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

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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 a reversal of a decline of corporate tax rates. 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.

Keywords: Global Minimum Tax, Tax Competition, OECD BEPS, Pillar II
JEL Classification: F23, F55, H25, H73

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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 put a floor on competition over corporate income tax rates. The hope among governments is that the agreement will reverse a decades-long decline of corporate tax rates driven by competition over real investments and profit shifting to low-tax jurisdictions.[1] The OECD estimates worldwide tax revenue gains of 150 billion US dollars annually.[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 4) all point to that tax revenue will go 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

[1]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.

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

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

[4]International Monetary Fund. International corporate tax reform. February 2023 and OECD's economic impact assessment of the two-pillar solution – Revenue estimates for Pillar 1 and 2 (Webinar 18 January, 2023).

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 QDMTT nor the SBIE. The QDMTT does not affect the tax burden of the the multinational as it only matters for which country collets the top up tax. In our baseline model we assume that the tax haven collects that revenue, 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] We show in an extension of the base model that a situation where the haven tax rate equals the GMT can be an equilibrium outcome of game between the haven and non-haven countries, that is, there is no incentive for the haven country to tax beyond the global minimum tax.

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

[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

shifting, which has a first order positive effect on revenues in high-tax countries because their tax 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 there 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] 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 in-

[7]Since the haven's tax rate is exogenous, our base model is different from the standard modeling of strategic complemetarity, 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).

crease. 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.

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 4.

Our paper is related to different literatures. 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 line with the intention of the GMT.

[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).

Our paper also contributes to an emerging literature that analyzes theoretically the effects of the global minimum tax. Johannesen (2021) 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 a three-country set-up and in addition to investigating the induced strategic tax setting effect of the GMT, we allow the use of lump sum subsidies as an alternative policy tool.

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. Section 4 discusses the results from a policy viewpoint and addresses possible extensions of the formal framework. Section 5 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 2.3 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 2.3 we go beyond the case of revenue maxmization and consider welfare maximization, where tax revenues in non-haven countries are used to finance a public good and households benefit from multinational acitivity.[12] In section 3 we consider subsidies as an alternative instrument, while holding tax rates constant.

[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).

2.1 The Firm's Decision Problem

A multinational firm, out of continuum (desribed 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.[13] The firm's *local* profit from operating its real activity 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. 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 2.3 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-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) 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

[13] See section 2.3.3 for a way of endogenizing s.

[14] See e.g., Kant (1988) and 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. 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, $\partial g_i^*/\partial t_i = 1/C'' > 0$.

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.[16] Let F be uniformly distributed on $[-\underline{F}, \overline{F}]$. The mass of firms is normalized to one, and $M(\hat{F}) = \frac{\hat{F}-\underline{F}}{\overline{F}-\underline{F}}$. 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

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

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

[16] 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.

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 and profit shifting decisions of firms, (3) and (6), into account. The Nash equilibrium is denoted as $t_1^*(t_h), t_2^*(t_h)$. The case of welfare maximization in non-haven countries is considered in section 2.3.

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

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

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.[17]

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

[17]The second order condition reads $-2mB_i^{*2} + \left[3mt_iB_i^* - 2M(\hat{F})\right]\frac{dg_i^*}{dt_i} - t_iM(\hat{F})\frac{\partial^2 g_i^*}{\partial t_i^{*2}}$, 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 $-2mB_i^{*2} + 3mt_iB_i^*\delta^{-1} - 2M_i(\hat{F})\delta^{-1}$, which is negative if $\delta s > 5/2$ (the first two terms are negative).

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.[18] 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

[18]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.

(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 ($t^*B^* < 1/(4m)$).

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 equilibrim 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. 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 4 and 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 $\Pi_i = \pi_i + \pi_h^i$ is given by

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

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.

2.3 Extensions: Welfare maximization and endogenous haven tax

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.

2.3.1 Welfare Maximization

In the baseline model we assume that non-haven governments maximize tax revenues. By contrast, consider now the situation where the government maximizes the utility of a representative household who has preferences over private consumption (or a private benefit from multinational activity) c and a public good G according to

$$W = u(c) + G(R), \tag{18}$$

where u and G are (strictly) concave functions. The public good is financed from tax revenue R, which is as given in the baseline model. The first element in (18) may introduce a trade off when setting the non-haven tax rate because it may reduce private consumption.

We consider two scenarios for the financing of private consumption. First, suppose private consumption is financed out of income generated from multinational activity in the country (e.g., wages from employment) and is thus proportional to the number of firms in the country $M_i(\hat{F})$.[19]

[19]Without loss of generatity the proportionality factor is set equal to 1 so that consumption equals the number

Welfare maximization for government i requires that

$$\frac{dW_i}{dt_i} = u'(c_i)\frac{dM_i}{dt_i} + G'(R_i)\frac{dR_i}{dt_i} = 0 \tag{19}$$

To see how an increase in the haven tax rate affects welfare of a non-haven country, we analyze

$$\frac{dW_i}{dt_h} = u'(c)\frac{dM_i}{d\hat{F}}\left(\frac{d\hat{F}}{dt_i}\frac{dt_i^*}{dt_h} + \frac{d\hat{F}}{dt_j}\frac{dt_j^*}{dt_h} + \frac{\partial\hat{F}}{\partial t_h}\right) + G'(R_i)\frac{dR_i}{dt_h}, \tag{20}$$

where the first term captures the haven's tax effect on the firm distribution and the last derivative is the total effect from the change in the haven tax rate (via the equilibrium non-haven tax rates). In a symmetric Nash equilibrium between non-haven countries, the term in large brackets is zero, which can be seen by using (7) and (8). Hence the welfare effect depends on the effect on government revenues. This is qualitatively identical to our analysis in section 2.2. Welfare of a non-haven country increases in the haven tax rate/GMT if government revenues increase because then public goods supply expands.

Second, suppose alternatively that private consumption is financed out of profits of all firms in the world, that is, the household owns a fraction of a diversified portfolio and thus world profits.[20] An increase in the haven tax rate affects domestic welfare of country i via three effects: first via a change in the tax rate of non-haven i, second via the tax rate of j (the strategic effect), and finally via a direct effect. The first is zero by the envelope condition. We are left with the second and third term and get

$$\frac{dW_i}{dt_h} = \frac{dW_i}{dt_j}\frac{dt_j^*}{dt_h} + \frac{\partial W_i}{\partial t_h}. \tag{21}$$

In section 2.2 the key determinant was the sign of the derivative dt_j^*/dt_h, because it was multiplied by $dR_i/dt_j > 0$ and the equivalent of the third term, $\partial R_i/\partial t_h$, was positive as well. Here we need to consider the sign of dW_i/dt_j and $\partial W_i/\partial t_h$. Both contain a positive component via tax revenues for country i, which increase when country j and the tax haven increase their tax rates. Yet, the increase in either tax rate lowers profits of firms, which lowers welfare of citizens in i.

of firms.

[20] An alternative is to assume that the household obtains profits from firms located in its own country. Such an assumption is hard to justify when firm location is endogenous though.

The tradeoff between private consumption and public good provision is the same as in Johannesen (2022). The negative effect on private consumption via reduced firm profits may not be important for the government if the decisive voter has little capital income. In this case, the case of welfare maximization parallels conceptually the one with revenue maximization. Welfare increases if the non-haven tax rate does not decline.

2.3.2 Endgenous 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. Consider an initial Nash equilibrium under tax revenue maximization such that

$$t_h^* < t_{min} < t_1^* = t_2^* = t^*, \tag{22}$$

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 for a Nash equilibrium in tax rates among the three governments:

$$t_h^{**} = t_{min} < t_1^{**} = t_2^{**} = t^{**}, \tag{23}$$

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 (23), is a Nash equilibrium if it does not pay for the haven to deviate from t_{min}.

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 (23), impose symmetry of the non-haven tax rates, to obtain

$$\frac{dR_h}{dt_h} = g^{**} - \frac{t_{min}}{C''(g^{**})}, \tag{24}$$

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

$$\frac{dR_h}{dt_h} = g^* - \frac{t_h^*}{C''(g^*)} = 0. \tag{25}$$

We compare (24) and (25). The first term in (24) is smaller than the first term in (25), 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 (24) 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.

2.3.3 *Endogenous sales*

We assumed that gross profit s is fixed and independent of the firm's location choice. We can think of s as being worldwide sales that are independent of location. Still, one could ask how sales are generated and whether they are subject to profit shifting problems as well. One way of dealing with the potential endogeneity of sales is to assume that s could be the result of an optimal capital stock decision k. For example, assume that $s = pf(k) - rk$, where p is the output price, and capital cost rk are fully tax deductible. In this case, the multinational's optimal capital choice, say k^*, is independent of location and hence $s(k^*)$ is a fixed term. Of course, capital use and cost of capital

might be manipulated by the firm, in particular when capital comes in the form of intangible assets such as patents for which market prices are not easily available. In this case, a further component of the firm's profit would be subject to profit shifting. In our modeling approach, by contrast, we have subsumed all profit shifting activities into one component only. Future work may consider improving this and allowing for multiple profit shifting activities.

2.3.4 *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. 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.

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 fcous 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 return to this issue in section 4.

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

$$\pi_i = (1 - t_i)[s - g_i] - C(g_i) + z_i, \tag{26}$$

where z_i is government i's subsidy to a firm located in country i . We analzye 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

$$r_i = t(s - g^*) - z_i(F), \tag{27}$$

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, 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

$$z_1^*(F) = F + z_2^*, \qquad z_2^*(F) = t(s - g^*). \tag{28}$$

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

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

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

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

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.

$$R_i = M_i(\hat{F}) \left[t_i B_i^* - z_i \right], \tag{29}$$

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

$$\frac{dR_i}{dz_i} = \frac{dM_i}{d\hat{F}} \left(\frac{d\hat{F}}{dz_i} \right) \left[t_i B_i^* - z_i \right] - M_i(\hat{F}) = m \left[t_i B_i^* - z_i \right] - M_i(\hat{F}) = 0. \tag{30}$$

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 $t_i B_i - z_i$ per firm, while the second term represents the additional fiscal cost from raising the subsidy marginally. Condition (30) for countries 1 and 2 characterize the Nash equilibrium in subsidies $z_1^*(t_h), z_2^*(t_h)$.[21]

Rewriting (30) to obtain $z_i = t_i B_i - M_i/m$, then substituting back into (29), we get a simple characterization of net revenues:

$$R_i = \frac{(M_i(\hat{F}))^2}{m} \tag{31}$$

We are interested in how (31) is affected by the global minimum tax. For this, we analyze first the effect of t_h on optimal subsidies z_i^*. Totally differentiate (30) for both non-haven countries to

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

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

$$\frac{dz_i}{dt_h} = \frac{1}{3} \left[\frac{t_j}{C''(g_j^*)} + \frac{2t_i}{C''(g_i^*)} + (g_i^* - g_j^*) \right]. \tag{32}$$

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 (32) 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 exogenously given.*

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.

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

$$\begin{aligned} \frac{dR_i}{dt_h} &= 2M_i(\hat{F}) \left[\frac{d\hat{F}}{dz_i} \frac{dz_i}{dt_h} + \frac{d\hat{F}}{dz_j} \frac{dz_j}{dt_h} + \frac{\partial \hat{F}}{\partial t_h} \right] \\ &= \frac{2M_i(\hat{F})}{3} \left[\frac{t_i}{C''(g_i^*)} - \frac{t_j}{C''(g_j^*)} + (g_j^* - g_i^*) \right]. \end{aligned} \tag{33}$$

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 (33) 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:

$$\frac{d\Pi_i}{dt_h} = \frac{dz_i^*}{dt_h} - g_i^*, \tag{34}$$

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 unambigously 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 (34).[22] 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 competiton 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.

3.3 Discussion of practical aspects

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 subsidise 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 prisoners' dilemma in the (Brander and Spencer (1985)) model. If the cost of distortionary taxation is large enough, however, and tax revenues are

[22]The mass of firms is assumed to be one, so that aggregate profit change is also given by (34).

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 commisssion 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 omnious sign. Future research needs to adress how one can reduce the incentives for subsidy competition.

4 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. Consequently, tax competition will still be an issue in the future. 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, 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 billon 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]

[23]See paragraphs 118.34, 118.37 og 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.

[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

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.

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.

Fiscal Monitor, Chapter 2: Coordinating Taxation Across Borders.

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

5 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 unambigously. 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 initally 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.

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 be come attractive to some countries in the wake of the GMT. A further implication of our investigation is that it matters how the tax

base is calulated 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.

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