The global minimum tax raises more revenues than you think, or much less

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Abstract

The OECD's proposal for a global minimum tax (GMT) of 15% aims for effective taxation of multinational firms by reducing the incentives to shift profits to tax havens. We study the revenue effects of the GMT by focusing on strategic tax setting effects. The direct effect from less profit shifting increases revenues in high-tax countries. A secondary effect, however, is that the value of attracting foreign investments increases, which intensifies tax competition. We show that when governments compete via firm-specific or uniform subsidies, the revenue gains from less profit shifting are exactly offset by higher subsidies. When competition is by tax rates, revenues may increase however.

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1 Introduction

In October 2021, 136 countries and jurisdictions agreed on a global minimum tax (GMT) of 15% for corporations. The deal falls under the OECD's two-pillar package and seeks to reduce shift profit shifting to tax havens and thus to create a level-playing field. The hope among many governments is that the agreement will raise substantially more tax revenues, which is in line with OECD estimates of worldwide tax revenue gains of 150 billion US dollars annually.[1] If successful, the initiative may also contribute to a reversal of a decades-long decline of effective corporate tax rates driven by both competition over real investments and profit shifting to low-tax jurisdictions.[2] From a historical perspective, the agreement appears unique when it comes to international tax coordination and, therefore, its success or failure will be of importance for future international tax coordination efforts.

The OECD's global minimum tax works like this. The effective tax rate of a subsidiary located in a low-tax country is found by dividing taxes paid by the subsidiary by its income (called GLOBE income). If the subsidiary has an effective rate of tax below the 15% minimum, the group must pay a top-up tax to bring its rate up to 15%. The top-up tax percentage (difference between 15% and the subsidiary's effective tax) is applied to the GLOBE income of the subsidiary, after taking adjustments to the tax base (substance based income exclusion, SBIE) and top-up taxes (qualified domestic top up tax rate, QDMTT) in the low-tax country into account.[3]

Studies that estimate the effect of Pillar 2 assume that there are no behavioral responses by governments and multinationals, and they only partly take into account some of the key features of Pillar 2, such as the SBIE and the QDMTT (see Perry (2022)). Recent estimates from the OECD and the IMF suggests that Pillar 2 will increase tax revenue globally in the range of USD 150 – 220 billion.[4] These most recent studies (detailed in section 5) all point to that tax revenue will go

[1] See OECD Newsletter on tax: https://www.oecd.org/tax/international-community-strikes-a-ground-breaking-tax-deal-for-the-digital-age.htm

[2] The global average statutory corporate tax rate has fallen from 49 percent in 1985 to 23 percent in 2019. See OECD Corporate Tax Statistics: Third Edition, 2021; Statutory corporate income tax rates, weighted by GDP.

[3] For details see OECD (2021), Statement on a Two-Pillar Solution to Address the Tax Challenges Arising from the Digitalisation of the Economy – 8 October 2021, OECD, Paris

[4] The IMF released their recent findings on the revenue estimates for Pillar 1 and 2 in a webinar on 18 January 2023. The presentation and the press release can be fonud here: https://www.oecd.org/tax/beps/webinar-economic-impact-assessment-two-pillar-solution.htm .

up, but it is unclear who gains the most of high-income countries and low-income countries.

In this paper, we study theoretically the revenue effects of the global minimum tax for non-haven countries by focusing on the strategic tax setting effects induced by the GMT. Our starting point of analysis is one with two high-tax countries and a tax haven. The high-tax countries have effective tax rates above, whilst the tax haven has an effective rate below the GMT. We do not model the specifics of the QDMTT nor the SBIE, but we assume that the tax haven collects the revenue that otherwise would be collected by the non-haven, and later show that it has the incentive to do so when its tax rate is endogenous. The SBIE reduces the top up tax, but does not eliminate the incentive to compete for mobile capital.

To the best of our knowledge, this study is the first to analyze theoretically the adjustment of tax rates in haven and non-haven countries as a result of a universal introduction of a global minimum tax when firm location decisions are endogenous. We share with Johannesen (2022) and Hebous and Keen (2021), discussed in more detail below, the interest in endogenous tax adjustment, and with Hines (2022) the effects of tax harmonization and minimum tax rates. Our work goes beyond the former literature, however, by explicitly modeling location decision of firms, and thus a real response to taxation, and not only in terms of profit shifting. Our approach, therefore, adds realism and in addition addresses the concern that actual corporate tax rates have been on a decline not only because of profit shifting, but also because of competition for real investment and firm location.[5]

In our base model we capture the global minimum tax through an exogenous increase in the haven's tax rate, which is in line with theoretical work by Johannesen (2022), who derives optimal haven tax rates as response to a global minimum tax, and with recommendations by one of the major international tax consultancy firms.[6]

With endogenous tax rates in non-havens the effect on tax revenues following an increase in the haven's tax rate is *a priori* not clear. The direct effect of the GMT is a reduction in profit shifting, which has a first order positive effect on revenues in high-tax countries because their tax

[5]For empirical evidence on the effects of taxation and tax competition on firm activity see M. Devereux, B., and Redoano (2008), Chirinko and D. Wilson (2017), Giroud and Rauh (2019), and M. Keen, Liu, and Pallan (2022).

[6]The consultancy firm KPMG argues that low-tax countries have an incentive to increase their corporate tax rate to capture some tax revenue that would otherwise be subject to tax elsewhere. See: https://home.kpmg/xx/en/home/insights/2021/05/global-minimum-tax-an-easy-fix.html

base grows. This makes higher taxes attractive at the margin. A secondary effect, however, is that for non-havens the value of attracting real foreign direct investments (i.e., the tax base of a multinational) increases due to less profit shifting, which in turn may intensify competition among non-havens for firms and their real activities. This tends to push tax rates down. Moreover, to the extent that tax competition is indeed reduced by the GMT and tax rates in non-haven countries increase, this in itself offsets in part the revenue gain in non-havens from less profit shifting.

We characterize the effects of the GMT for two different types of non-haven instruments: tax rates (section 2) and subsidies (section 3). The former captures the situation where governments use business taxes like the corporate tax rate as the main fiscal instrument to attract firms. The adjustment of the corporate tax rate could be seen as a long-term outcome of the GMT. Subsidies, by contrast, are often used by governments to target specific firms, or are used when business tax rates are hard to change politically. Empirical evidence provided by Ossa (2019), Mast (2020) and Slattery and Zidar (2020) show that US states and localities make indeed use of various forms of subsidies to attract businesses.

When governments compete in tax rates, we show that an increase in the non-haven tax rate is sufficient for non-haven tax revenues to increase (Prop. 1), which is akin to strategic complementarity.[7] In this case, revenues increase by more than what would be predicted from the reduction in profit shifting alone. The non-haven tax rate increases (decreases) if the initial tax revenues per firm are low (high). In further characterization (Prop. 2), we find that if profit shifting is very costly, tax competition is lax and thus non-haven tax rates are likely to decrease as a response to the GMT. By contrast, when profit shifting has eroded tax revenues of non-haven governments initially, tax revenues increase.

The outcome is very different when non-haven governments compete for firms by using subsidies, while tax rates are assumed constant and identical: the net fiscal revenues of non-haven countries are not affected by the introduction of a global minimum tax. This holds regardless of whether subsidies are firm-specific or uniform (Prop. 3-5). In both cases the equilibrium subsidy levels change when the haven tax rate increases, but in such a way that net revenues do not increase.

[7] Since the haven's tax rate is exogenous, our base model is different from the standard modeling of strategic complementarity, where all players have reaction functions. Whether tax rates are strategic substitutes or complements is analyzed in Chirinko and D. Wilson (2017) and Parchet (fc).

For example, under uniform subsidies the revenue gains for non-havens from less profit shifting are exactly offset by higher subsidies, and thus leave overall net revenues of non-havens unchanged. In this case, the fiscal capacity of a government falls way short of what would be predicted by the reduction in profit shifting alone.

The danger of offsetting incentives is real. Switzerland, for example, considers subsidies that counter the effect of the minimum tax.[8] If the Swiss policy response were to spill over to other countries, the global minimum tax agreement should be complemented with a restriction to limit competition with subsidies in order to generate the envisioned revenue gains for non-havens, as we discuss further in section 3.

Our paper is related to different literature. The starting point for policies aimed at curbing competition over mobile capital and profit shifting is the canonical tax competition model: benevolent governments set tax rates without taking into account the effect national tax policy has on other countries' tax bases. As a result, a fiscal externality arises that makes competition harmful in the sense that tax rates are set too low and public goods are underprovided in equilibrium.[9] The tax competition literature has given rise to a large literature on coordination of tax rates when countries compete to attract real investment. Konrad and Schjelderup (1999) come closest to the setting of the GMT in that they study whether a group of countries can gain from harmonizing their capital income taxes if the rest of the world does not follow suit. They show that cooperation among the subgroup of countries is beneficial if tax rates in the initial fully non-cooperative Nash equilibrium are strategic complements.[10] The tax coordination literature is surveyed in Michael Keen and Konrad (2013) who conclude that "... the agreement of minimum tax rates at levels somewhat above the lowest in the observed outcome is likely to be a fruitful path to coordinating away from inefficient outcomes than is agreeing on common rates."[11] Their conclusion, then, is in

[8] Among the measures considered are research grants, social security deductions and tax credits to offset any changes to headline tax rates. See: https://www.swissinfo.ch/eng/switzerland-plans-subsidies-to-offset-g7-corporate-tax-plan/46696800

[9] See e.g., Zodrow and Mieszkowski (1986) and John D Wilson (1986); John Douglas Wilson (1999) surveys the literature.

[10] Vrijburg and Mooij (2016) analytically derive conditions under which the slope of the tax-reaction function is negative in a classical tax competition model.

[11] The idea of the GMT is not new. In the area of corporate taxation, the Ruding Committee (Ruding (1992)) proposed for the EU a common minimum tax rate of 30 percent in 1992. For an empirical analysis of tax coordination and minimum taxes in the context of wealth taxes see Agrawal, Foremny, and Martinez-Toledano (2022).

line with the intention of the GMT.

Our paper also contributes to an emerging literature that analyzes theoretically the effects of the global minimum tax. Johannesen (2022) assumes that profits by multinationals are fixed and only the location of reporting profits is endogenous. He shows that the global minimum tax causes a coordinated tax rate increase in tax havens to the level of the minimum tax, which affects welfare in non-haven countries through two channels. First, a higher equilibrium tax rate in havens increases the total tax liabilities of multinational firms and represents a loss of private consumption for the owners of the firms located in non-haven countries. This lowers welfare in non-haven countries. Second, a higher tax rate in tax havens has a positive effect on welfare in non-haven countries as it reduces profit shifting and bolsters tax revenue. The net welfare effect is ambiguous. Hebous and Keen (2021) also assume that firms profits are fixed, while the location of reported profits is endogenous, and show in a two-country framework that a haven country may benefit from an exogenous increase in its own tax rate under plausible assumptions about strategic complementarity of tax policies.

Our analysis sets itself apart from the studies above in that we consider the real allocation of firm activity on top of profit shifting and in addition to investigating the induced strategic tax setting effect of the GMT, we allow the use of subsidies as an alternative policy tool. The recent work by Ferrari et al. (2023) models and quantifies the effects of a global minimum tax in a rich model with profit shifting and real investment decisions. Unlike our work, however, it does not model the endogenous adjustment of tax rates of all non-haven countries.

Finally, our paper relates to the work by Slemrod and Wilson (2009), who model the endogenous pricing of concealment services by tax havens in a model of tax competition for capital between non-haven countries. The exogenous elimination of tax havens in their model is similar in spirit but qualitatively different to our introduction of a global minimum tax. Slemrod and Wilson (2009) find that the elimination of tax havens is welfare improving for non-havens, while a similar strong statement cannot be made in the context of the GMT. A more recent contribution Hindriks and Nishimura (2022) analyses the success of a global minimum tax when countries are asymmetric and incentives to enforce the tax are endogenous. Enforcement incentives may break down under sufficient asymmetry, which may lead to a failure of the the GMT. While the mechanism is different from our model, the authors reach a conclusion similar to ours when subsidies are available.

The outline of the paper is as follows. In Section 2 we outline the model and study tax rate competition, while in section 3 we consider subsidy competition. In section 4 we consider extensions of the base model, in particular we introduce a non-revenue motive for non-haven countries. Section 5 discusses the results from a policy viewpoint and addresses possible extensions of the formal framework. Section 6 sums up our results .

2 A Model of Profit Shifting and Tax Competition for Firms

We consider a framework with three countries: Countries 1 and 2 (indexed by $i, j = 1, 2$) are non-havens countries and compete for firms. Country 3 is a tax haven to which profits are shifted from multinational firms operating their real activity in one of the two non-haven countries. Let tax rates on profits be denoted by t_1, t_2 for countries 1 and 2, respectively, and by t_h the rate for the tax haven. We assume that initially $t_h < t^{min} < (t_1, t_2)$, with t^{min} being the global minimum tax rate.

We capture the introduction of the global minimum tax t^{min} by an exogenous increase in t_h, but in section 4.3 we show that similar results can be obtained under an endogenous haven tax rate. The revenue from the GMT goes by assumption to the tax haven, as argued in the introduction, because otherwise the haven would leave tax money on the table. Our assumption is in line with Johannesen (2022), who establishes this outcome as result of a non-cooperative game. We focus on the induced effects of the GMT on changes in tax policy in non-haven countries, and their effects on firm location. Formally, we consider a non-cooperative game between countries 1 and 2, which set their policies simultaneously, in anticipation of firms making their location and profit shifting choices.

The main question is whether revenues in non-haven countries increase. Government revenues come from taxing profits. We assume that non-haven governments maximize tax revenues, which reflects the desire to increase tax payments from multinationals. In section 4.1 we go beyond the case of revenue maximization and consider a non-tax revenue motive.[12] In section 3 we consider subsidies as an alternative instrument, while holding tax rates constant.

2.1 The Firm's Decision Problem

A multinational firm, out of continuum (described below), operates its real activity either in country 1 *or* 2, while shifting profits to the tax haven, country 3. There are many multinational firms operating in different industries (hence no interaction in sales/pricing). Each firm earns gross profit s (i.e., sales) regardless of location, which can be thought of the value of sales in countries 1 and 2.[13] The parent firm's profit from producing and selling goods when located in country $i = 1, 2$ is

$$\pi_i = (1 - t_i)[s - g_i] - C(g_i), \tag{1}$$

where g_i is a transfer price to be paid for one unit of an intermediate good/intangible sold by the subsidiary of the firm located in country 3, the tax haven, and $C(g)$ is the strictly convex cost function for shifting profits. As is standard in the literature on profit shifting, the true price of the intermediate is normalized to zero and deviations from the true price are costly.[14] Costs to conceal abusive transfer pricing are assumed to be non-deductible, as is common in the literature, but we discuss in section 4.3 the implication of making concealment costs tax deductible.[15]

The firm shifts profits out of its non-haven company into the tax haven, where no real activity takes place. The subsidiary's profit in the tax haven is

$$\pi_h^i = (1 - t_h)g_i, \tag{2}$$

where the superscript i on the profit term indicates that the parent company is located in non-

[12] As long as there is underprovision of public goods, welfare maximization often gives qualitatively similar results as long as the government objective function includes the provision of public goods. For example, this property has been shown to hold in Janeba and Smart (2003).

[13] In section 4.1 we present a model with endogenous s.

[14] See e.g., Kant (1988) and A. Haufler and Schjelderup (2000); Göx and Schiller (2006) surveys the literature.

[15] A standard assumption in the literature is to assume that concealment costs are not tax deductible, see e.g., Huizinga, Laeven, and Nicodeme (2008) and Gresik, Schindler, and Schjelderup (2017).

haven country i. The optimal profit shifting price $g_i^* = g_i(t_i, t_h)$ is found by maximizing the sum of (1) and (2), $\Pi_i = \pi_i + \pi_h^h$, with respect to g_i, and is characterized by condition (3), reflecting the equalization of marginal benefits (tax savings) and marginal concealment costs,

$$C^{'}(g_i^*) = t_i - t_h,\ i = 1, 2. \tag{3}$$

When the haven's tax rate is below the non-haven's one, as we assume, profits are shifted into the haven. For given t_i an increase in the haven's tax rate reduces profit shifting and thus raises the firm's tax base in non-havens, that is,

$$\partial g_i^* / \partial t_h = -1/C^{''}(g_i^*) < 0 \tag{4}$$

This mechanical effect features prominently below when we consider the effects of a global minimum tax, as it represents a source of revenue gains for non-haven governments from the GMT. An increase in country i's tax rate has the opposite effect, $\partial g_i^* / \partial t_i = 1/C^{''} > 0$.[16]

Firms differ in their preference for country 1 relative to country 2, perhaps because different industries find different aspects of a country's characteristics relevant. Let F be the additional fixed cost of operating in country 1 relative to operating in country 2, which are assumed to be not tax deductible.[17] Let F be uniformly distributed on $[-\underline{F}, \overline{F}]$. Below we often invoke symmetry of country, which requires $\underline{F} = -\bar{F}$. The mass of firms is normalized to one, and $M(\hat{F}) = \frac{\hat{F} - \underline{F}}{\bar{F} - \underline{F}}$. Denote by $M_i(\hat{F})$ the mass of firms located in country i if the indifferent firm has fixed cost $\hat{F}$, and $m = 1/(\overline{F} - \underline{F})$ its constant density. We have $M_1 = M(\hat{F}), \quad M_2 = 1 - M(\hat{F})$ for countries 1 and 2, respectively, and furthermore

$$\frac{dM}{d\hat{F}} = \frac{dM_1}{d\hat{F}} = -\frac{dM_2}{d\hat{F}} = m. \tag{5}$$

[16] In most OECD countries multinationals must declare the chosen transfer prices on services and goods when they submit their accounts for tax purposes. The declaration may state the correct price (arm's length price) on the transaction or disguising it to shift profit to a low-taxed affiliate. The transfer pricing literature has approached this problem in several ways. One approach is through mechanism design, another is that it is costly to report falsely and that these costs are increasing in the difference between the true and the declared price. The various approaches in the literature are surveyed in Göx and Schiller (2006).

[17] A firm may have a better understanding of legal and societal mechanisms in country 2 relative to country 1, which makes it relatively more costly to operate in country 1.

In this section we assume that F is not observable to the government, although it knows the distribution, and hence the government cannot condition its tax policy on F. In section 3 we allow for firm-specific subsidies that condition on F.

The marginal firm that is indifferent between non-haven locations, taking optimal profit shifting condition (3) into account, is obtained from solving $\pi_1 + \pi_h^1 - \hat{F} = \pi_2 + \pi_h^2$, and has fixed cost

$$\begin{aligned} \hat{F} &= t_2 B_2^* - t_1 B_1^* + t_h(g_2^* - g_1^*) + C(g_2^*) - C(g_1^*) \\ &= F(t_1, t_2, t_h, g_1^*(t_1, t_h), g_2^*(t_2, t_h)), \end{aligned} \tag{6}$$

where $B_i^* = s - g_i^*$ is the tax base, taking optimal profit shifting (3) into account. Firms with fixed cost below the critical value, $F \leq \hat{F}$, operate in country 1, while those with fixed cost above it, $F > \hat{F}$, operate in country 2.

An increase in the haven's tax rate (for given non-haven tax rates) affects the fixed cost threshold, and thus the identity of the marginal firm

$$\frac{\partial \hat{F}}{\partial t_h} = \frac{\partial \pi_h^1}{\partial t_h} - \frac{\partial \pi_h^2}{\partial t_h} = g_2^* - g_1^*. \tag{7}$$

Condition (7) shows that the haven tax rate changes the firm distribution via its mechanical effect on a subsidiary's profit (π_h^i) if the transfer prices used in the non-haven countries are not the same. Recalling that firms with low fixed cost (below $\hat{F}$) locate in country 1, firms move to country 1 upon an increase in the haven rate if country 1 firms have a lower transfer price and hence $g_2^* > g_1^*$ (which is equivalent to country 1 having the lower tax). All indirect effects via a change of the profit shifting prices are zero by the envelope conditions for profit maximization (3). What remains is the direct effect from the haven's tax rate on profits.

Moreover, a change in a non-haven tax rate (for a given haven tax rate) affects the marginal firm as follows:

$$\frac{\partial \hat{F}}{\partial t_1} = -B_1^*, \quad \frac{\partial \hat{F}}{\partial t_2} = B_2^*. \tag{8}$$

An increase in the own tax rate drives some firms out of the country, as is standard in the literature on tax competition.

2.2 Tax Rate Competition

We now turn to the analysis of tax revenues. In non-haven countries $i = 1, 2$ these are given by

$$R_i = M_i(\hat{F}) \left[t_i B_i^* \right], \tag{9}$$

while in the haven country these are

$$R_h = t_h [M_1(\hat{F}) g_1^* + M_2(\hat{F}) g_2^*]. \tag{10}$$

Non-haven governments maximize (9) by choosing tax rates in a simultaneous Nash game, taking the haven tax rate as given, and taking the location (6) and profit shifting (3) decisions of firms into account. The Nash equilibrium is denoted as $t_1^*(t_h), t_2^*(t_h)$.

Maximizing non-haven country i's revenues with respect to t_i, we get the first order condition

$$\begin{aligned} \frac{dR_i}{dt_i} &= \frac{dM_i}{d\hat{F}} \frac{d\hat{F}}{dt_i} t_i B_i^* + M_i(\hat{F}) \left(B_i^* + t_i \frac{dB_i^*}{dt_i} \right) \\ &= - m t_i B_i^{*2} + M_i(\hat{F}) \left(B_i^* - t_i \frac{dg_i^*}{dt_i} \right) = 0. \end{aligned} \tag{11}$$

The first term represents the loss in tax revenues from firms leaving the country due to a marginally higher tax. The second term captures the effect on the tax base of a firm (for a given mass of firms). Conditions (11) for $i = 1, 2$ characterize implicitly the Nash equilibrium tax rates (t_1^*, t_2^*) as function of the haven's tax rate t_h.[18]

[18] The second order condition reads $-2mB_i^{*2} + \left[3mt_i B_i^* - 2M(\hat{F}) \right] \frac{dg_i^*}{dt_i} - t_i M(\hat{F}) \frac{\partial^2 g_i^*}{\partial t_i^{*2}}$, which is hard to sign in general. In case of a quadratic concealment cost function $C(g) = \delta g^2/2$, the second order condition simplifies to $-2mB_i^{*2} + 3mt_i B_i^* \delta^{-1} - 2M_i(\hat{F})\delta^{-1}$, which is negative if $\delta s > 5/2$ (the first two terms are negative).

The effect of t_h on net revenues in country i is, using conditions (7), (8) and (11),

$$\begin{aligned}\frac{dR_i}{dt_h} &= \frac{dR_i}{dt_i}\frac{dt_i^*}{dt_h} + \frac{dR_i}{dt_j}\frac{dt_j^*}{dt_h} + \frac{\partial R_i}{\partial t_h} \\ &= \frac{dM_i}{d\hat{F}}\left(\frac{d\hat{F}}{dt_j}\frac{dt_j^*}{dt_h} + \frac{\partial \hat{F}}{\partial t_h}\right) t_i^* B_i^* + M_i(\hat{F}) t_i^* \frac{\partial B_i^*}{\partial t_h} \\ &= m\left(B_j \frac{dt_j^*}{dt_h} + (g_j^* - g_i^*)\right) t_i^* B_i^* - t_i^* M_i \frac{\partial g_i^*}{\partial t_h}.\end{aligned} \tag{12}$$

The first term in (12) is zero by first order condition (11). The second term is the strategic effect that comes from the change in the other country's tax rate. The last term comprises a mechanical effect on the transfer price from the global minimum tax, which is positive for non-haven revenues as mentioned above, and a relocation effect based on (7), which is zero in a symmetric tax situation. Therefore, the key issue for the sign of (12) is whether t_j^* rises or falls with t_h. If t_j^* rises, then (in a symmetric equilibrium) revenues in i increase by more than the mechanical effect because dR_i/dt_j is positive. However, if t_j^* falls with t_h, revenues go up by less than the mechanical effect. This is our first result.

Proposition 1. *If in a symmetric Nash equilibrium the non-haven tax rate does not decrease after the introduction of the GMT, tax revenues in non-haven countries increase.*

Note that Proposition 1 refers to a sufficient condition. A decrease in the non-haven tax rates could be consistent with an overall revenue increase, if the mechanical effect is sufficiently large.

To shed light on the crucial sign of the derivative dt_j^*/dt_h in (12), we totally differentiate the first order conditions for revenue maximization (11) for $i = 1, 2$, and use the notation $V^i := dR_i/dt_i = 0$ and $V_j^i := d^2R_i/dt_i dt_j$ for $i = 1, 2$, where $j = 1, 2, h$. Hence, $V_i^i < 0$ is the second order condition for revenue maximization. We obtain

$$V_i^i \frac{dt_i^*}{dt_h} + V_j^i \frac{dt_j^*}{dt_h} + V_h^i = 0, \; i, j = 1, 2, \; i \neq j.$$

Solving the system of two equations results in

$$\frac{dt_j^*}{dt_h} = \frac{V_i^i V_h^j - V_i^j V_h^i}{V_j^i V_i^j - V_i^i V_j^j}. \tag{13}$$

The expression can be simplified if one assumes a symmetric equilibrium with $t_1^* = t_2^* = t^*$. In this case, $V_j^i = V_i^j$, $V_i^i = V_j^j$ for $i, j = 1, 2, i \neq j$,and $V_h^1 = V_h^2 = V_h$. Equation (13) can thus be written as

$$\frac{dt^*}{dt_h} = -\frac{V_h}{V_i^j + V_i^i}. \tag{14}$$

The denominator is negative $V_i^j + V_i^i < 0$, that is, the direct effect of an own tax increase on the marginal revenue gain is in absolute value larger than the cross effect of the other country's tax increase. This follows from the stability condition of the Nash equilibrium.[19] Hence, under symmetry the sign of (14) is equal to the sign of V_h, which represents the partial effect of the haven's tax rate on the first order condition for revenue maximization, i.e., the effect of the tax haven's tax on the marginal benefit and marginal cost of raising country i's tax. Differentiating (11) to derive V_h, we obtain

$$\begin{aligned} V_h &= -2mt_iB_i\frac{\partial B_i}{\partial t_h} + \frac{dM}{d\hat{F}}\frac{d\hat{F}}{dt_h}\left(B_i^* - t_i\frac{dg_i^*}{dt_i}\right) + M_i(\hat{F})\left(\frac{\partial B_i^*}{\partial t_h} - t_i\frac{\partial^2 g_i^*}{\partial t_i \partial t_h}\right) \\ &= \left[2mt_iB_i - M_i(\hat{F})\right]\frac{\partial g_i^*}{\partial t_h} + \frac{dM}{d\hat{F}}\frac{d\hat{F}}{dt_h}\left(B_i^* - t_i\frac{dg_i^*}{dt_i}\right) - t_iM_i(\hat{F})\frac{\partial^2 g_i^*}{\partial t_i \partial t_h} \end{aligned} \tag{15}$$

Condition (15) has three terms. The second vanishes under equal tax rates, as the term $d\hat{F}/dt_h$ is zero in a symmetric Nash equilibrium, see (7). In that case, the firm distribution in the non-havens is unaffected by the haven tax rate. The third term is also zero under a further condition: The derivative in the last term equals $-(C''')^{-1}dg_i^*/dt_h$, and is zero if the concealment cost function is quadratic (C'' is constant). Hence, the first term in square brackets is crucial for the sign of V_h, as the derivative of the transfer price regarding the haven tax rate is negative, $\partial g_i^*/\partial t_h < 0$, see (4). Recognizing that in a symmetric equilibrium $M(\hat{F}) = 1/2$, we find under a quadratic concealment cost function that V_h and thus non-haven tax rates decrease with the global minimum tax if the initial tax revenue is relatively large ($t^*B^* > 1/(4m)$), but positive if it is relatively small ($t^*B^* < 1/(4m)$).

[19] To see this, note that the slope of the reaction function in the tax game between non-haven countries is given by the sign of $dt_i/dt_j = -V_j^i/V_i^i > 0$. $V_j^i > 0$ because a country must be on its upward sloping part of the per firm tax revenue curve. Hence tax rates of non-haven countries are strategic complements. Stability requires that with symmetric non-haven countries the reaction function has a slope less than one, implying that the denominator of (14) is negative. See Fudenberg and Tirole (1991), p. 24.

The inequality is difficult to interpret in so far as it contains endogenous variables via B^*, but we can say something more about the left side of the inequality in case of a quadratic concealment cost function $C = \delta g^2/2$. When the cost of profit shifting become very large, $\delta \to \infty$, the transfer price g^* goes toward zero and the tax base converges to s. The Nash equilibrium tax rate is $t^* = 1/(2ms)$ and hence $t^*B^* = 1/(2m)$, which is larger than $1/(4m)$. Therefore, in this case, V_h is negative and the non-haven tax rate falls with the introduction of the GMT. Intuitively, in this situation there is little profit shifting to begin with and thus the benefit of the GMT on profit shifting is negligible. The reverse claim, for very low cost of profit shifting the initial tax revenue is small, is not necessarily true because non-haven tax revenues are not always a monotone function of the cost of profit shifting.

What can be stated, however, is that an opposite situation arises when profit shifting is so severe, such that taxable income $B^* = s - g^*$ of multinationals becomes zero, which implies $t^* = \delta s + t_h$. In this case, $t^*B^* = 0$, and therefore V_h and the non-haven tax rate clearly rise. The introduction of the minimum tax raises tax revenues by more than the mechanical effect. We may state.

Proposition 2. *Assume that non-haven countries compete via tax rates for a continuum of multinational firms, which locate their real activity in one non-haven country and have quadratic concealment cost for profit shifting. Starting from a symmetric Nash equilibrium in non-haven tax rates, the introduction of a global minimum tax:*

a) raises (lowers) the non-haven tax rate if before the introduction of the GMT the tax revenues per firm are low (high), i.e. $t^*B^* < (>) 1/(4m)$. *Tax revenues per firm are high initially when profit shifting costs are very large* $\delta \to \infty$, *but are low when initially profit shifting is so severe that* $B^* = 0$.

b) raises tax revenues in the haven country if the elasticity of profit shifting with respect to the haven's tax rate is greater than -1.

Statement a) is a core result of the paper, as it identifies conditions that make the GMT a success or failure in terms government revenues for non-haven countries. The result is not driven by a trade-off between private consumption and public good provision, as in Johannesen (2022) or

Ferrari et al. (2023), but rather from the full endogenous adjustment of non-haven tax rates when only tax revenues matter. Interestingly, the results can be interpreted as saying that the GMT is more likely to benefit non-haven governments if before the introduction of the GMT due to heavy profit shifting government revenues in non-havens are low. This carries policy implications relating to previous efforts in containing profit shifting such as OECD's BEPS initiative, which we discuss further in section 5. Statement b) in Proposition 2 can be easily seen by differentiating (10) to obtain

$$\frac{dR_h}{dt_h} = g^* \left(1 + \frac{t_h}{g^*}\frac{dg^*}{dt_h}\right), \tag{16}$$

which is positive if $\epsilon = \frac{t_h}{g^*}\frac{dg^*}{dt_h} > -1$, where the elasticity captures the total equilibrium effect on the transfer price (that is the direct effect of t_h on g^* as well as the indirect effect of t_h via changes in $t_i, i \neq h$).

Proposition 2 has immediate implications for the effect of the global minimum tax on firms. If worldwide tax revenues rise, these are paid by firm owners, and hence profits decline. At the same time, wasteful profit shifting may be reduced. The net effect can be derived formally: Conditional on a firm's location, and taking optimal profit shifting into account, the effect of the global minimum tax on world profits of a multinational firm $\mathit{\Pi}_i = \pi_i + \pi_h^i$ is given by

$$\frac{d\mathit{\Pi}_i}{dt_h} = -B_i^* \frac{dt_i^*}{dt_h} - g_i^*, \tag{17}$$

which is negative if the tax in non-haven countries does not fall. This is the same sufficient condition as for the non-haven country to benefit from the GMT.

Moreover, we note that spending on profit shifting $C(g^*)$ declines when the tax rate of non-havens does not increase by more than the increase of the haven country through the GMT, that is, $dt^*/dt_h < 1$, because then the optimal profit shifting price (3) decreases.

3 Subsidy Competition

Competition for firms may occur through a number of instruments besides taxes, such as government subsidies, good public infrastructure or a high quality labor force. In this section we focus on the role of subsidies that are often used by governments to attract firms (see, for example, Ossa (2019), Mast (2020), and Slattery and Zidar (2020)). Subsidies are attractive because they may be firm-specific and thus better targeted compared to taxes. On the other hand, subsidies are costly to the government and may be in conflict with international rules such as those from the WTO or state aid rules in the EU.

We assume that tax rates t_1, t_2 are non-zero, but exogenous, and governments compete for firms with subsidies z_i. The reason for exogenous corporate tax rates could be that they are much more salient in the public and thus subject to strong political forces, which make changes difficult. We consider two polar cases of subsidies: Firm-specific and uniform. The former allows the government to condition the subsidy on a firm's fixed cost (the only heterogeneity between firms in our model), while in the latter this is not feasible, perhaps because the government lacks information. In either case, we can write a firm's profit (before fixed cost) as

$$\pi_i = (1 - t_i)[s - g_i] - C(g_i) + z_i, \tag{18}$$

where z_i is government i's subsidy to a firm located in country i . We analyze how the introduction of a GMT changes net revenues of non-haven governments, that is, we return to the assumption of government revenue maximization.

3.1 Firm-specific subsidies

We assume initially that the non-haven governments observe F and condition subsidies on it so that $z_i(F)$. Non-havens compete firm by firm, as there exists a separate subsidy instrument for each firm. Competition for firms is a form of Bertrand competition. To simplify the analysis, let us assume that exogenous tax rates are the same, $t_1 = t_2 = t$. Then a firm's optimal transfer price and the amount of tax revenues collected in non-havens are the same regardless of where the firm locates.

The net fiscal revenue of country i from attracting a firm with fixed cost F is

$$r_i = t(s - g^*) - z_i(F), \tag{19}$$

where the optimal transfer price g^* is given by (3). If $F < 0$, country 1 has a locational advantage and can offer the better deal for the firm. Specifically, we construct the Nash equilibrium in subsidies for a specific firm: Country 2 makes the maximum bid, which brings its net fiscal revenues from that firm to zero if it were to attract the firm at that subsidy, i.e., $z_2(F) = t(s - g^*)$. Given that tax rates, other firm parameters, and the optimal transfer price are the same for both location choices, the firm locates in country 1 if and only if $z_1(F) - F \geq z_2(F)$. Country 1 offers just enough to attract the firm.

A Nash equilibrium is a pair of bids

$$z_1^*(F) = F + z_2^*, \qquad z_2^*(F) = t(s - g^*). \tag{20}$$

The firm locates in 1, as it is indifferent between locations, and government 2 has no incentive to offer a higher subsidy. If it did, it would attract the firm, but realize a net revenue loss. A similar argument applies when $F > 0$, with country 2 winning and the firm locating there.

Note that the fiscal revenue that the winning country 1 collects is

$$r_1 = t(s - g^*) - z_1(F) = -F > 0$$

(and $F > 0$ in case of country 2 winning a firm with high fixed cost of operating in country 1), which is independent of tax rates of all three countries! Since the argument applies to all firms, the introduction of a GMT does not change the overall net fiscal position of non-haven countries. While the GMT changes the equilibrium transfer price g^*, the bidding process neutralizes the induced change because the loosing country's bid equals always the variable profit of the firm, while the winning country's bid differs from that only by the fixed cost advantage. We summarize:

Proposition 3. *When countries compete in firm-specific subsidies conditional on fixed cost while non-haven tax rates are identical and exogenous, the introduction of the global minimum tax leaves non-haven net revenues unaffected.*

3.2 Uniform subsidies

In contrast, we now assume that subsidies cannot be made conditional on fixed cost and are therefore uniform for all firms locating in a country. We show that the conclusion about the neutrality of the GMT on non-haven revenues continues to hold. Uniform subsidies are necessary when the government lacks information about fixed cost.

The marginal firm that is indifferent between non-haven locations, taking optimal profit shifting condition (3) into account, is obtained from solving $\pi_1 + \pi_h^1 - \hat{F} = \pi_2 + \pi_h^2$, and has fixed cost

$$\hat{F} = t_2 B_2^* - t_1 B_1^* + t_h(g_2^* - g_1^*) + C(g_2^*) - C(g_1^*) + z_1 - z_2. \tag{21}$$

Changes in subsidies work one for one at the firm threshold, but in the opposite direction from taxes,

$$\frac{d\hat{F}}{dz_1} = 1, \ \frac{d\hat{F}}{dz_2} = -1. \tag{22}$$

We note the difference to the effect of tax rates on the threshold $\hat{F}$, as given by condition (8), where the effect depends on the tax base, which in turn depends on the profit shifting choice and the own tax rate. The subsidy, by contrast, does not effect the tax base and thus the extent of firm shifting in (22).

The revenue effects for non-havens and the haven country depend on the level of the initial tax rate differential and the adjustment of subsidies.

$$R_i = M_i(\hat{F}) \left[t_i B_i^* - z_i \right], \tag{23}$$

To study the latter, we consider the comparative statics of the Nash equilibrium in subsidies z_1^*, z_2^*. These values are obtained by focusing on net revenue maximization with respect to z_i, which leads to the first order condition

$$\frac{dR_i}{dz_i} = \frac{dM_i}{d\hat{F}} \left(\frac{d\hat{F}}{dz_i} \right) \left[t_i B_i^* - z_i \right] - M_i(\hat{F}) = m \left[t_i B_i^* - z_i \right] - M_i(\hat{F}) = 0. \tag{24}$$

The first term containing the square bracket is the gain in net revenues when at the margin m

additional firms enter the country, bringing net revenues of $t_iB_i - z_i$ per firm, while the second term represents the additional fiscal cost from raising the subsidy marginally. Condition (24) for countries 1 and 2 characterize the Nash equilibrium in subsidies $z_1^*(t_h), z_2^*(t_h)$.[20]

Rewriting (24) to obtain $z_i = t_iB_i - M_i/m$, then substituting back into (23), we get a simple characterization of net revenues:

$$R_i = \frac{(M_i(\hat{F}))^2}{m} \tag{25}$$

We are interested in how (25) is affected by the global minimum tax. For this, we analyze first the effect of t_h on optimal subsidies z_i^*. Totally differentiate (24) for both non-haven countries to obtain

$$dz_i = -t_i \frac{\partial g_i^*}{dt_h} dt_h - \left[(g_j^* - g_i^*)dt_h + dz_i - dz_j \right],$$

for $i = 1, 2, i \neq j$, which after solving leads to

$$\frac{dz_i}{dt_h} = \frac{1}{3} \left[\frac{t_j}{C''(g_j^*)} + \frac{2t_i}{C''(g_i^*)} + (g_i^* - g_j^*) \right]. \tag{26}$$

Note that this expression simplifies to $t/C''(g^*) > 0$ in case of identical tax rates, $t_1 = t_2 = t > 0$ and thus equal transfer prices $g_1^* = g_2^*$. In such a situation the global minimum tax raises subsidies to firms unambiguously. When tax rates are not identical, however, the sign of the change is less clear, as it depends on the difference in tax rates (and therefore transfer prices) and the curvature of the concealment cost function. We can make progress if we assume that the concealment cost function is quadratic, $C(g) = \delta g^2/2$, where $\delta > 0$ is a cost shifting parameter, and thus the second derivative $C''(g) = \delta$ is constant and $g^* = (t_i - t_h)/\delta$. The change in the subsidy (26) becomes $t_i/\delta > 0$. Hence, in equilibrium the country with the higher tax rate increases its subsidy more than the low tax country.

Proposition 4. *Assume that governments compete for firms via uniform subsidies, but tax rates are exogenous.*

a) When exogenous tax rates are the same in non-haven countries, the GMT increases subsidies by the amount of the mechanical effect from less profit shifting.

[20] The objective function is strictly concave in z_i, as the second derivative is $-2m < 0$.

b) When exogenous tax rates are not identical, the GMT increases subsidies more in the high tax country than in the low tax country, assuming a quadratic concealment cost function for profit shifting.

Next we analyze how the global minimum tax affects net revenues in non-havens. The effect of t_h on net revenues of non-havens is

$$\begin{aligned}\frac{dR_i}{dt_h} &= 2M_i(\hat{F})\left[\frac{d\hat{F}}{dz_i}\frac{dz_i}{dt_h} + \frac{d\hat{F}}{dz_j}\frac{dz_j}{dt_h} + \frac{\partial \hat{F}}{\partial t_h}\right] \\ &= \frac{2M_i(\hat{F})}{3}\left[\frac{t_i}{C''(g_i^*)} - \frac{t_j}{C''(g_j^*)} + (g_j^* - g_i^*)\right]. \end{aligned} \tag{27}$$

It is immediately clear that with equal tax rates, the global minimum tax leaves net revenues in non-havens unaffected, as the revenue effects from GMT induced direct and indirect changes in the firm allocation across countries offset each other. The result is robust to asymmetric tax rates if one assumes a quadratic concealment cost function. In this case the terms in the square bracket of (27) cancel out each other. While the high-tax country competes more aggressively by increasing its subsidy more than the low-tax country, the direct effect of the GMT is to shift firms to the low-tax country. The two effects offset each other in this particular case.

Furthermore, the effect of the GMT on revenues in the tax haven is similar to the case with tax rate competition. In case of symmetric tax rates ($t_1 = t_2$) it can be written again as in (16). A difference is that in the case of subsidy competition, tax rates are given by assumption and do not adjust. Hence, the elasticity of profit shifting in the present case is only a partial equilibrium response, while in (16) it involves an equilibrium response.

Proposition 5. *Assume that non-haven countries compete via uniform subsidies for a continuum of multinational firms, which locate in one of two non-haven countries, while tax rates are exogenously given.*

a) When the exogenous non-haven tax rates are the same, the introduction of a global minimum tax leads to increases in subsidies that offset the gain from less profit shifting. In that case net revenues in non-haven countries remain unchanged. The result holds also in case of asymmetric tax rates if the concealment cost function is quadratic.

b) The global minimum tax increases revenues of the haven country if the (partial) elasticity of profit shifting regarding the haven's tax rate is greater than -1.

It is also straightforward to calculate the effect on a firm's global profit, given its location and taking optimal profit shifting into account:

$$\frac{d\Pi_i}{dt_h} = \frac{dz_i^*}{dt_h} - g_i^*, \tag{28}$$

The first term is the change in subsidies, while the second is the higher tax applying to shifted profits in the haven country. Effects via changes in the optimal transfer price can be ignored due to an envelope argument. Again, we can sign the expression with an additional assumption: Under a quadratic concealment cost function, the effect on a firm's profit is unambiguously positive and equals t_i/δ, that is, the firm benefits from the GMT.

The latter result in conjunction with Proposition 5a appears paradoxical, as there are only winners (or, more precisely, no losers): the firms and the haven country gain, while non-havens are unaffected. It is explained by the efficiency gain in less wasteful profit shifting. When the cost of profit shifting are quadratic $C(g) = \delta g^2/2$ and the optimal transfer price is $g^* = (t_i - t_h)/\delta$, an increase in t_h reduces spending on profit shifting $C(g)$ by $(t_i - t_h)/\delta$, which equals exactly the joined gain in tax revenues of tax havens (16) and profit of firms (28).[21] If one considers spending on profit shifting is wasteful, as we do, then the global minimum tax has a positive effect, as profit shifting is reduced. At the same time, however, competition via uniform subsidies enriches only haven governments, while non-haven governments are unaffected.

Our result relates to the findings by Slemrod and Wilson (2009), who consider parasitic tax havens that influence tax competition among non-havens. In their model, an exogenous elimination of tax havens improves welfare because wasteful income shifting is reduced and public good supply in non-havens expands.

[21] The mass of firms is assumed to be one, so that aggregate profit change is also given by (28).

3.3 Discussion

Our analysis makes it clear that subsidies can be used as a tool to counter the GMT. Noked (2020) shows that both BEPS and Pillar 2 imply an advantage to non-tax subsidies (e.g., outright subsidy or investment grant) over economically equivalent tax benefits, and that multinational enterprises are generally better off when they receive non-tax subsidies instead of equivalent tax benefits. Thus, countries have a stronger incentive to adopt non-tax subsidies in order to attract the investment of multinational enterprises. Collie (2000) finds that even with distortionary taxation, in a symmetric model with imperfect competition, all countries subsidize their firms in the Nash equilibrium until price is equal to the marginal cost of imperfect competition. This leads to a Pareto-efficient outcome rather than the usual prisoner's dilemma in the (Brander and Spencer (1985)) model. If the cost of distortionary taxation is large enough, however, and tax revenues are sufficiently valued, the case for subsidies as an equilibrium outcome under imperfect competition is weakened.

In practice, the European Union has a policy designed to limit a member country's incentive to favor particular domestic firms through subsidies at the expense of their foreign competitors (Article 92(1) of the EU treaty). Despite this, the EU Commission has had to handle a steady flow of cases where state subsidies breech EU law (see Mason (2019)). Furthermore, the number of trade dispute cases, where subsidies have been used to win market shares in international markets, have risen over time (Hoekman and Nelson (2020)). These trends pose an ominous sign. Future research needs to adress how one can reduce the incentives for subsidy competition.

4 Extensions

In this section we revisit our results in modified setups, relating in particular to the objective function of non-haven governments and the endogeneity of the haven tax rate.

4.1 Welfare Maximization

In the baseline model we assume that non-haven governments maximize tax revenues, like tax havens. We now introduce a second, non-tax revenue motive for non-haven governments when choosing tax rates or subsidies. This not only makes non-havens different from havens, but also adds a bit of realism. We are interested in analyzing to what extent the insights from Propositions 2 and 5 on the effects of the GMT on tax rate and (uniform) subsidy competition are robust to this modification. It is clear that a non-tax revenue motive is likely to change the level of taxes and subsidies in equilibrium. Our interest, however, lies in how the introduction of the global minimum tax changes the welfare level of non-haven countries, which boils down to understanding how the GMT affects the marginal benefit and marginal cost of setting tax rates and subsidies, as became clear, for instance, in the derivation of the sign of V_h in section 2.2.

To model a non tax-revenue motive in a simple way we assume in the spirit of Haufler and Wooton (2010) and others, that there are transportation cost $\tau > 0$ for exporting (some) goods from country i to j. In our setup, transportation cost are partially reflected in market prices. This introduces a non-tax motive for a government to attract a firm, because locally produced goods are cheaper than imports, thus raising consumer welfare.

Specifically, a representative household in country i has quadratic-linear preferences of the form

$$U_i = y_i + \int_\mu \left[\alpha x_i(\mu) - \frac{\beta x_i(\mu)^2}{2} \right] d\mu + \gamma R_i, \tag{29}$$

where y is consumption of a numeraire good, $x(\mu)$ is consumption of a variety (indexed by μ) of a continuum of goods, and α, β, γ are positive parameters. The marginal benefit of the public good γ is assumed to be constant to simplify the analysis. One unit of tax revenues is converted into one unit of the public good, so that γR_i is the utility from public good consumption. Total private consumption spending is financed out of labor income. Labor supply is assumed to be exogenous and normalized to 1. Firms are owned by absentee owners, so profit income does not matter for the household.

The numeraire good is produced by competitive firms using labor as only input. We assume that this good can be traded without transportation cost and is produced by both countries. Hence wage rates are equalized across countries: $w_i = w$ for $i = 1, 2$. On the other hand, each variety of x is produced by a single, separate multinational firm, which acts as a monopolist.[22] Denote the price of a variety in country $j = 1, 2$ when the multinational firm is located in $i = 1, 2$ by $p_{j(i)}$ and the quantity sold by $x_{j(i)}$. For example, $x_{2(1)}$ represents the exports of a firm located in country 1 to country 2. Headquarter profits of a firm, which is located in i, are

$$\pi_i = (1 - t_i)[(p_{i(i)} - w)x_{i(i)} + (p_{j(i)} - w - \tau)x_{j(i)} - g_i] - C(g_i) = (1 - t_i)B_i - C(g_i), \tag{30}$$

where τ are the transportation cost. B_i is defined by the term in square brackets and represents the tax base of the firm. The local profit of the subsidiary in the haven country, $\pi_h^i = (1 - t_h)g_i$, and the optimal profit shifting decision characterized by $C'(g_i^*) = t_i - t_h$ are unaffected and the same as in (2) and (3).

In the appendix, we derive the goods market equilibrium for a variety, which is the same for all varieties (up to where the firm is located). In combination with the optimal transfer pricing decision this allows us to determine the marginal firm with fixed cost $\hat{F}$ that is indifferent between the two non-haven countries. The condition is qualitatively very similar to the base models, i.e. equations (6) and (21) for tax rate and subsidy competition, respectively. The term s is replaced by terms relating to the equilibrium outputs and prices, which are a function of the parameters α, β, τ, w. Note that these are independent of all tax rates because sales and wage costs are tax deductible.

In the appendix we also show that welfare in country i can be written as

$$\begin{aligned} W_i &= w + \lambda \left[\frac{\beta}{2} \left(M_i(\hat{F})x_{i(i)}^2 + (1 - M_i(\hat{F}))x_{i(j)}^2 \right) \right] + \gamma R_i, \\ &:= w + \lambda S_i + \gamma R_i \end{aligned} \tag{31}$$

[22]This feature could be relaxed by introducing a fixed number of domestic firms in each market and in each country, which produce only for the local market and do not export. In the ensuing oligopolistic market outcome, the price of the good is higher when the multinational firm serves the local market by exports from another country compared to when it produces locally, thus capturing the element of the current setup with a monopolist.

where the revenues from taxes are $R_i = M_i(\hat{F})t_iB_i$, as before. The term in square brackets S_i captures the non-tax revenue motive, as $x_{i(i)} > x_{i(j)}$. Lower prices of locally produced goods imply higher consumption. Since the output market structure is the same given the firm's location, surplus S depends on the quantities consumed and the mass of firms located in a country. Finally, $\lambda \in [0, 1]$l is a parameter to indicate the strength of the non-tax revenue motive; $\lambda = 0$ (in combination with $\gamma = 1$) is thus equivalent (ignoring constant w) to the setup of sections 2 and 3, while $\lambda = 1$ means the government maximizes household utility.

We now state the main result of this section. The proof is found in the Appendix.

Proposition 6. *Assume that non-haven countries maximize social welfare, as in (31), where λ reflects the strength of the non-tax revenue motive.*

a) Under tax rate competition, the effect of the GMT on the net marginal benefit of raising a country's tax rate (V_h) is declining in λ for given tax rates.

b) Under (uniform) subsidy competition the effect of the GMT on the net marginal benefit of raising the subsidy is independent of λ. The introduction of the GMT leads net revenues of non-havens unchanged, regardless of the strength of the non-tax revenue motive.

This result has immediate implications: Proposition 5 on uniform subsidy competition is unaffected by the introduction of the non-tax revenue motive, while under tax rate competition consideration of such motive leads ceteris paribus to lower tax rates (not necessarily relative to before the GMT was introduced, but relative to not considering non-tax revenue motive) and thus lower welfare. The ceteris paribus condition reflects the fact that for the full effect of the GMT on tax rates the size of the second-order effects V_i^i and V_i^j need to be considered as well as the other elements of V_h that may be affected indirectly via λ.

The intuition for Proposition 6 is the following. Raising one's tax rate creates a negative welfare effect (similarly when the subsidy is reduced) when the non-tax revenue motive is active because some firms leave the country and goods must be imported at higher prices. In equilibrium the mass of firms relocating as the tax rate increases is given by

$$\frac{dM_i(\hat{F})}{d\hat{F}} \frac{d\hat{F}}{dt_i} = -mB_i^* \tag{32}$$

under tax rate competition and by

$$\frac{dM_i(\hat{F})}{d\hat{F}}\frac{d\hat{F}}{dz_i} = m \tag{33}$$

under subsidy competition. The opposite sign is simply reflecting the fact that a higher tax is detrimental to attracting firms, while beneficial under higher subsidies. What is important, however, is that the GMT affects the tax base B_i^* positively, as less profits are shifted $\partial B_i^*/\partial t_h = -\partial g_i^*/\partial t_h > 0$, while there is no such affect when subsidies are used because they work directly on the marginal firm rather than indirectly via taxation and the firm's tax base. In other words, under tax rate competition the right hand side of (32) is a function of the GMT, while under subsidy competition (33) is not. As shown in the appendix, d^2S_i/dt_idt_h is in general not zero, while d^2S_i/dz_idt_h=0.

We conclude that welfare maximization may lead to partially different outcomes compared to revenue maximization. While our findings on subsidy competition are robust, the finding on tax rate competition suggest that subtle effects complicate the analysis further. We like to emphasize that our way of modeling of a non-tax revenue motive is only one out of many others and thus we cannot claim a general result. However, our results indicate in which way non-tax revenue motives influence the outcome and thus sheds light on the underlying mechanism. Furthermore, we note that the extended setup allows for consideration of asymmetries in country sizes, for example, by modeling different market sizes through the demand parameter α. We expect that larger countries are more attractive locations for multinational firms, as this saves transportation costs, which in turn makes higher tax rates sustainable. This reasoning follows Haufler and Wooton (2010), among others.

4.2 Endogenous haven tax rate

We assumed the haven tax rate to be exogenous, and would adjust to t_{min}, once the GMT is introduced. Suppose instead that the haven tax rate is endogenously chosen, as are the non-haven tax rates. Consider an initial Nash equilibrium under tax revenue maximization such that

$$t_h^* < t_{min} < t_1^* = t_2^* = t^*, \tag{34}$$

that is, a symmetric equilibrium among non-havens with a common tax level above the GMT, while the haven taxes below that initially. Now consider the following situation after introduction of the GMT as a candidate Nash equilibrium in tax rates among the three governments:

$$t_h^{**} = t_{min} < t_1^{**} = t_2^{**} = t^{**}, \tag{35}$$

where the non-haven tax rates equal to t^{**} are a best response to each other and to the haven tax rate at GMT level. The candidate, described in (35), is a Nash equilibrium if it does not pay for the haven to deviate from t_{min}. In that case Proposition 2 is confirmed in the presence of endogenous haven taxation.

It is easy to see that undercutting the minimum tax is not profitable for the tax haven because the multinational pays a top up tax in the non-haven countries, without any adjustment in transfer prices. Hence undercutting just leaves more revenues for the non-havens and cannot be profitable. An increase beyond the GMT level may or may not be beneficial for the haven. To see this, differentiate R_h with respect to t_h at the candidate given by (35), impose symmetry of the non-haven tax rates, to obtain

$$\frac{dR_h}{dt_h} = g^{**} - \frac{t_{min}}{C''(g^{**})}, \tag{36}$$

where $g^{**} = C^{-1'}(t^{**} - t_{min})$ comes from the condition for optimal profit shifting (3). The condition describes the trade off between greater revenues from a mechanical effect (for given profit shifting) and the loss in revenues from fewer profits being shifted.

We can derive a statement when this derivative is negative (and hence the candidate is a Nash equilibrium). To do so, consider the initial Nash equilibrium before the GMT was introduced, under which it must be true for the haven that

$$\frac{dR_h}{dt_h} = g^* - \frac{t_h^*}{C''(g^*)} = 0. \tag{37}$$

We compare (36) and (37). The first term in (36) is smaller than the first term in (37), that is $g^{**} < g^*$, if $t^* - t_h^* \geq t^{**} - t_{min}$. In that case, the benefits of raising the haven's tax rate are smaller under the GMT. The second term is larger in absolute value (i.e. more negative) under the GMT if C'' is constant because $t_{min} > t_h^*$. Taken together, we conclude that (36) is negative (under quadratic concealment costs): an increase of taxation is not profitable, as the marginal benefits are smaller and the marginal cost are higher compared to the situation in the initial tax equilibrium.

To conclude, the condition for no profitable deviation from the GMT holds when in equilibrium the tax difference between non-haven and haven countries shrinks (and C'' constant), which holds if the non-haven tax rate does not increase by more than the haven tax rate goes up when the GMT is introduced. This holds for sure when $V_h < 0$, which was discussed above. In this case Proposition 2 holds under endogenous haven taxation.

4.3 Tax deductible concealment cost

In line with previous literature, we assumed that concealment cost $C(g)$ are not tax deductible. Without this assumption the analysis is similar, but not identical. As far as the firm's decision goes, the optimal transfer price becomes a nonlinear function of the non-haven tax rate, i.e., $C'(g_i) = (t_i - t_h)/(1 - t_i)$. This is without consequence in so far that all tax-induced adjustments via the transfer price vanish due to an envelope argument. Hence, the comparative statics of the marginal firm with respect to the haven and non-haven tax rates (eq. 7 and 8) stay (qualitatively) the same. The same argument does not hold for government optimization problems and hence Proposition 2 does not easily extend. Tax rate changes affect government revenues through changes in g^* and thus B^*, which are now more involved. For example, the mixed derivative in the last term of (15) becomes a more complex object, which makes the signing of the revenue effects from the GMT more complicated without adding much insight, even though the tax deductibility of concealment cost may be a reasonable assumption on practical grounds.

5 Implementation Issues of the GMT

The SBIE and the QDMTT rule

A multinational enterprise must pay a top-up tax on behalf of subsidiaries in jurisdictions with effective tax rates below the GMT. The top-up tax is found by multiplying a top up tax rate with excess profits. The top up tax rate is the difference between the GMT and the effective tax in the low-tax country. Excess profits is the GLOBE income (the denominator in the calculation of the effective tax rate) minus the substance based income exclusion (SBIE), which is calculated as a percentage mark-up (5% in the long run) on tangible assets and payroll costs. For subsidiaries of multinationals that have real activity, the SBIE matters because it reduces the tax base that the top up rate is applied to. Thus, it makes it more attractive to invest in a low-tax jurisdiction and reduces the effective rate of tax in low-tax jurisdiction below the level of the GMT. In our formal analysis we have abstracted from the issue relating to the substance based income exclusion. Future research should address this aspect by allowing for real investment in low-tax countries.

A low-tax country may collect the top up tax if it applies a "qualified domestic top up tax (QDMTT)". The QDMTT should be designed according to the rules of Pillar 2 so that the tax rate used must not be below the top up tax rate and the tax base must be the same as under Pillar 2 or broader.[23] From a low-tax jurisdiction's perspective, it does not make sense to impose a higher tax rate on excess profits than the top up tax rate or to use a broader tax base than excess profits because it would increase the tax burden of the multinational company and make the low-tax jurisdiction less attractive as a place of investment. If a low-tax country does not implement the QDMTT it leaves "money on the table" for other countries without affecting the tax burden of the multinational. It seems logical, then, that the GMT will imply that most low-tax countries would implement the QDMTT-rule. Consistent with this outcome, we assumed in our baseline model that the tax haven collects the tax equivalent to the GMT.

Revenue implications of the GMT

The economic impact of the GMT on tax revenue, investment, and profit shifting is difficult to estimate because the combined effect of BEPS and Pillar 2 (and possibly Pillar 1 once agreed upon) are intertwined and of unprecedented character. Thus, predicting behavioral responses by MNEs in investment and profit as well as responses by governments regarding their domestic corporate tax policies (such as changes in tax rates or tax incentives) are therefore difficult as well. Accordingly,

[23]See paragraphs 118.34, 118.37, 118.38 in the publication: Tax Challenges Arising from the Digitalisation of the Economy – Administrative Guidance on the Global Anti-Base Erosion Model Rules (Pillar Two). OECD Publishing, Paris.

current estimates are at best qualified guesswork. Common for all existing studies on the effect of Pillar 2 is the assumption that headline corporate tax rates are unchanged. Another weakness of existing studies is that they either do not take into account the "qualified domestic top up tax" (QDMTT) or they omit the substance-based income exclusion (SBIE). Both the QDMTT and the SBIE have potentially big effects on tax revenues in single jurisdictions.

The OECD has adjusted its estimates on the effect of Pillar 2 upwards from a central estimate of USD 150 billion to an estimated annual global revenue gains of USD 220 billion based on calculations for the year 2018.[24] The revised OECD estimate takes into account the effect of the substance exclusion (SBIE) but not the QDMTT. Revenue estimates from IMF predict that the GMT - when the SBIE is in place - will increase global corporate income tax revenues by about 5.7 percent (USD 150 billion), which is before any behavioral responses by firms and governments.[25] This estimate is in line with the original OECD estimate that was revised upwards to USD 220 billion recently. The IMF study also examines the effect of the GMT on global tax competition by assuming that profit shifting has become less attractive and estimate that due to less competition, global tax revenue would increase to 8.1 percent (7.6 percent with SBIE).

UNCTAD (2022) assumes that all source countries adopt the QDMTT and that all pre-Pillar 2 tax haven income is (un)shifted.[26] Based on these assumptions, but omitting the SBIE, they estimate that Pillar 2 will increase tax revenues that arise from FDI by 20 percent globally. Developing countries (including emerging economies) would see a 15 percent increase in FDI generated tax revenues whereas developed economies a gain about 31 percent.

Researchers from the EU Tax Observatory Barake et al. (2021) using 2016 and 2017 country-by-country reporting data and data from ORBIS have estimated that the European Union would increase its corporate income tax revenue by a quarter of current corporate tax revenue, and that the United States would gain about €57 billion a year. They do not make specific assessment on the revenue implications for developing countries nor do they take into account the effect of the QDMTT and the SBIE.

[24]See OECD's economic impact assessment of the two-pillar solution – Revenue estimates for Pillar 1 and 2 (Webinar 18 January, 2023).

[25]See the reports; International corporate tax reform, IMF (2023) (February 2023) and IMF (2022), April 2022 Fiscal Monitor, Chapter 2: Coordinating Taxation Across Borders.

[26]UNCTAD World Investment Report 2022. International Tax Reforms and Sustainable Investment.

The studies referenced above predict that global corporate tax revenue in both low- and high-tax countries will increase following the GMT if corporate headline rates stay constant. Our study shows that the GMT may raise or lower tax rates and tax revenues depending on the intensity of tax competition and shows the importance of allowing tax rates to adjust endogenously. Our findings are aligned with the studies above when governments compete in tax rates in the sense that if the GMT leads to an increase in the non-haven tax rate this is a sufficient condition for non-haven tax revenues to increase (our Proposition 1). A deeper analysis shows that non-haven countries increase their headline rates when profit shifting has eroded tax revenues of non-haven governments. In this case initial tax competition for firms is intense (our proposition 2). As alluded to above, the case when profit shifting is easy and competition is intense, means that BEPS has not had an impact. If one expects BEPS to make it more costly to shift profits, our analysis indicate that tax revenue may fall. In this sense our results are intertwined with both BEPS and Pillar 2.

6 Conclusion

We set up a three country model that allows us to study the revenue effects of the global minimum tax for non-haven and haven countries by focusing on the strategic tax setting effects induced by the GMT. Non-haven countries compete via tax rates or subsidies, which drive the location decisions of a continuum of multinational firms and their profit shifting to a haven affiliate. We derive two main results. First, our analysis shows that the tax revenue effects of the GMT depend crucially on whether competition is over tax rates or over subsidies. If tax rates are exogenous, but governments compete for firms with a subsidy, the GMT leaves net tax revenues in non-haven countries unchanged, while increasing those of the haven country. In this subsidy game, multinationals benefit unambiguously. While this result goes hand in hand with a reduction in wasteful profit shifting, it does not generate the intended positive revenue effects for non-havens. The use of firm-specific subsidies is common in the US (see Slattery and Zidar (2020)), and hence we should expect governments to make use of them.

Second, if countries compete via tax rates, the GMT may raise or lower non-haven tax rates and tax revenues. This result may be surprising at first glance, and demonstrates the importance of allowing tax rates to adjust endogenously. The condition for an increase in tax rates and revenues can be related to the intensity of initial tax competition, which in turn depends on the cost of profit shifting. If shifting profits is easy, initial tax competition for firms is intense. In this scenario, revenues in non-havens rise. However, tax rates and tax revenue in non-haven countries may fall if the opposite is true, that is, tax revenue is initially large and competition is lax, for example because profit shifting is very costly. This result has interesting implications, as it suggests that previous attempts of reducing profit shifting, for example via the OECD's BEPS initiative, may have made the introduction of a global minimum tax less beneficial.

Our analysis assumes that the coalition of countries that have agreed on the GMT is stable. It is well known from the literature on cartels in the setting of firms that defecting from a coalition may be beneficial if either the probability of being caught, or the penalty for defection, is low. The analysis of coalition stability in the context of an international agreement among countries such as the GMT, however, is somewhat different from that of firms forming coalitions. The coalition stability problem of an agreement like the GMT may be overcome if signatory countries are linked via common policies in other fields and common institutional arrangements such as the various OECD initiatives (e.g., BEPS, Pillar 1 and 2, automatic tax information exchange agreements, country reports etc.). The various types of cooperation within the OECD may thus generate instruments for punishing defecting countries.

From a policy perspective, our paper highlights what may happen if the introduction of the GMT leads to competition over other incentives than tax. The danger of offsetting incentives is real, as discussed above. Incentives such as subsidies, tax holidays, free trade zones, and land and infrastructure paid for by governments to attract firms will become attractive to some countries in the wake of the GMT. Future work should address the adjustment of such instruments, including subsidies that take a more distortive role than we have considered here, that is, related to a firm decision variable other than location, such as capital investment or R&D. A further implication of our investigation is that it matters how the tax base is calculated under the GMT scheme. If there are loopholes, competition will again be over other instruments than tax rates. The risk, then, is that the potential benefit from the GMT is counteracted by such incentives. Even if all non-tax incentives are eliminated, our analysis shows that a rise in tax revenue among high-income high-tax countries due to the GMT is by no means assured.

7 Appendix

In this appendix we provide the details for the model with welfare maximization and the proof of Prop. 6.

We start with solving for the goods market equilibrium. A household maximizes (29) subject to the budget constraint

$$y_i + \int_\mu p_i x_i(\mu) d\mu = w, \tag{38}$$

taking public goods and all prices as given. Good y is the numeraire and there is a continuum of good x, indexed by μ. Recall that labor supply is normalized to 1 and the wage w is equalized across countries due to same linear technology and zero transportation cost. In the following we drop the index μ if no confusion is possible. Optimal inverse consumer demand for a variety is

$$p_i = \alpha - \beta x_i. \tag{39}$$

The firm maximizes (30) by choosing either price or quantity for each market, given its firm location. Using the inverse demand function, the firm's first order condition for profit maximization (markets can be considered separately because costs are linear in output and the wage is constant) is

$$-\beta x_{i(i)} + p_i - w = 0 \tag{40}$$

in the domestic market, and

$$-\beta x_{j(i)} + p_j - w - \tau = 0 \tag{41}$$

in the export market. In goods market equilibrium, which equates demand x_i and supply, either $x_{i(i)}$ or $x_{j(i)}$, we obtain

$$x_{i(i)} = \frac{\alpha - w}{2\beta} \tag{42}$$

in the local market and

$$x_{j(i)} = \frac{\alpha - w - \tau}{2\beta} \tag{43}$$

in the export market ($j \neq i$). We assume that parameters are such that all quantities are non-negative. Prices follow from inverse demand

$$p_{i(i)} = \frac{\alpha + w}{2} \tag{44}$$

and

$$p_{j(i)} = p_{i(j)} = \frac{\alpha + w + \tau}{2}. \tag{45}$$

Inserting these values into the household utility function (29) gives

$$U_i = w + S_i + \gamma R_i = w + \left[\frac{\beta}{2}\left(M_i(\hat{F})x_{i(i)}^2 + (1 - M_i(\hat{F}))x_{i(j)}^2\right)\right] + \gamma R_i, \tag{46}$$

where $w + S_i$ describes the utility from consuming private goods. Condition (46) shows the benefit of local production over imports. Shifting the production of one variety to one own's country raises S_i by $\beta(x_{i(i)}^2 - x_{i(j)}^2)/2 > 0$.

Social welfare $W_i = w + \lambda S_i + \gamma R_i$ builds on expression (46) by weighing the term in square brackets by $\lambda \in [0, 1]$. A Leviathan type government, which is interested only in the size of the public sector (ignoring the constant wage), is represented by $\lambda = 0$, and a benevolent government by $\lambda = 1$.

The total profit of a multinational firm located in i with a subsidiary in haven h is (in absence of subsidies and ignoring fixed costs), taking optimal transfer price g_i^* into account, given by

$$\Pi_i = \pi_i + \pi_h^i = (1 - t_i)\left[\frac{1}{\beta}\left(\left(\frac{\alpha - w}{2}\right)^2 + \left(\frac{\alpha - w - \tau}{2\beta}\right)^2\right) - g_i\right] - C(g_i^*) + (1 - t_h)g_i^*. \tag{47}$$

The indifferent firm between the two non-haven countries is characterized by the condition

$\Pi_1 - \hat{F} = \Pi_2$. From this we derive the partial effects

$$\frac{d\hat{F}}{dt_1} = -B_1^*, \frac{d\hat{F}}{dt_2} = -B_2^*, \frac{d\hat{F}}{dt_h} = g_2^* - g_1^*, \tag{48}$$

which mirrors (7) and (8).

7.1 Tax rate competition

Government revenues used for public good provision are

$$R_i = M_i(\hat{F})t_iB_i^* = M_i(\hat{F})t_i\left[\frac{1}{\beta}\left(\left(\frac{\alpha-w}{2}\right)^2 + \left(\frac{\alpha-w-\tau}{2\beta}\right)^2\right) - g_i^*.\right] \tag{49}$$

Now consider the optimal choice of the tax rate when the government maximizes welfare $W_i = w + \lambda S_i + \gamma R_i$. This gives

$$\begin{aligned}\frac{dW_i}{dt_i} &= \lambda\frac{dS_i}{dt_i} + \gamma\frac{dR_i}{dt_i}\\ &= \frac{dM_i}{d\hat{F}}\frac{d\hat{F}}{dt_i}\left(\gamma t_iB_i^* + \lambda\frac{\beta}{2}(x_{i(i)}^2 - x_{i(j)}^2)\right) + \gamma M_i(\hat{F})\left(B_i^* + t_i\frac{dB_i^*}{dt_i}\right) = 0.\end{aligned} \tag{50}$$

Note that this boils down to (11) if $\gamma = 1$ and $\lambda = 0$.

The effect of the GMT on welfare in i is given by

$$\begin{aligned}\frac{dW_i}{dt_h} &= \frac{dW_i}{dt_i}\frac{dt_i}{dt_h} + \frac{dW_i}{dt_j}\frac{dt_j}{dt_h} + \frac{\partial W_i}{\partial t_h}\\ &= \left[(\lambda S_i + \gamma t_iB_i^*)\frac{dM_i}{d\hat{F}}\frac{d\hat{F}}{dt_j}\right]\frac{dt_j}{dt_h} + (\lambda S_i + \gamma t_iB_i^*)\frac{dM_i}{d\hat{F}}\frac{\partial\hat{F}}{\partial t_h} - \gamma t_iM_i\frac{\partial g_i^*}{\partial t_h}\\ &=\lambda S_im\left[B_j^*\frac{dt_j}{dt_h} + (g_j^* - g_i^*)\right] + \gamma t_i\left[mB_i^*\left[B_j^*\frac{dt_j}{dt_h} + (g_j^* - g_i^*)\right] - M_i\frac{\partial g_i^*}{\partial t_h}\right],\end{aligned} \tag{51}$$

where we made use of the first order condition for welfare maximization in i (50). In a symmetric equilibrium, the terms involving the difference in transfer prices $g_j^* - g_i^*$ drops, $B_i^* = B_j^* = B^*$, $M_i = 1/2$ and we obtain

$$\frac{dW_i}{dt_h} = [\lambda S_i + \gamma B^*t_i]\,mB^*\frac{dt_j}{dt_h} - M_i\frac{\partial g_i^*}{\partial t_h}. \tag{52}$$

The condition is equivalent to (18) if $\gamma = 1$ and $\lambda = 0$. Note that the two terms in the square bracket have the same (positive) sign. Ceteris paribus, the non-tax revenue motive magnifies the effect from the base model. If tax rates increase in equilibrium, so much the better. If tax rates decline, the worse it is. We can sign the welfare effect to be positive if $dt_j/dt_h \geq 0$ since $-M_i \frac{\partial g_i^*}{\partial t_h} > 0$.

A key aspect is therefore whether the tax rate t_j rises or not with the GMT. For this we need to evaluate the effect of GMT on the net marginal benefit of raising the tax, similar to the steps take in section 2.2, i.e., V_h

$$\begin{aligned} V_h = \frac{d^2 W_i}{dt_i dt_h} &= \lambda \frac{d^2 S_i}{dt_i dt_h} + \gamma \frac{d^2 R_i}{dt_i dt_h} \\ &= \left[\gamma (M_i - 2mt_i B) - \lambda m B\right] \frac{\partial B}{\partial t_h} - \gamma M_i t_i \frac{\partial^2 g_i^*}{\partial t_i t_h}. \end{aligned} \tag{53}$$

The sign of V_h determines the sign of the equilibrium tax change. We note that, ceteris paribus, V_h becomes smaller with λ, as the partial effect is given by

$$\frac{\partial V_h}{\partial \lambda} = -mB \frac{\partial B}{\partial t_h} < 0. \tag{54}$$

The ceteris paribus clause is necessary because a change in λ also effects the tax rate and tax base in equilibrium, thus the other terms in V_h. In any case, the key feature is that V_h is dependent on λ, and the direct effect is to make an equilibrium tax decrease “more likely”.

7.2 Subsidy Competition

In the presence of subsidies, net fiscal revenues are given by $R_i = M_i(t_i B_i - z_i)$. The first order condition for welfare maximization reads

$$\begin{aligned}\frac{dW_i}{dz_i} &= \lambda\frac{dS_i}{dz_i} + \gamma\frac{dR_i}{dz_i} \\ &= \frac{dM_i}{d\hat{F}}\frac{\partial\hat{F}}{\partial z_i}\left[\lambda\frac{\beta}{2}\left(x_{i(i)}^2 - x_{j(i)}^2\right) + \gamma((t_iB_i - z_i))\right] - \gamma M_i \\ &= m\left[\lambda\frac{\beta}{2}\left(x_{i(i)}^2 - x_{j(i)}^2\right) + \gamma((t_iB_i - z_i))\right] - \gamma M_i = 0. \end{aligned} \tag{55}$$

The term in square bracket captures the additional consumer surplus and the additional net revenue from attracting more firms at the margin through a higher subsidy. The last term reflects the fiscal cost of raising the subsidy. Moreover, we note that the non-tax revenue motive shifts up the reaction function because of the benefit in consumer surplus when a multinational firm is attracted.

Note that in (55) the part involving λ is independent of t_h. Hence

$$\frac{dW_i}{dz_i dt_h} = \gamma\frac{d^2R_i}{dz_i dt_h} \tag{56}$$

does not directly depend on λ.

Now consider the effect of the GMT. We get

$$\frac{dW_i}{dt_h} = -m\left[\lambda\frac{\beta}{2}(x_{i(i)}^2 - x_{j(i)}^2) + \gamma((t_iB_i - z_i))\right]\frac{dz_j}{dt_h} + \gamma\left[(g_j - g_i)(t_iB_i - z_i) + t_iM_i\frac{\partial B_i}{\partial t_h}\right]. \tag{57}$$

To obtain $\frac{dz_j}{dt_h}$, totally differentiate (55) for both countries. Because the term in (55) involving λ is independent of tax rates, the comparative statics are the same as in base model, i.e. (26). Plugging this into (57), assuming symmetry, we get

$$\frac{dW_i}{dt_h} = 0. \tag{58}$$

In other words, the GMT has no effect on social welfare, regardless of the value of the non-tax revenue motive. This appears perhaps surprising because λ appears in the condition dW_i/dt_h, but note that also the the level of the subsidy adjusts, exactly by the benefit of having a firm.

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