when $\sigma < \dfrac{(\alpha_2 - \mu r)t_1^N - (\alpha_2 - r)}{t_1^N - t_2^N}$.

Case (b): $\alpha_2(1-t_1^N) - (1-\mu t_1^N)r + (t_1^N - t_2^N)\sigma \geq 0$ (i.e., $\sigma \geq \dfrac{(\alpha_2 - \mu r)t_1^N - (\alpha_2 - r)}{t_1^N - t_2^N}$). From (6), for all $t_m \in \left(t_2^N, t_1^N\right)$, $k_2^m = \dfrac{\alpha_2(1-t_m) - (1-\mu t_m)r + (t_m - t_2^N)\sigma}{1-t_m}$ and $\dfrac{d^2 R_2^m}{dt_m^2}$ is given by (C1). We distinguish two subcases.

Subcase (b1): $\sigma \in \left[\dfrac{(\alpha_2 - \mu r)t_1^N - (\alpha_2 - r)}{t_1^N - t_2^N}, \dfrac{r(1-\mu)}{1-t_2^N}\right]$. Recall that $\dfrac{r(1-\mu)}{1-t_2^N} < \min\left\{\dfrac{r\left(2+t_m\right)\left(1-\mu\right)}{2-t_2^N\left(4-t_m\right)+t_m}, \bar{\sigma}^S(t_1^N)\right\}$, from which we can show: $\forall t_m \in \left(t_2^N, t_1^N\right)$, $\dfrac{d^2 R_2^m}{dt_m^2} < 0$.

Subcase (b2): $\sigma > \dfrac{r(1-\mu)}{1-t_2^N}$. It is straightforward to show: when $\sigma \geq \sup\limits_{t_m \in \left(t_2^N, t_1^N\right)} \dfrac{r\left(2+t_m\right)\left(1-\mu\right)}{2-t_2^N\left(4-t_m\right)+t_m} = \dfrac{r\left(1-\mu\right)\left(2+t_2^N\right)}{\left(1-t_2^N\right)\left(2-t_2^N\right)}$, $\dfrac{d^2 R_2^m}{dt_m^2} < 0$ holds for all $t_m \in \left(t_2^N, t_1^N\right)$.

Combining Subcases (b1) and (b2) indicates that: $R_2^m(t_m)$ is concave (and so quasiconcave) for $t_m \in \left(t_2^N, t_1^N\right)$ when $\sigma \in \left[\dfrac{(\alpha_2 - \mu r)t_1^N - (\alpha_2 - r)}{t_1^N - t_2^N}, \dfrac{r(1-\mu)}{1-t_2^N}\right]$, or when $\sigma \in \left[\dfrac{r\left(1-\mu\right)\left(2+t_2^N\right)}{\left(1-t_2^N\right)\left(2-t_2^N\right)}, \bar{\sigma}^S(t_1^N)\right]$.

In summary, $R_2^m(t_m)$ is quasiconcave for $t_m \in \left(t_2^N, t_1^N\right)$, if $\sigma \leq \dfrac{r(1-\mu)}{1-t_2^N}$ or if $\dfrac{r\left(1-\mu\right)\left(2+t_2^N\right)}{\left(1-t_2^N\right)\left(2-t_2^N\right)} \leq \sigma \leq \bar{\sigma}^S(t_1^N)$.

Appendix D. The analysis of the case of $\sigma \in \left(0, \underline{\sigma}\right]$

Notice that $0 < \sigma \leq \underline{\sigma} \;\Rightarrow\; t_m > \dfrac{\alpha_2 - r}{\alpha_2 - \mu r}$. Then given (1) and (12), it is straightforward to show that: $\forall t_2 \in [0,1]$, $k_2 = 0$. So when $\sigma \leq \underline{\sigma}$, country 2 becomes a tax haven with no capital investment such that the shifted profits (if any) constitute its only tax base. The following proposition states that there exists a continuum of Nash equilibria in this case.

Proposition D.1. *In the case of* $\sigma \in (0, \underline{\sigma}]$, *two countries set equilibrium tax rates in the following way:*

(i) *For* $t_m \le t_1^*$, $t_1^m = t_1(t_m)$ *and* $t_2^m \in [0, t_m]$;

(ii) *For* $t_m > t_1^*$, *two countries' equilibrium taxes are (*$t_1^m = t_1(t_m)$, $t_2^m \in [0, t_m]$*) when* $R_1(t_1(t_m), t_m) > R_1^m(\tilde{t}_1, t_2^m)$, *(*$t_1^m = \tilde{t}_1$, $t_2^m \in [0, \hat{t}_2^m]$*) when* $R_1(t_1(t_m), t_m) < R_1^m(\tilde{t}_1, t_2^m) < \overline{R}_1$, *and (*$t_1^m = \tilde{t}_1$, $t_2^m \in [0,1]$*) when* $R_1^m(\tilde{t}_1, t_2^m) \ge \overline{R}_1$; *both (*$t_1(t_m)$, $t_2^m \in [0, t_m]$*) and (*$\tilde{t}_1$, $t_2^m \in [0, t_m]$*) are equilibrium tax rates when* $R_1(t_1(t_m), t_m) = R_1^m(\tilde{t}_1, t_2^m)$,

where $\tilde{t}_i := \max\left\{0, \dfrac{(\sigma - \sigma_i^m) t_m}{\sigma}\right\}$, $R_1(t_1(t_m), t_m) = \varphi_1(t_1(t_m)) - \dfrac{t_1(t_m)[t_1(t_m) - t_m]}{\delta}$,

$$R_1^m(\tilde{t}_1, t_2^m) = \begin{cases} \dfrac{(\alpha_1 - r)^2}{2(2 - t_m)} & \text{if } \sigma > \sigma_1^m \\ \dfrac{(\alpha_1 - r)^2}{2(2 - t_m)} - \dfrac{(\sigma_1^m - \sigma)^2 (2 - t_m) t_m^2}{2(1 - t_m)^2} & \text{if } \sigma \le \sigma_1^m \end{cases}, \text{ and } \hat{t}_2^m \in (t_m, \overline{t}_1).$$

Proof. Given country 2's tax rate, country 1 can choose $t_1 = t_m$ to earn a positive revenue, i.e., $R_1^m(t_m, t_2) > 0$. By the same reasoning as in the proof of Proposition 2, we have: $\pi_1^m(t_1^m, t_2^m) > 0$ and $t_1^m < \dfrac{\alpha_1 - r}{\alpha_1 - \mu r}$.

We first prove part (i). From Lemma 3(i), when $t_m \le t_1^*$, undercutting the minimum is a strictly dominated strategy for country 1. So its equilibrium tax rate must meet $t_1^m \ge t_m$. In what follows, we analyze two cases.

Case (i): assume that $0 \le t_2^m \le t_m$. Then repeating Step 2 in the proof of Proposition 2(ii), we have $t_1^m = t_1(t_m)$. On the other hand, given $t_1^m = t_1(t_m)$, country 2's revenue function is:

$$R_2^m(t_2,t_1^m)=\begin{cases}\dfrac{t_m(t_1^m-t_m)}{\delta} & if\quad 0\le t_2<t_m\\ \dfrac{t_2(t_1^m-t_2)}{\delta} & if\quad t_m\le t_2<t_1^m\\ 0 & if\quad t_2\ge t_1^m\end{cases}$$

. Together with $\frac{t_1^m}{2}<\frac{\alpha_1-r}{2(\alpha_1-\mu r)}\le\frac{\alpha_2-r}{\alpha_2-\mu r}<t_m$, we can show that any tax rate choice on interval $[0,t_m]$ is country 2's best response.

Case (ii): assume that $t_2^m>t_m$. In this case, notice that: $\forall t_1\in\left[t_m,\min\left\{\overline{t}_1,t_2^m\right\}\right]$, $R_1^m(t_1,t_2^m)=\varphi_1(t_1)$ with $\varphi_1'(t_1)>0$. This implies that $t_1^m>t_m$. Recall that the only source of revenues for country 2 is taxing the profit shifted from country 1, which implies that country 2 undercuts country 1, i.e., $t_2^m<t_1^m$. So country 2's equilibrium revenue is $R_2^m(t_2^m,t_1^m)=\dfrac{t_2^m\left(t_1^m-t_2^m\right)}{\delta}$. Then by the same reasoning as in Step 3 in the proof of Lemma 1, for a tax rate t_2' that is marginally below t_2^m, we get: $R_2^m(t_2',t_1^m)>R_2^m(t_2^m,t_1^m)$, which contradicts the definition of Nash equilibrium. So there is no Nash equilibrium in this case.

Combining Cases (i) and (ii) leads to part (i).

Now we prove part (ii). When $t_m>t_1^*$, we analyze the following three cases.

Case (i): assume that $t_2^m\le t_m$. By the same reasoning as in Step 2 in the proof of Proposition 2(iii), it is straightforward to show: $t_1^m=t_1(t_m)$ when $R_1(t_1(t_m),t_m)>R_1^m(\tilde{t}_1,t_2^m)$, and $t_1^m=\tilde{t}_1$ when $R_1(t_1(t_m),t_m)<R_1^m(\tilde{t}_1,t_2^m)$. Country 1 is indifferent between choosing $t_1(t_m)$ and $\tilde{t}_1$ when $R_1(t_1(t_m),t_m)=R_1^m(\tilde{t}_1,t_2^m)$. On the other hand, for $t_1^m=t_1(t_m)$, country 2's revenue function is the same as in Case (i) in the proof of part (i). For $t_1^m=\tilde{t}_1$, country 2 cannot attract any paper profit from country 1 such that $R_2^m(t_2,t_1^m)=0$, $\forall t_2\in[0,1]$. Hence, any tax choice on interval $[0,t_m]$ is country 2's best response to t_1^m.

Case (ii): assume that $t_2^m>t_m$ and $t_1^m>t_m$. By the same reasoning as in case (ii) in the proof of Proposition D.1(i), we can show that no Nash equilibrium exists in this case.

Case (iii): assume that $t_2^m>t_m$ and $t_1^m\le t_m$. From Lemma 3, it must be that $t_1^m=\tilde{t}_1$. On the other hand, for $t_1\in[t_m,1]$, country 1's revenue function depends on the relationship between t_2^m and $\dfrac{\alpha_1-r}{\alpha_1-\mu r}$ in the following way:

When $t_2^m \geq \dfrac{\alpha_1 - r}{\alpha_1 - \mu r}$, $R_1^m(t_1, t_2^m) = \begin{cases} \varphi_1(t_1) & if \quad t_m \leq t_1 < \dfrac{\alpha_1 - r}{\alpha_1 - \mu r} \\ 0 & if \quad t_1 \geq \dfrac{\alpha_1 - r}{\alpha_1 - \mu r} \end{cases}$; When $t_2^m < \dfrac{\alpha_1 - r}{\alpha_1 - \mu r}$,

$$R_1^m(t_1, t_2^m) = \begin{cases} \varphi_1(t_1) & if \quad t_m \leq t_1 < t_2^m \\ R_1(t_1, t_2^m) & if \quad t_2^m \leq t_1 < \hat{t}_1 \\ 0 & if \quad t_1 \geq \hat{t}_1 \end{cases}, \tag{D1}$$

where $\hat{t}_1 \in \left(t_2^m, \dfrac{\alpha_1 - r}{\alpha_1 - \mu r} \right)$ is the unique value of t_1 such that $\pi_1^m(\hat{t}_1, t_2^m) = \left[f_1(k_1) - \mu r k_1 - \dfrac{t_1 - t_2^m}{\delta} \right] \Bigg|_{t_1 = \hat{t}_1} = 0$.

Given (D1), solving the maximization problem $\max\limits_{t_1 \in [t_m, 1]} R_1^m(t_1, t_2^m)$ yields:

$$\arg\max_{t_1 \in [t_m, 1]} R_1^m(t_1, t_2^m) = \begin{cases} t_1(t_2^m) & if \quad t_m < t_2^m \leq t_2^{\#} \\ t_2^m & if \quad t_2^{\#} < t_2^m \leq \overline{t}_1 \\ \overline{t}_1 & if \quad t_2^m > \overline{t}_1 \end{cases}, \tag{D2}$$

where $t_2^{\#} \in \left(t_1^N, \overline{t}_1 \right)$ is the unique value of t_2 satisfying $t_1(t_2^{\#}) = t_2^{\#}$.

Plugging (D2) into (D1) yields the value function:

$V(t_2^m) := \max\limits_{t_1 \in [t_m, 1]} R_1^m(t_1, t_2^m) = \begin{cases} R_1(t_1(t_2^m), t_2^m) & if \quad t_m < t_2^m \leq t_2^{\#} \\ \varphi_1(t_2^m) & if \quad t_2^{\#} < t_2^m \leq \overline{t}_1 \\ \overline{R}_1 & if \quad t_2^m > \overline{t}_1 \end{cases}$, which is continuous in t_2^m for all $t_2^m \in [t_m, 1]$ and strictly increases with t_2^m for all $t_2^m \in (t_m, \overline{t}_1)$.

Notice that $(\tilde{t}_1, t_2^m)$ are Nash equilibrium tax rates if and only if $R_1^m(\tilde{t}_1, t_2^m) \geq V(t_2^m)$, where $R_1^m(\tilde{t}_1, t_2^m) = \begin{cases} \dfrac{(\alpha_1 - r)^2}{2(2 - t_m)} & if \quad \sigma > \sigma_1^m \\ \dfrac{(\alpha_1 - r)^2}{2(2 - t_m)} - \dfrac{(\sigma_1^m - \sigma)^2 (2 - t_m) t_m^2}{2(1 - t_m)^2} & if \quad \sigma \leq \sigma_1^m \end{cases}$. Then it is straightforward to show the following:

If $R_1(t_1(t_m),t_m) < R_1^m(\tilde{t}_1,t_2^m) < \overline{R}_1$, then there exists a threshold $\hat{t}_2^m$ such that $t_1^m = \tilde{t}_1$, $t_2^m \in (t_m, \hat{t}_2^m]$ are equilibrium tax rates, where $\hat{t}_2^m \in (t_m, \overline{t}_1)$ is the unique value of t_2^m satisfying $V(\hat{t}_2^m) = R_1^m(\tilde{t}_1, \hat{t}_2^m)$;

If $R_1^m(\tilde{t}_1,t_2^m) \geq \overline{R}_1$, then $t_1^m = \tilde{t}_1$, $t_2^m \in (t_m, 1]$ are equilibrium tax rates;

If $R_1^m(\tilde{t}_1,t_2^m) \leq R_1(t_1(t_m),t_m)$, then there is no Nash equilibrium.

Lastly, combining Cases (i), (ii) and (iii) leads to part (ii) of the proposition. **Q.E.D.**

Appendix E. The extension: including labor

In the main text, we have analyzed a simplified version of the GMT where capital is the only (variable) input in the MNE's production process. Now we extend the base model to include labor input and provide a complete picture of the GMT. Specifically, the affiliate in country i employs capital k_i and labor l_i to produce a homogenous good according to a general Cobb-Douglas production technology $f_i(k_i,l_i) := k_i^{\lambda} l_i^{\beta}$, with $\lambda, \beta \in (0,1)$ and $\lambda + \beta < 1$. Each affiliate pays a wage rate w_i for each unit of labor. Labor is immobile, and the labor endowment in each country is $\overline{l}_i$ with $\overline{l}_1 > \overline{l}_2 > 0$. With this setup, country 1 (country 2) is the large country (small country) in the sense that country 1 has a larger population. The wage rate is endogenously determined by the labor market clearing condition $l_i = \overline{l}_i$, which equates labor demand l_i and labor endowment $\overline{l}_i$. In line with most countries' corporate tax systems, we assume that payroll cost is fully tax deductible and that a fraction $\mu \in [0,1)$ of capital cost can be deducted from the corporate tax base. The GloBE income (i.e., taxable profit) of affiliate i is $\pi_i = f_i(k_i) - \mu r k_i - w_i l_i + (-1)^i g$. The other settings in the base model are kept unchanged.

Absent the GMT, the MNE's after-tax profit is:

$$\Pi = \sum_{i=1}^{2} \left[(1-t_i)\left(f_i - \mu r k_i - w_i l_i + (-1)^i g\right) - (1-\mu) r k_i \right] - \frac{\delta}{2} g^2 .$$

The tax revenue of country i reads:

$$R_i = t_i \pi_i = t_i \left(f_i - \mu r k_i - w_i l_i + (-1)^i g \right).$$

Similar to the base model, we can establish the existence and uniqueness of the Nash equilibrium with $t_i^N \in \left(0, \dfrac{1-\lambda}{1-\mu\lambda}\right)$, $i = 1,2$. At equilibrium, the small country sets a lower tax rate (i.e., $t_2^N < t_1^N$) to attract paper profits from the large country.

Now consider the introduction of the GMT with rate $t_m \in \left(t_2^N, t_1^N\right)$. In the short run, countries' tax rates are fixed, and only the MNE can adjust its strategies. The GMT is inactive for affiliate 1, while affiliate 2 has to pay a top-up tax, since country 2's tax rate is below the minimum. The SBIE allows the low-tax affiliate to deduct a fraction of the carrying value of tangible assets and payroll expenses from its GloBE income. For simplicity, we assume a common carve-out rate σ for capital stock and wage cost. Then the top-up tax paid by affiliate 2 is $(t_m - t_i)\left[\pi_i - \sigma(k_i + w_i l_i)\right]$.

The MNE's total after-tax profit reads:

$$\begin{aligned}\Pi^m &= \sum_{i=1}^{2}\left[\left(1-t_i^N\right)\left(f_i - \mu r k_i - w_i l_i + (-1)^i g\right) - \left(1-\mu\right) r k_i\right] - (t_m - t_2^N)\left[f_2 - \mu r k_2 - w_2 l_2 + g - \sigma(k_2 + w_2 l_2)\right] - \frac{\delta}{2} g^2 \\ &= (1-t_1^N)(f_1 - \mu r k_1 - w_1 l_1 - g) - (1-\mu) r k_1 + (1-t_m)(f_2 - \mu r k_2 - w_2 l_2 + g) - (1-\mu) r k_2 \\ &\quad + \underbrace{\sigma(t_m - t_2^N)(k_2 + w_2 l_2)}_{\text{tax saved from the SBIE}} - \frac{\delta}{2} g^2\end{aligned}$$

Under the QDMTT, the short-run revenues of two countries are:

$$R_1^m = t_1^N (f_1 - \mu r k_1 - w_1 l_1 - g),$$

$$\begin{aligned}R_2^m &= t_2^N (f_2 - \mu r k_2 - w_2 l_2 + g) + (t_m - t_2^N)\left[f_2 - \mu r k_2 - w_2 l_2 + g - \sigma(k_2 + w_2 l_2)\right] \\ &= t_m (f_2 - \mu r k_2 - w_2 l_2 + g) - \underbrace{\sigma(t_m - t_2^N)(k_2 + w_2 l_2)}_{\text{loss from the deduction of SBIE}}\end{aligned}.$$

The short-run revenue effect of the GMT is given by the following:

Proposition E.1. *In the short run where countries' tax rates are fixed,*

(i) *the large country benefits from the GMT;*

(ii) *introducing a GMT with minimum rate marginally higher than the small country's equilibrium tax without the GMT increases (reduces) the small country's tax revenue if* $\phi_2(t_2^N) := \left[-\frac{\partial k_2 / k_2}{\partial t_2 / t_2} - \frac{t_2}{1-t_2}\frac{-\bar{l}_2 f_{2lk}''}{k_2 f_{2kk}''} - \frac{1}{1-t_2}\frac{w_2 \bar{l}_2}{k_2} - 1\right]\Bigg|_{t_2 = t_2^N} > 0 \ (<0)$.

This proposition holds for a general form of production function. $\phi_2(t_2^N)$ incorporates several key variables evaluated at country 2's tax rate t_2^N: the tax elasticity of capital investment (in absolute value) $-\frac{\partial k_2 / k_2}{\partial t_2 / t_2}$, the elasticity of substitution between labor and capital (in absolute value) $-\frac{\bar{l}_2 f_{2lk}''}{k_2 f_{2kk}''}$, and the ratio of payroll cost to capital stock $\frac{w_2 \bar{l}_2}{k_2}$.

Notably, Proposition E.1(ii) also applies to the base model where labor input is absent. Letting $\bar{l}_2 = 0$, we have $\phi_2(t_2^N) = -\frac{\partial k_2^N / k_2^N}{\partial t_2^N / t_2^N} - 1$. So when capital is the only (variable) production input, a marginal GMT reform increases (reduces) the short-run revenue of country 2 if the elasticity of capital investment in absolute value is greater (smaller) than unity. This is an equivalent statement of Proposition 1(ii) in the base model.

Given the Cobb-Douglas production technology, we can present that: $\forall i = 1,2$, $\phi_i(t) = \left[-\frac{\partial k_i / k_i}{\partial t_i / t_i} - \frac{t_i}{1-t_i} \frac{-\bar{l}_i f''_{ilk}}{k_i f''_{ikk}} - \frac{1}{1-t_i} \frac{w_i \bar{l}_i}{k_i} - 1 \right]\Bigg|_{t_i = t} = \frac{t\left(1-\mu-\beta\left(1-\mu t\right)\right)}{\left(1-\lambda\right)\left(1-t\right)\left(1-\mu t\right)} - \frac{\beta r\left(1-\mu t\right)}{\lambda\left(1-t\right)^2} - 1 =: \phi(t)$.

In the long run, both the MNE and the governments can adjust their behavior in response to the GMT. The following proposition characterizes the long-run equilibrium tax rates.

Proposition E.2. *After the introduction of the GMT, two countries set equilibrium tax rates in the following way:*

(i) *For* $\phi(t_m) \le 0$, $t_1^m = t_1(t_m)$, $t_2^m = t_m$;

(ii) *For* $\phi(t_m) > 0$, *two countries' equilibrium taxes are (* $t_1^m = t_1(t_m)$, $t_2^m = \tilde{t}_2$ *) when* $R_1(t_1(t_m), t_m) > R_1^m(\tilde{t}_1, \tilde{t}_2)$, *and (* $t_1^m = \tilde{t}_1$, $t_2^m = \tilde{t}_2$ *) when* $R_1(t_1(t_m), t_m) < R_1^m(\tilde{t}_1, \tilde{t}_2)$; *both (* $t_1(t_m)$, $\tilde{t}_2$ *) and (* $\tilde{t}_1$, $\tilde{t}_2$ *) are equilibrium tax rates when* $R_1(t_1(t_m), t_m) = R_1^m(\tilde{t}_1, \tilde{t}_2)$, *where* $\tilde{t}_2 < t_m$.

When $\phi(t_m) \le 0$, the GMT binds the small country and makes the large country choose tax rate along the initial best-response function. By contrast, when $\phi(t_m) > 0$, the small country will undercut the GMT rate and collect top-up taxes at equilibrium. Consider introducing a GMT with minimum rate marginally higher than the small country's equilibrium tax without the GMT. Then using Propositions E.1(ii) and E.2(i), we can conclude that: the marginal reform will raise the small country's revenue in the long run if it harms the small country in the short run, as in the base model (see Remark 5).

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