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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 lump sum subsidies, the revenue gains from less profit shifting are exactly offset by higher subsidies. When competition is by corporate 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: Suppose a subsidiary of a multinational firm is located in a country, which has a tax rate below the global minimum tax. In response to the GMT it has two choices. It can increase its corporate tax to the minimum level and thus collect more tax revenue. The alternative is to keep its tax rate unchanged and leave it to the country where the parent firm of the subsidiary has its headquarters to tax the difference between the tax levied and the global minimum tax. This is often referred to as the a 'top-up tax'. In either case, the multinational group will pay more in tax.

If everything goes according to plan and most countries implement the global minimum tax, high-tax countries stand to gain because most multinational companies are headquartered in high-income, high-tax countries, which would collect the revenues from the top-up rate. Barake, Neef, Chouc, and Zucman (2021) estimate 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. Revenue gains would be smaller in developing countries. These estimates are short run estimates in the sense that the calculations are based on the assumptions that there are no exemptions of income from the application of the minimum tax (so called carve-outs) and that neither low-tax jurisdictions nor non-haven countries change their tax rates.[3]

[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] Under Pillar 2 of the OECD proposal, substance-based carve-outs consist of a reduction in the tax base on

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. We assume a best-case scenario where all (non-haven) countries implement a minimum tax rate. In such a scenario, the global minimum tax will make profit shifting to tax havens less attractive because for given tax rates the actual tax differential between haven and non-haven countries declines. At the same time, the GMT provides strong incentives for those countries who have headline tax rates below the global minimum tax to increase their domestic rates, especially since not doing so will effectively export tax revenues to the non-haven countries.

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 works, however, by explicitly modeling location decision of firms, and thus a real response to taxation, 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. [4]

We capture the global minimum tax through an exogenous increase in the haven's corporate tax rate. As pointed out by Devereux, Simmler, Vella, Wardell-Burrus, et al. (2021), the design of the substance-based carve-out defines the effective rate of tax under the GMT and is instrumental in how low-tax countries respond. According to Devereux et al. (2021), there are two prime candidates for the design of the carve-out labeled model A and B.[5] The OECD has opted for model A and our analysis is in line with this model, under which low-tax countries have a strong incentive to

which the GMT will be applied. This reduction is based on two factors: employee compensation and tangible assets. 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]For empirical evidence on the effects of taxation and tax competition on firm activity see Devereux, B., and Redoano (2008), Chirinko and Wilson (2017), Giroud and Rauh (2019), and Keen, Liu, and Pallan (2022).

[5]Under model A the denominator in the effective rate of tax (ERT) is taxes paid and the numerator is accounting income less carve-out. Model B, in contrast, defines the ERT as taxes paid divided by accounting income. Both models calculate the top up rate as accounting income less carve-out times the top up tax rate. The latter is given by max (0, 15% - ERT).

increase their tax rates to the level where the 'top-up tax' is zero, since a rise to this level does not affect the tax liability of the multinational firm. Our assumption 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 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 increases due to less profit shifting, which in turn may intensify competition for firms and there real activities among non-haven countries. 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.

There are two main findings from our analysis: First, the revenue effect of the global minimum tax depends crucially on whether competition is over tax rates or over other incentive instruments such as subsidies. *When governments compete by using lump sum subsidies, while corporate tax rates are constant, 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.* Corporate tax rates might be hard to change, perhaps because of political economy considerations. The danger of offsetting incentives is real. Switzerland, for example, considers subsidies that counter the effect of the minimum tax. Among the measures considered are research grants, social security deductions and tax credits to offset any changes to headline tax rates.[7] 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. 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 other instruments in order to generate the envisioned revenue gains for

[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

[7]See: https://www.swissinfo.ch/eng/switzerland-plans-subsidies-to-offset-g7-corporate-tax-plan/46696800

non-havens, as we discuss further in section 3.

Second, and in contrast, when governments compete via tax rates, while assuming away lump sum taxes, tax revenues and tax rates in non-havens may go up or down. We show that an increase in the non-haven tax rate is sufficient for non-haven tax revenues to increase, which is akin to strategic complementarity.[8] *The non-haven tax rate increases (decreases) if the initial tax revenues per firm are low (high). In further characterization, we find that if profit shifting is very costly, tax competition is lax and thus non-haven tax rates are likely to decrease. More generally, we identify a condition for non-havens to benefit, namely if the sum of the elasticities of the non-haven tax rate and the multinational firm's tax base, each with respect to the haven tax rate, is positive* ($\epsilon_{t,t_h} + \epsilon_{B,t_h} > 0$).

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 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

[8]Since the haven's tax rate is exogenous, our 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 Wilson (2017) and Parchet (fc).

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

[10]Vrijburg and de 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

the intention of the GMT.

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 lump sum subsidies are available.

The outline of the paper is as follows. In Section 2 we outline the model and study both tax

and minimum taxes in the context of wealth taxes see Agrawal, Foremny, and Martinez-Toledano (2022).

rate and subsidy competition. Section 3 discusses the results from a policy viewpoint and addresses possible extensions of the formal framework. 4 sums up our results .

2 A Model of Profit Shifting and 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 (regardless of whether the haven's tax rate was optimally chosen or takes some given starting value).[12] 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 and subsidy 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 net of any subsidies. To simplify the analysis, we assume that non-haven governments maximize tax revenues net of any subsidies. This reflects the desire to increase tax payments from multinationals. As long as the underprovision of public goods is severe, we expect that welfare maximization would give qualitatively similar results as long as the government objective function includes the provision of public goods.[13] Our assumption is plausible if the owners of multinational firms are mostly non-residents and thus not directly relevant for domestic

[12] If the revenue effect of the marginal increase is positive and independent of the initial level of t_h, the conclusion about the revenue effect goes beyond the marginal increase and would hold if t_h is raised to t^{min}.

[13] For example, this property has been shown to hold in Janeba and Smart (2003).

welfare purposes.

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.[14] The firm's *local* profit from operating its real activity in country $i = 1, 2$ is

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

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 z_i is a lump sum subsidy to the firm by government i. 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.[15] Costs to conceal abusive transfer pricing are assumed to be non-deductible, as is common in the literature, but we discuss in section 3 the implication of making concealment costs tax deductible.[16]

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 characterized by condition (3), reflecting the equalization of marginal benefits (tax savings) and marginal concealment costs,

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

[14] The value s could be the result of an optimal capital stock decision. For example, assume that $s = pf(k) - rk$, and capital cost are fully tax deductible. In this case, the multinational's capital choice, say k^*, is independent of location and hence $s(k^*)$ is a fixed term.

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

[16] 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).

When the haven's tax rate is below the non-haven's one, as we assume, profits are shifted into the haven. Condition (3) reveals that 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. 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.[17] 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

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

F is not observable to the government, although it knows the distribution, and hence the government cannot condition its tax and subsidy instruments on F.

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

$$\begin{aligned}\hat{F} &= (t_2 - t_1)s + (t_1 - t_h)g_1^* - (t_2 - t_h)g_2^* + C(g_2^*) - C(g_1^*) + z_1 - z_2 \\ &= t_2 B_2^* - t_1 B_1^* + t_h(g_2^* - g_1^*) + C(g_2^*) - C(g_1^*) + z_1 - z_2 \\ &= F(t_1, t_2, t_h, g_1^*(t_1, t_h), g_2^*(t_2, t_h), z_1, z_2),\end{aligned} \tag{6}$$

where $B_i^* = s - g_i^*$ is the tax base, taking optimal profit shifting (3) into account. The last line

[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.

describes the marginal firm more compactly as function of policy instruments. 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

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

All indirect effects via a change of the profit shifting price are zero by the envelope conditions for profit maximization (3). Country 1 gains (loses) firms from a haven's tax increase if it has the lower (higher) tax rate, as this translates into a lower (higher) transfer price. Moreover, changes in a non-haven tax rate (for a given haven tax rate) affects the marginal firm as follows:

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

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

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

$$\frac{d\hat{F}}{dz_1} = 1, \quad \frac{d\hat{F}}{dz_2} = -1. \tag{9}$$

2.2 Tax Rate Competition

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

$$R_i = M_i(\hat{F}) \left[t_i B_i^* - z_i \right], \tag{10}$$

while in the haven country these are

$$R_h = t_h [M_1(\hat{F}) g_1^* + M_2(\hat{F}) g_2^*]. \tag{11}$$

Non-haven governments maximize (10) by choosing either tax rates or subsidies in a simultaneous Nash game, taking the haven tax rate as given, and taking the location and profit shifting decisions of firms into account. The Nash equilibrium is denoted as $t_1^*(t_h), t_2^*(t_h)$ and $z_1^*(t_h), z_2^*(t_h)$, respectively. In this section we focus on tax rate competition and set subsidies to zero in order to focus solely on tax effects.

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

$$\begin{aligned}\frac{dR_i}{dt_i} &= \frac{dM_i}{d\hat{F}}\frac{d\hat{F}}{dt_i}t_iB_i^* + M_i(\hat{F})\left(B_i^* + t_i\frac{dB_i^*}{dt_i}\right)\\ &= -mt_iB_i^{*2} + M_i(\hat{F})\left(B_i^* - t_i\frac{dg_i^*}{dt_i}\right) = 0.\end{aligned} \tag{12}$$

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 (12) 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]

The effect of t_h on net revenues in country i is, using conditions (4) and (11),

$$\begin{aligned}\frac{dR_i}{dt_h} &= \frac{dR_i}{dt_i}\frac{dt_i^*}{dt_h} + \frac{dR_i}{dt_j}\frac{dt_j^*}{dt_h} + \frac{\partial R_i}{\partial t_h}\\ &= \frac{dM_i}{d\hat{F}}\left(\frac{d\hat{F}}{dt_j}\frac{dt_j^*}{dt_h} + \frac{\partial\hat{F}}{\partial t_h}\right)t_i^*B_i^* + M_i(\hat{F})t_i^*\frac{\partial B_i^*}{\partial t_h}\\ &= m\left(B_j\frac{dt_j^*}{dt_h} + (g_j^* - g_i^*)\right)t_i^*B_i^* - t_i^*M_i\frac{\partial g_i^*}{\partial t_h}.\end{aligned} \tag{13}$$

The first term in (13) is zero by first order condition (12). 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, as mentioned above, and a relocation effect based on (7), which is zero in a symmetric tax situation.The key issue for the sign of (13) 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 the first term is positive. However, if t_j^* falls with t_h,

[18]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).

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.

An alternative way of analyzing the effect of the GMT on non-haven tax revenues in a symmetric equilibrium is to write tax revenues as $R_i = 0.5t^*B^*$, where each non-haven country gets half of the firms. Differentiating this with respect to the haven tax rate gives

$$\frac{dR_i}{dt_h} = \frac{1}{2}\left[t^*\frac{dB^*}{dt_h} + \frac{dt_i^*}{dt_h}B^*\right] = \frac{R_i}{t_h}\left[\epsilon_{B,t_h} + \epsilon_{t,t_h}\right],$$

which is positive when the sum of the elasticities - the elasticity of the tax base $\epsilon_{B,t_h} = \frac{dB^*}{dt_h}\frac{t_h}{B^*}$ and the elasticity of the non-haven tax rate $\epsilon_{t,t_h} = \frac{dt_i^*}{dt_h}\frac{t_h}{t^*}$, each with respect to the haven tax rate - is greater than zero. Note that the first elasticity is a measure of the total effect of the haven tax rate, both directly and indirectly via the equilibrium response of the non-haven tax rate.

To shed light on the crucial sign of the derivative dt_j^*/dt_h in (13), we totally differentiate the first order conditions for revenue maximization (12) 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

$$\frac{dt_j^*}{dt_h} = \frac{V_i^iV_h^j - V_i^jV_h^i}{V_j^iV_i^j - V_i^iV_j^j}. \tag{14}$$

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 (14) can thus be written

as

$$\frac{dt^*}{dt_h} = -\frac{V_h}{V_i^j + V_i^i}. \tag{15}$$

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. 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 (15) is negative. See Fudenberg and Tirole (1991), p. 24. Hence, under symmetry the sign of (15) 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. We obtain after some algebra

$$\begin{aligned} V_h &= \frac{dM}{d\hat{F}}\frac{d\hat{F}}{dt_h}\left(B_i^* - t_i\frac{dg_i^*}{dt_i}\right) - M(\hat{F})\left(\frac{\partial g_i^*}{\partial t_h} + t_i\frac{\partial^2 g_i^*}{\partial t_i \partial t_h}\right) + mt_iB_i^*\frac{\partial g_i^*}{\partial t_h} \\ &= \left[2mt_iB_i^* - M(\hat{F})\right]\frac{\partial g_i^*}{\partial t_h} - t_iM(\hat{F})\frac{\partial^2 g_i^*}{\partial t_i \partial t_h}. \end{aligned} \tag{16}$$

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). The 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. 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 latter condition 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. The reason is that non-haven tax revenues are not necessarily a monotone function of the cost of profit shifting because the cost of profit shifting affect the tax base and tax rates of all countries in a non-trivial way.

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-havens tax rates, the introduction of a global minimum tax:*

a) raises (lowers) the non-haven tax rate if the initial tax revenues per firm are low (high). Tax revenues per firm are high initially when profit shifting costs are very large, but are low when initially profit shifting is very severe.

b) *increases tax revenues in non-haven countries if* $\epsilon_{t,t_h} + \epsilon_{B,t_h} > 0$.

c) 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 c) in Proposition 2 can be easily seen by differentiating (11) to obtain

$$\frac{dR_h}{dt_h} = g^* \left(1 + \frac{t_h}{g^*} \frac{dg^*}{dt_h}\right), \tag{17}$$

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 firms $\Pi_i = \pi_i + \pi_h^i$ is given by

$$\frac{d\Pi_i}{dt_h} = -B_i^* \frac{dt_i^*}{dt_h} - g_i^*, \tag{18}$$

which is negative if the tax in non-haven countries tax rate 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 Subsidy Competition

We now turn to the situation when tax rates t_1, t_2 are non-zero, but exogenous, and governments compete for firms with a lump sum subsidy 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. By contrast, subsidies may come in different forms and thus are less transparent. Of course, subsidies are often tied to specific firm activities, such as R&D spending, sales or employment. To model this explicitly, would require an additional firm decision variable, which makes the analysis less tractable. By focusing instead on lump sum subsidies, we consider a polar case to the one in the previous section, which we hope give first insights as to how distortionary subsidies tied to other firm activity may work. Empirically, various forms of subsidies for firms play an important role, as shown in Ossa (2019), Mast (2020), and Slattery and Zidar (2020).

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. 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

$$\frac{dR_i}{dz_i} = \frac{dM_i}{d\hat{F}} \left(\frac{d\hat{F}}{dz_i} \right) [t_i B_i^* - z_i] - M_i(\hat{F}) = m \, [t_i B_i^* - z_i] - M_i(\hat{F}) = 0. \tag{19}$$

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 (19) for countries 1 and 2 characterize the Nash equilibrium in subsidies $z_1^*(t_h), z_2^*(t_h)$.[19]

Rewriting (19) to obtain $z_i = t_i B_i - M_i/m$, then substituting back into (19), we get a simple characterization of net revenues:

$$R_i = \frac{(M_i(\hat{F}))^2}{m} \tag{20}$$

We are interested in how (20) is affected by the global minimum tax. For this, we analyze first the effect of t_h on optimal subsidies z_i, and totally differentiate (19) 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

$$\frac{dz_i}{dt_h} = \frac{1}{3} \left[\frac{t_j}{C''(g_j^*)} + \frac{2t_i}{C''(g_i^*)} + (g_i^* - g_j^*) \right]. \tag{21}$$

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 (21) 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 3. *When governments compete for firms via lump sum subsidies, the effects of a*

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

global minimum tax depend on exogenous tax rates.

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.

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

$$\begin{aligned}\frac{dR_i}{dt_h} &= 2M_i(\hat{F})\left[\frac{d\hat{F}}{dz_i}\frac{dz_i}{dt_h}+\frac{d\hat{F}}{dz_j}\frac{dz_j}{dt_h}+\frac{\partial\hat{F}}{\partial t_h}\right] \\ &= \frac{2M_i(\hat{F})}{3}\left[\frac{t_i}{C''(g_i^*)}-\frac{t_j}{C''(g_j^*)}+(g_j^*-g_i^*)\right]. \end{aligned} \tag{22}$$

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 (22) 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 tax haven tax revenues is similar to the case with tax rate competition and in case of symmetric tax rates ($t_1 = t_2$) and can be written again as in (17). 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 (17) it involves an equilibrium response.

Proposition 4. *Assume that non-haven countries compete via lump sum subsidies for a continuum of multinational firms, which locate in one of two non-haven countries.*

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 tax

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 elasticity of profit shifting regarding the haven's tax rate is not too large in absolute value.

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

$$\frac{d\Pi_i}{dt_h} = \frac{dz_i^*}{dt_h} - g_i^*, \tag{23}$$

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 is unambigously positive and equals t_i/δ, that is, the firm benefits from the GMT.

The latter result in conjunction with Proposition 4a 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 (22) and profit of firms (23).[20] 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 lump sum subsidies enriches only haven governments, while non-haven governments are unaffected. It should be noted here that the latter needs to be intepreted with care, as we assumed a revenue maximizing non-haven government. The outcome of the subsidy game is problematic if government revenues were used to provide public goods, which are underprovided, and the ownership of firms rests outside the non-haven countries. In that situation, the global minimum tax does not benefit non-haven countries.

Our result relates to the findings by Slemrod and Wilson (2009), who consider parasitic tax

[20]The mass of firms is assumed to be one, so that aggregate profit change is also given by (23).

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 Discussion and Extensions

In this section we discuss some of our assumptions and possible extensions.

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 s 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 firms 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.

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 would become 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 (16) becomes a more complex object, which makes the signing of the revenue effects from the GMT even more complicated

without adding much insight, even though the tax deductibility of concealment cost may be a reasonable assumption on practical grounds.

Our analysis makes it clear that we think of subsidies as a tool that might be used to counter the GMT. Noked (2020) shows that both BEPS and Pillar 2 imply an advantage to non-tax subsidies 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 model (Brander and Spencer (1985)). 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 imprefect competition is weakened.

In practice, the European Union has a policy designed to limit member countries incentives 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 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 corporate tax rates or other tax incentives, 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 other incentive

instruments. If corporate tax rates are exogenous, but governments compete for firms with a lump sum 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 corporate 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, revenue in tax havens also rise, but multinational after-tax profits decline. 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 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. Note, however, that both our formal results as well as the effect of BEPS are only qualitative statements, and would need to be calibrated in a more realistic model than the one we have examined here.

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 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. An implication of our investigation is also 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. And then there is the issue of who will will not be part of the GMT-deal. Failure to get the GMT bill through the US Congress, for example, will probably spell the end of the GMT.

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