The Global Minimum Tax*

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Abstract

This paper develops a formal model of international tax competition to study the welfare effects of the global minimum tax: a recent policy initiative that submits lightly taxed foreign profits to top-up taxes in home countries. The net welfare effect of the global minimum tax is generally ambiguous from the perspective of non-havens: it raises welfare by curbing profit shifting but lowers it by increasing equilibrium tax rates in havens – a transfer from non-haven firms to haven governments. The net welfare effect is unambiguously positive when the global minimum rate is so high that profit shifting ends.

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1 Introduction

The recent academic literature offers a dismal diagnosis of the global corporate tax system. Multinational firms book a significant and increasing share of their profits in tax havens with low or zero effective tax rates. Governments have responded to profit shifting by cutting their own corporate tax rates in a fierce race-to-the-bottom. Both developments have contributed to the erosion of effective tax rates on global firms with adverse consequences for efficiency and equality.

This diagnosis has caught the attention of policymakers and a major reform of the international tax system is under way. A key element of the reform, agreed by 136 countries in October 2021 and scheduled to take effect from 2023, is a global minimum tax on profits at the rate of 15%. The minimum tax will primarily be enforced through top-up taxes in the home countries of multinational firms: If Google's profits in Bermuda are effectively taxed at 1%, the U.S. will impose an additional 14% tax to bring the total tax rate up to 15%.

The global minimum tax is designed to have several positive effects from the perspective of non-haven governments with a redistributive motive. First, top-up taxes mechanically secure governments more revenue from firms that shift profits to tax havens with low tax rates. Second, the global minimum tax reduces the incentive to shift profits, which further boosts revenue collection and reduces the deadweight loss associated with tax planning. Finally, it may ease the external constraints on tax policy choices and thus enable countries to tax profitable firms at higher rates and redistribute more. Early estimates set the revenue gain from the first mechanism alone to around $50 billion per year in the United States (Clausing, Saez and Zucman, 2021) and even more in the European Union (Barake et al., 2021).

In this paper, I study the global minimum tax in a model of international tax competition. The key advantage of the formal model over more casual analysis is that it treats not just firm behavior, but also national tax policies as endogenous to changes in the global tax environment. While the analysis shows that a global minimum tax at a sufficiently high rate increases welfare in non-havens by eliminating the distortions created by profit shifting, it also shows that a global minimum tax at a relatively low rate may produce just the opposite result. This surprising result emerges because the global minimum rate allows competing tax havens to coordinate on a non-zero tax rate. The resulting tax payments from profit-shifting firms to tax-haven governments represent a welfare loss from the perspective of non-havens that may dominate the welfare gain created by the decrease in profit shifting.

The model includes two types of countries: *non-havens* where multinational firms conduct

their real economic activity and *havens* where they operate empty shell companies for the purpose of profit shifting. Countries first choose tax policies with the aim of maximizing national welfare. Multinational firms then choose where to book profits while balancing the tax savings and concealment costs associated with shifting profits away from the real activities. The formal analysis proceeds by, first, determining the non-cooperative equilibrium in corporate tax rates with and without a global minimum tax and, then, identifying how a marginal increase in the global minimum tax affects welfare.

Absent a global minimum tax, any policy equilibrium involves zero tax rates on profits in havens and non-zero tax rates in non-havens.[1] On the one hand, havens have no domestic tax base and therefore use the corporate tax rate to attract shifted profits. Since firms only shift profits to the havens with the lowest tax rate in the world, havens compete their tax rates down to zero. On the other hand, real countries choose the tax rate that is optimal given the profit shifting opportunities created by havens. Higher taxes are associated with a mechanical transfer from firm owners to the government, but also create a behavioral revenue loss by inducing more profit shifting.

When a global minimum tax is introduced, a new policy equilibrium emerges where all havens set tax rates at the global minimum rate. Intuitively, the global minimum tax breaks the race-to-the-bottom because havens with a tax rate below the global minimum are no more attractive from the perspective of firms than havens with a tax rate exactly at the global minimum. When the global minimum tax is not too high, all non-havens set their tax rates above this level. The tax differential between havens and non-havens implies that it remains optimal for firms to shift profits despite the new cost in the form of tax payments in havens.

Within this framework, I show that a marginal increase in the global minimum tax rate affects welfare in non-havens through two channels. First, it *lowers* welfare by raising the equilibrium tax rate in havens and thus increasing the total tax liabilities of firms. The mechanical effect on firms' tax liabilities represents a loss of private consumption for the owners, which lowers welfare in non-havens. Second, it *raises* welfare by narrowing the tax differential between havens and non-havens and thus deterring profit shifting. The effect on government revenue from this broadening of the tax base in non-havens represents a gain of public consumption, which raises welfare.[2] It follows that the net effect of raising the global minimum tax rate on welfare in

[1] There is no unique policy equilibrium, but a range of equilibria where at least two havens set a zero tax rate and the remaining havens (if any) set a positive rate. These equilibria all have the same economic properties: all shifted profits are taxed at a zero rate and all havens earn zero government revenue.

[2] A number of other effects cancel out by application of the envelope theorem. Firm adjustments of their profit shifting policy in response to a marginal increase in the global minimum tax rate have no first-order effects on

non-havens is ambiguous. The effect is more likely to be positive when profit shifting responds strongly to changes in the tax incentives and when the government places low weight on the marginal private consumption of firms owners.

The framework allows for a concrete assessment of the welfare implications of introducing the global minimum tax at a low rate. A recent paper estimates that annual profit to havens amounts to around $600 billion (Tørsløv, Wier and Zucman, 2018). If the global minimum tax is introduced at a rate of 1%, the resulting increase in equilibrium tax rates in havens mechanically raises tax payments by $6 billion, a loss of private consumption for firm owners in non-havens. Firms respond by reducing profit shifting, a gain of revenue for governments in non-havens. Whether this is enough to make the overall welfare effect positive depends on the sensitivity of profit shifting as well as the marginal social value of the private consumption of firm owners. On the one hand, assuming a zero weight on firm owners, the loss associated with additional tax payments in havens is disregarded and the global minimum tax improves welfare even if the reduction in profit shifting is tiny. On the other hand, assuming a weight equal to the average individual, the revenue gain associated with the reduction in profit shifting needs to be larger than $6 billion in order for the minimum global tax to be welfare-improving. With a corporate tax rate of 20%, profit shifting must fall by at least $30 billion, which requires a semi-elasticity of shifted profits with respect to the tax rate in havens of at least 5.[3]

While these results suggest that the global minimum tax can potentially reduce welfare in non-havens, we also show that the welfare effect is unambiguously positive when the rate is sufficiently high. In this case, multinational firms abandon profit shifting altogether, which eliminates all distortions in the model. This raises welfare in non-havens in two ways relative to a situation without a global minimum tax. First, the sum of private and government consumption is maximized, as firms no longer waste resources on profit shifting. Second, the split between private and government consumption is fully efficient, as the tax instrument is not associated with a marginal deadweight loss.

From a policy perspective, the paper highlights the risk of introducing a global minimum tax at a rate that is too low so that profit shifting continues and havens capture the revenue

after-tax profits. Similarly, government adjustments of their tax policy in non-havens have no first-order effects on welfare.

[3]To our knowledge, there are no existing estimates of this parameter in the literature. Importantly, it is distinct from the most commonly estimated parameter in the profit shifting literaure: the semi-elasticity of *reported profits* with respect to the tax differential (e.g. Huizinga and Laeven, 2008). Recent work emphasizes the large elasticity of profits shifted to a haven with respect to its own tax rate (Garcia-Bernardo and Janský, 2021). Again, this is distinct from the parameter relevant in our context: the elasticity of profits shifted to *all* havens with respect to the minimum tax rate in any haven.

gain associated with taxation of shifted profits. It is unclear whether the 15% rate to be implemented as from 2023 is high enough to deter profit shifting and ensure that the gains accrue to the countries where firms operate.

The paper contributes to a small literature on the global minimum tax, which provides a mostly verbal analysis of key questions regarding institutional design and implementation (e.g. Devereux et al., 2020; Becker and Englisch, 2021) and makes projections about revenue effects (Clausing, Saez and Zucman, 2021; Barake et al., 2021). The most related paper develops a formal model with a low-tax and a high-tax country and argues that the global minimum tax is likely to benefit the low-tax country due to the strategic complementarity of tax rates (Hebous and Keen, 2021). While our focus is mostly on the welfare consequences for non-havens, our model also implies that havens benefit from the global minimum tax: it stops the competition for profits and raises their equilibrium government revenue above zero.

2 Background

The policy process

Recognizing that the globalization and digitization of the world economy had created substantial opportunities for tax avoidance, the OECD launched a coordinated policy effort in 2012 to address base erosion and profit shifting by multinational firms (OECD, 2012). An action plan suggested a range of concrete policy measures aiming to close specific avoidance schemes and to improve the ability of tax administrations to detect avoidance (OECD, 2013). A large set of countries, OECD members as well as other countries participating in the policy process through the so-called Inclusive Framework, agreed to implement the broad policy package into their national legislations starting in 2016.

While this so-called BEPS process successfully led to a coordinated reform of the global tax environment, many experts argued that the progress was insufficient and that more fundamental changes were warranted. At the same time, several governments started targeting profit shifting with non-standard policy measures that went significantly beyond the BEPS package, for instance levies on the revenue of multinational tech companies (Faulhaber, 2019). This raised fears that a wave of unilateral and uncoordinated policy efforts would be harmful to the global economy by adding significant complexity to the tax landscape.

In response to these concerns, the OECD launched a new round of negotiations that eventually led to an agreement on a two-pillar reform concluded in October 2021 (OECD, 2021). Pillar One allocates some taxing rights to governments based on firm sales. This is particularly

important in the context of the digital economy where value-creation is highly mobile and firms can have significant sales in a country without a physical presence. Pillar Two introduces a global minimum tax rate of 15%. Putting a floor under the effective tax rate on profits is intended to discourage profit shifting to tax havens and stop the erosion of tax bases in high-tax countries. Both elements of the reform are scheduled to take effect as from 2023.

The global minimum tax

The key innovation in Pillar Two is the global minimum tax, which implies that business profits are taxed at a minimum effective rate of 15% regardless of the jurisdiction where they are booked. If a firm books profits in a jurisdiction where they are taxed at a lower rate, the home country of the firm can impose an additional top-up tax up to the global minimum rate. For instance, if Google books profits in Bermuda that are effectively taxed at 5%, the U.S. can impose an additional tax of 10% to bring the total taxation in line with the global minimum tax.[4]

For the purposes of applying the top-up tax, the home country needs to determine the effective tax rate paid by each multinational firm in each foreign jurisdiction. The computation is based on accounting information from the country-by-country financial reporting (CbC) introduced under the BEPS package. These reports contain information about tax liabilities and net profits in each of the countries where a given firm operates, and the effective tax rate is computed as the ratio of tax liabilities to net profits.

There are a several notable exceptions to these general principles. First, as a general rule, the global minimum tax only applies to multinational firms with a global revenue in excess of €750 million; however, individual countries are allowed to apply a lower threshold. Second, a so-called carve-out rule reduces the net profits used in the computation of the effective tax rate with reference to the firm's tangible assets and labor costs.[5] This reflects that the global minimum tax mainly targets profits shifted from foreign jurisdictions and to a lesser extent profits generated with local production factors (real capital and labor). Third, a *de minimis* rule excludes jurisdictions where the scale of the firm's operations, in terms of revenue and

[4]If the home country of a firm does not exercise its right to impose top-up taxes on profits taxed at less than 15%, other countries hosting affiliates of the firm may deny deductibility of payments to the low-tax country up to the point where effective taxation reaches 15%. The home country's right to impose top-up taxes is known as the Income Inclusion Rule (IIR) whereas host countries' right to deny deductions is known as the Undertaxed Payment Rule (UTPR).

[5]Initially, profits are lowered by an amount equal to 5% of tangible assets and labor costs for the purposes of computing the effective tax rate. For a transition period of 10 years, this fraction will be higher, starting at 8% and gradually declining to 5%.

profits, is low.

3 Model

We consider a world with N countries, some of which are havens and others are non-havens. There are three types of agents. *Firms* conduct real economic activities in non-havens, but may engage in costly efforts to shift some of their profits to havens. *Households* own the firms and consume their net profits, which they receive as dividends. *Governments* tax profits and use the revenue to provide a public good that is valued by the households. We make more specific assumptions about the objectives and constraints of each type of agent below.

The sequence of events is the following. First, governments simultaneously choose their domestic policies while taking as given the global minimum tax rate and anticipating firms' responses to their policy choice. Second, firms choose the allocation of profits taking as given all dimensions of the tax environment. We are seeking to characterize the Nash equilibrium in the non-cooperative game played by governments. The ultimate question is how the equilibrium welfare of non-haven countries is shaped by the global minimum tax rate.

3.1 Firms

Each non-haven is home to a single multinational firm with headquarters in the home country and a subsidiary in each of the other countries in the world. The firms' objective is to maximize their payouts to the owners. To keep the model simple, we assume that firms' gross profits, and thus the underlying real economic activities, are fixed. The only choice facing firms is where to report profits for tax purposes. While profit shifting can generate tax savings, we assume that firms incur concealment costs in countries where they under-report profits

In terms of notation, $\overline{\pi}_{ij}$ denotes the gross profits that the firm based in country i derives from its activities in country j. Since no real activity takes place in havens, $\overline{\pi}_{ij} = 0$ when j is a haven. We ignore the possibility of losses and assume that $\overline{\pi}_{ij} \geq 0$ when j is a non-haven. Moreover, π_{ij} denotes the profits that the firm based in country i chooses to report for tax purposes in country j. We assume that all profits have to be reported somewhere so that a firm's total reported profits equal its total true profits, $\sum_j \pi_{ij} = \sum_j \overline{\pi}_{ij}$,[6] and that firms do not report losses, $\pi_{ij} \geq 0$.[7] Further, $\triangle_{ij} = \max(\overline{\pi}_{ij} - \pi_{ij}, 0)$ denotes under-reporting in country j by the

[6]This assumption rules out that part of the firm's profits is not taxable in any jurisdiction. Such stateless income (Kleinbart, 2010) can arise, for instance, through the use of hybrid entities or hybrid financial instruments in the firms' tax planning (Johannesen, 2014; Hardeck and Wittenstein, 2018).

[7]Losses have no immediate tax implications but are typically allowed to offset taxable profits in other fiscal

firm based in country i and $s_{ij}(\triangle_{ij})$ denotes the resulting concealment costs. To obtain closed-form solutions, we assume a quadratic functional form for the concealment costs, $s_{ij} = \triangle_{ij}^2/2\gamma$, but the same qualitative results would obtain with any convex cost function. Finally, Π_i^* denotes the maximized total profits of the firm in country i net of taxes and concealment costs. We assume that firms pay out this amount to the shareholders in proportion to their ownership share.

3.2 Households

Household preferences are represented by the standard utility function $u(c, G)$ where c denotes private consumption and G denotes public goods. We assume that households own shares in the firm based in their own country, but not in firms based in other countries, and we allow for heterogeneity in firm ownership. Specifically, we assume that each household in country i is characterized by a parameter α that expresses its ownership share of the firm based in country i where α is distributed with density $f(\cdot)$.[8] The private consumption of a given household in country i is thus $c = \alpha\Pi_i^* + z$ where the former term is dividend income and the second term is other income. Households make no choices but simply consume all of their income.

3.3 Governments

We assume that governments choose public policies with the objective of maximizing national welfare:

$$W = \int \Psi(u(c, G))f(\alpha)d\alpha \tag{1}$$

where $\Psi(\cdot)$ is a social welfare function with standard properties, $\Psi'(\cdot) > 0$ and $\Psi''(\cdot) < 0$.

In the main analysis, each government has a single policy instrument: the tax rate t applying to reported profits. The revenue raised with this tax in country j is the sum of the profits reported there by firms based in all countries of the world multiplied by the country's tax rate: $t_j \sum_i \pi_{ij}$. Absent a global minimum tax, this is also the value of the public good, as there are no other sources of revenue.

When a global minimum tax is introduced, governments in non-havens may raise additional revenue from top-up taxes. Specifically, if the firm based in country i reports profits in a country

years under some conditions. It is difficult to incorporate this feature in static models and most papers in the literature therefore assume that firms do not report losses. However, a couple of recent papers highlight the implications of losses for taxation of multinational firms (Koethenbuerger et al, 2019; Becker et al., 2020).

[8] Existing papers show that cross-border ownership of firms introduces a tax exporting motive for governments to tax firms at suboptimally high rates (Huizinga and Nielsen, 1997).

j where the tax rate is below the global minimum tax rate t_M, such profits are taxed in country i at a rate equal to the tax differential, $t_M - t_j$. The revenue raised with top-up taxes in country i thus equals $\sum_j \max[(t_M - t_j, 0)]\pi_{ij}$.

Finally, we also explore the implications of allowing a second policy instrument: a government subsidy to firm profits at the rate of q. The expenses incurred by the government in country j is the sum of the profits reported there by firms based in all countries of the world multiplied by the country's subsidy rate: $q_j \sum_i \pi_{ij}$.

4 Analysis

In this section, we analyze the model described above. We first determine the allocation of profits chosen by multinational firms given the international tax environment (Section 4.1). We then identify the Nash equilibrium in the non-cooperative game played by governments when they set tax rates anticipating how they shape firm behavior (Section 4.2). We finally analyze how equilibrium welfare in non-havens depends on the choice of the global minimum tax rate (Section 4.3).

4.1 Allocation of profits

Absent a global minimum tax, the net profits of the multinational firm based in country i can be stated as:

$$\Pi_i(\pi_{i1}, \pi_{i2}, ..., \pi_{iN}) = \sum_j \overline{\pi}_{ij} - \sum_j t_j \pi_{ij} - \sum_j s_{ij}(\triangle_{ij}) \tag{2}$$

where the first term is the firm's total gross profits, the second term is the firm's total tax payments on reported profits and the last term is the firm's total concealment costs associated with under-reporting. While the first term is exogenous, the second and third terms depend on the allocation of reported profits $(\pi_{i1}, \pi_{i2}, ..., \pi_{iN})$ chosen by the firm. In the presence of a global minimum tax, net profits have an additional negative term comprising top-up taxes paid in the firm's home country on profits reported in foreign countries with a tax rate below the global minimum: $-\sum_j \max[(t_M - t_j, 0)]\pi_{ij}$.

The firm chooses the vector of reported profits so as to maximize net profits. The following two lemmas describe the allocation of profits chosen by the multinational firms, with and without a global minimum tax rate.

Lemma 1. *Assume there is no global minimum tax and let t_L denote the lowest tax rate in the world. The firm based in country i reports profits in the following way:*

(a) The amount of profits optimally reported in a country j where $t_j > t_L$ is given by:

$$\pi_{ij}^* = \overline{\pi}_{ij} - \gamma(t_j - t_L) \tag{3}$$

or 0 if $\pi_{ij}^* < 0$.

(b) The amount of profits optimally reported in a country j where $t_j \leq t_L$ is given by:

$$\pi_{ij}^* = \overline{\pi}_{ij} + \triangle_i^*/H \tag{4}$$

where $\triangle_i^*$ denotes the firm's total underreporting across all countries where $t > t_L$ and H is the number of countries with $t \leq t_L$.

Proof. See Appendix. □

These findings imply that multinational firms under-report profits in all countries where the tax rate is not the lowest in the world. Intuitively, they under-report up to the point where the marginal concealment cost, $s'_{ij}(\cdot)$, equals the marginal tax saving associated with profit shifting to the most favorable tax environment, $t_j - t_L$, or where reported profits are zero.[9] The under-reporting is mirrored by over-reporting where the tax rate is the lowest in the world. If two or more countries share the lowest tax rate, the Lemma states that they benefit equally from the over-reporting. Strictly speaking, multinational firms are indifferent between over-reporting profits in two or more countries with the same low tax rate and we break the tie by assuming that over-reporting is split equally between the countries.

Lemma 2. *Assume there is a global minimum tax at the rate of t_M and that top-up taxes therefore apply to profits reported in countries with a tax rate below that rate. If $t_L > t_M$, Lemma (1) applies directly. If $t_L \leq t_M$, Lemma (1) applies with t_M replacing t_L.*

Proof. See Appendix. □

This result shows that the global minimum tax puts a floor under the effective tax rate that multinational firms can obtain through cross-border profit shifting. If $t_L > t_M$, the global minimum tax is not binding and t_L remains the lowest obtainable tax rate. If $t_L < t_M$, the existence of top-up taxes implies that t_M, and not t_L, is effectively the lowest obtainable tax rate. This has implications on both sides of the profit shifting decision. One the one hand, t_M, rather than t_L, is governing the amount of under-reporting chosen by the multinational firms in countries with high tax rates (part (a) of the Lemma). On the other hand, all countries with tax rates at t_M, and not just those with the tax rate t_L, benefit from over-reporting (part (b) of the Lemma).

[9] In a sense, tax aggressive (Johannesen, Tørsløv and Wier, 2020).

4.2 Tax rates

We are searching for a Nash equilibrium in which all governments set the tax rate that maximizes national welfare given the tax rates set by all other governments. We consider environments with and without a global minimum tax in turn.

4.2.1 No global minimum tax

Proposition 1. *In the absence of a global minimum tax, the following choices constitute a policy equilibrium:*
(a) all havens set the tax rate equal to zero
(b) non-tax havens set the tax rate that satisfies

$$\frac{W'_G}{W'_C} = \frac{\Omega}{1+\epsilon} \tag{5}$$

where ϵ is the elasticity of profits reported in the non-haven with respect to the tax rate; Ω is the share of total profits in a country that accrues to the local multinational firm; W'_G is the marginal value of the public good (i.e. the average of $\Psi'(\cdot)u'_G$ taken over all households) and W'_C is the marginal value of dividend income (i.e. the average of $\Psi'(\cdot)u'_c$ taken over all households weighted by household ownership shares in the firm).[10]

Because firms only shift profits to places with the lowest tax rate in the world and havens have no tax base other than the shifted foreign profits they can attract, havens compete their tax rate down to zero and earn no revenue in the equilibrium.[11] As required in a Nash equilibrium, no individual haven can increase its revenue, and thus improve welfa re for its residents, by changing its tax rate given the zero tax rates set by other havens.

The governments in non-havens set their tax rate while taking it for given that firms have the opportunity to shift profits to a zero-tax environment. We derive the first-order condition for the optimal tax rate by differentiating the welfare function with respect to their own tax rate:

$$\int \Psi'(\cdot)\left(u'_c\frac{dc}{dt} + u'_G\frac{dG}{dt}\right)f(\alpha)d\alpha = 0 \tag{6}$$

A small change in the tax rate that applies to firm profits affects the private consumption of all households who own shares as well as the size of public good. In the optimum, the net welfare

[10] The precise definitions from the perspective of country i are $\Omega_i = \pi_{ii}/\sum_j \pi_{ji}$ and $\epsilon_i = \frac{d(\sum_j \pi_{ji})/\sum_j \pi_{ji}}{dt_i/t_i}$.

[11] This is akin to Bertrand competition where price-setting firms compete the price down to marginal costs and earn no profits.

effect must be zero. We restate the first-order condition in the following way:

$$W'_C \underbrace{\left(- \pi_{ii} \right)}_{dC/dt} + W'_G \underbrace{\left(\sum_j \pi_{ji} + \frac{d\pi_{ji}}{dt_i} t_i \right)}_{dG/dt} = 0 \tag{7}$$

where W'_C is the marginal welfare weight on private consumption (i.e. the sum of $\Psi'(\cdot)u'_c$ over all households weighted by their ownership shares in the firm) and W'_G is the marginal welfare weight on the public good (i.e. the sum of $\Psi'(\cdot)u'_G$ over all households). To arrive at eq. (5), we divide by $\sum_j \pi_{ji}$ and rearrange using the definitions of Ω and ϵ.

To gain intuition, we examine the two terms of eq. (8) in turn. The first term is the negative welfare effect of a marginal tax increase working through lower private consumption of firm owners. The change in aggregate private consumption, dC/dt, equals the mechanical decrease in the after-tax profits of the local firm. While the firm responds to a higher tax by shifting more profits, this has no first-order effect on after-tax profits.[12] The welfare weight, W'_C, accounts for the unequal distribution of dividend income by weighing the household-level marginal welfare weights with ownership shares. The second term is the positive welfare effect working through higher government revenue.[13] The change in the size of the public good, dG/dt, depends both on the mechanical effect and on firms' profit shifting responses. The revenue loss created by profit shifting responses represents a deadweight loss of taxation, which reflects that profit shifting requires socially wasteful concealment efforts.[14]

Equation (5) characterizing the equilibrium policy choice in non-havens is familiar from standard models of tax competition (Keen and Konrad, 2013) although the interpretation is somewhat different. It is useful to compare to a closed economy where the government would tax profits up to the point where $W'_G = W'_C$, thus equalizing the marginal welfare gains associated with private and public consumption. In an open economy, the policy choice departs from this benchmark for two reasons. First, profit shifting responses ($\epsilon > 0$) introduce a cost of taxation, which induces governments to choose lower tax rates. This is similar to standard models of tax competition where governments tax productive capital and the elasticity of the capital supply with respect to taxation shapes the equilibrium policy choice in the same way as ϵ. Second, to

[12] The effect on global after-tax profits, $\Pi(\cdot)$ of a small increase in profit shifting out of country i is $t_i - t_L - s'(\cdot)$, which is precisely zero when the *ex ante* allocation of profits is chosen optimally. This is an application of the envelope theorem.

[13] The welfare effect can, in principle, be negative if the *ex ante* tax rate exceeds the revenue-maximizing level such that a marginal tax increase lowers revenue.

[14] Firms generally shift profits out of country i up to the point where $t_i - t_L - s'(\cdot) = 0$. In the equilibrium where $t_L = 0$, this implies that $t_i = s'(\cdot)$ so that the marginal revenue loss due to profit shifting responses mirrors the marginal use of resources on concealment.

the extent that profits partly accrue to foreign firms ($\Omega < 1$), the incidence of the tax is partly on foreign firm owners, which induces governments to choose higher tax rates (Huizinga and Nielsen, 1997).

We emphasize that there are many other equilibria than the one described in Proposition (1) with the same economic properties. In particular, any configuration where at least two havens set the tax rate equal to zero and non-havens set the tax rate that satisfies eq. (5) constitutes an equilibrium. Profits will only be shifted to the subset of havens with a zero rate such that all havens earn a zero revenue and no haven can increase government revenue by changing their tax rate given the tax rates chosen by others.

4.2.2 A global minimum tax

Proposition 2. *Assume that governments have a single policy instrument: a tax on profits. In the presence of a global minimum tax at the rate of t_M that is not too high, the following choices constitute a policy equilibrium:*
(a) all havens set the tax rate equal to t_M
(b) non-tax havens set the tax rate that satisfies eq. (5)

In the presence of a global minimum tax, a haven government cannot do better than setting a tax rate of t_M given that all other havens also set a tax rate of t_M. On the one hand, reducing the rate below t_M will not induce multinational firms to shift more profits to the haven, as the resulting tax savings in the haven are exactly offset by top-up taxes in the firms' home countries (see Lemma 2). On the other hand, raising the rate above t_M implies that multinational firms no longer shift any profits to the haven, as other havens offer effective taxation at t_M. From the perspective of an individual haven, t_M therefore strictly dominates any tax rate higher and lower than t_M by raising more government revenue for the same level of private consumption.

The policy choice also changes in non-havens; however, as long as the global minimum tax is not too high, the qualitative trade-off remains the same and the solution continues to be characterized by eq. (5). In quantitative terms, it is unclear if the tax rates chosen by non-haven governments is higher or lower under a global minimum tax. To see this ambiguity, consider what happens to the incentives of a non-haven government when, starting from the equilibrium without the global minimum tax, the tax rate in havens increases to t_M. First, firms start paying tax in havens and, because they cut back on profit shifting, they also increase tax payments in non-havens. This implies a higher W'_C and a lower W'_G, which creates an incentive to *lower* the tax rate. Second, the elasticity of profit shifting with respect to the tax rate ϵ is

now lower, which creates an incentive to *raise* the tax rate.[15]

At higher values of the global minimum tax, the trade-off underlying the policy decision in non-havens may change. While we do not study this scenario in detail, we note that the change occurs when, evaluated at the choices described in Proposition 3, at least one non-haven can increase its welfare by setting the tax rate t_M rather than the local optimum described by eq. (5). For sufficiently low values of t_M, this does not happen as a tax rate of t_M generates approximately zero revenue. However, at higher values of t_M, attracting foreign tax base in the form of shifted profits by mimicking the tax rate choice of havens may become attractive for non-havens. Importantly, each additional non-havens opting for this policy choice makes the choice less attractive for others, as aggregate shifted profits decreases and the number of countries sharing this tax base between them increases. This suggests the existence of a "mixed equilibrium" where some non-havens set the tax rate t_M, other non-havens set the rate described by eq. (5), and welfare levels are equalized between the two groups so that no non-haven can increase its welfare by changing its tax rate. Finally, when t_M takes very high values, multinational firms shift no profits for any relevant value of the tax rate in non-havens, which implies that the optimal tax rate in non-havens is characterized by $W'_G/W'_C = \Omega$, as $\epsilon = 0$.[16]

4.2.3 Offsetting subsidies

We now consider an extended model where governments choose not just a tax rate on profits t, but also a subsidy rate q. Importantly, we assume that top-up taxes apply if and only if the tax rate is below the global minimum rate, $t < t_N$, regardless of the subsidy rate q.

Proposition 3. *Assume that governments have two policy instruments: a tax on profits and a subsidy. In the presence of a global minimum tax, the following choices constitute a policy equilibrium:*
(a) all havens set both the tax rate and the subsidy rate equal to t_M
(b) non-tax havens set the positive tax rate that satisfies eq. (5) and zero subsidies

This policy equilibrium is economically identical to the equilibrium without a global minimum tax described in Proposition 1. First, the effective tax rate on profits shifted to havens

[15] While the terms $d(\sum_j \pi_{ji})/dt_i$ and t_i are unchanged when the tax rate in havens increases to t_M, the term $\sum_j \pi_{ji}$ becomes larger and the overall elasticity therefore smaller.

[16] Such a "mixed equilibrium" emerges in Johannesen (2010) where it is imperfect mobility of profits rather than a global minimum tax that attenuates tax competition for profits and creates a rent to be shared between low-tax jurisdictions. In the global policy equilibrium, the share of non-havens setting a low tax rate adjusts to ensure that non-havens achieve the same level of welfare by pursuing a low-tax and a high-tax strategy.

(i.e. net payments in havens plus top-up taxes in the home country) is zero.[17] Second, havens earn zero net revenue, but no individual haven can change their policies in a way that generates a net revenue above zero given the policy choices of other havens.[18] Third, non-havens take it for given that multinational firms can shift profits to havens at a zero tax cost and set the tax rate that maximizes welfare conditional on this constraint. This is the exact same tax rate as in the equilibrium without a global minimum tax.[19]

Intuitively, when governments in havens have two policy instruments they are able to undo the constraint created by the global minimum tax: the tax rate is set high enough to neutralize the global minimum tax and the subsidy rate is chosen to obtain the desired net tax rate. Consequently, the tax competition for profits unfolds in the same way as without a global minimum tax and the equilibrium is economically identical.[20]

4.3 Welfare

In the baseline model, the policy choice by non-haven governments is distorted by two countervailing forces: the mobility of profits (ϵ) tends to raise the cost of public funds *above* the true social cost whereas the scope for tax exporting created by cross-border ownership of profits (Ω) tends to lower the cost of public funds *below* the true social cost. This complicates the welfare analysis of the global minimum tax. According to standard second-best theory, the welfare effect of alleviating one distortion is ambiguous in the presence of other distortions (Lipsey and Lancaster, 1956).

Before proceeding to the welfare analysis, we therefore make the following assumption, which effectively eliminates the distortion coming from tax exporting:

Assumption 1. *All profits in country i accrue to the firm based in country i, i.e. $\Omega = 1$.*

The assumption allows us to focus on how the global minimum tax addresses the distortion created by profit shifting while ignoring its interaction with cross-border ownership and other

[17] Specifically, $t = s$ implies that there is no net payment in havens while $t \geq t_M$ implies that there is no top-up tax in the home country.

[18] All policy combinations where $t > q$ deter profit shifting to the haven, as the effective tax rate is lower in other havens, and thus generate zero revenue. All policy combinations where $t = q$ generate zero net revenue, as the expenses to the subsidy equal the income from the tax. All policy combinations where $t < q$ generate negative revenue, as the expenses to the subsidy exceed the income from the tax.

[19] As before, there are many other equilibria with the same economic properties. First, each haven can obtain the same net tax rate, the economically relevant parameter, with infinitely many different combinations of the tax rate and the subsidy rate. Second, as before, there are infinitely many equilibria where the net tax rate is zero in at least two havens and positive in all others.

[20] This is reminiscent of Cremer and Gahvari (2000) where coordination on nominal tax rates leads to a race-to-the bottom in tax enforcement.

possible sources of policy imperfections. To justify this approach, we note that much of the recent empirical literature on corporate taxation is concerned with profit shifting and highlights that it is a quantitatively important phenomenon (e.g. Tørsløv et al., 2018; Damgaard et al., 2019).[21] Moreover, the global minimum tax is explicitly *designed* to address the distortions associated with profit shifting.

Proposition 4. *Introducing a global minimum tax at a low rate has an ambiguous effect on welfare in non-havens: it lowers welfare by mechanically increasing firms' foreign tax costs and increases welfare by mitigating the erosion of the domestic tax base through profit shifting. On balance, the welfare effect is more likely to be positive when the private consumption of firm owners has a low marginal weight in the social welfare function, i.e.* $W'_C(\cdot)$ *is small relative to* $W'_G(\cdot)$*, and when profit shifting is highly sensitive to the tax differential between havens and non-havens.*

Proof. See Appendix. □

To assess how the global minimum tax affects welfare in non-havens, we differentiate the welfare function for country i with respect to the rate t_M.

$$\frac{dW}{dt_M} = W'_C \underbrace{\left(- \triangle^*_{ii} \right)}_{\partial C/\partial t_M} + W'_G \underbrace{\left(\frac{d\pi_{ii}}{dt_M} t_i \right)}_{\partial G/\partial t_M} \tag{8}$$

The first term captures that a small increase in the global minimum tax *lowers* welfare by increasing firms' tax liabilities in havens. Increasing the global minimum tax rate induces a one-to-one increase in the equilibrium tax rate in havens, as shown in Proposition 3, and thus mechanically raises the tax cost incurred by the firm based in i. This represents a loss of private consumption for firm owners, which lowers welfare. The second term captures that a small increase in the global minimum tax *raises* welfare by curbing profit shifting. With a higher equilibrium tax rate in havens, firms reduce profit shifting, as shown in Lemma 1. While the reduced profit shifting has no first-order effect on after-tax profits (by application of the envelope theorem), it raises government revenue in non-havens. This represents a gain of public consumption, which raises welfare. Further, the government optimally adjusts its own tax rate, as discussed in the previous section, but this has no first-order effect on country's welfare (by application of the envelope theorem).

[21] Tørsløv et al. (2018) show that around 40% of the foreign profits earned by multinational firms are booked in tax havens. Consistent with that finding, Damgaard et al., (2019) show that "phantom FDI" into empty corporate shells overwhelmingly located in tax havens account for around 40% of the global stock of foreign direct investment.

This result provides a convenient starting point for assessing the welfare effects of introducing the global minimum tax at a low rate. A recent estimate sets the profits shifted to havens globally at around $600 billion. If the global minimum tax is introduced at a rate of 1%, the resulting increase in equilibrium tax rates in havens mechanically raises firm tax payments by $6 billion, which constitutes a welfare-reducing loss of private consumption in non-havens. In response, firms reduce profit shifting, which creates a revenue gain for governments in non-havens. Whether this gain is large enough to make the overall welfare effect positive generally depends on the sensitivity of profit shifting to havens as well as the marginal welfare weight on the private consumption of firm owners.[22] One benchmark is $W'_C \approx 0$, reflecting that firms are largely owned by high-income households with little weight in the social welfare function. In this case, the first term drops out and the reform improves welfare even if the reduction in profit shifting is tiny. Another benchmark is where $W'_C \approx W'_G$ reflecting that firm ownership is equally distributed. In this case, the revenue gain associated with the reduction in profit shifting needs to be larger than the private loss of $6 billion for the reform to be welfare-improving. With a corporate tax rate of around 20%, profit shifting must fall by at least $30 billion, which requires a semi-elasticity of shifted profits with respect to the tax rate in havens of at least 5.

Proposition 5. *Introducing a global minimum tax at a sufficiently high rate has an unambiguously positive effect on welfare in non-havens. It can achieve the first-best where the welfare losses created by profit shifting (i.e. concealment costs and tax payments in havens) are zero and the tax rate is undistorted so that:*

$$W'_G(\cdot) = W'_C(\cdot) \tag{9}$$

Proof. See Appendix. □

If the global minimum tax is levied at a sufficiently high rate, e.g. higher than the corporate tax rates set by the non-havens themselves, multinational firm abandon profit shifting altogether. This raises welfare in non-havens in two ways relative to a situation without a global minimum tax. First, the sum of private and government consumption is higher, as firms no longer waste resources on profit shifting. Second, the split between private and government consumption is fully efficient, as the tax instrument is not associated with a marginal deadweight loss.

[22] In a richer model, the incidence of firm taxes would be shared beween owners and workers. Indeed, there is strong empirical evidence of significant pass-through of the corporate tax to workers through wages (Arulampalam, Devereux and Maffini, 2012; Fuest, Peichl and Siegloch, 2018). With such a pass-through, W'_C should be formed as the average of $\Psi'(\cdot)u'_c$ weighted by each household's share of the tax costs through ownership and employment.

Proposition 6. *A global minimum tax that is not high enough to eliminate profit shifting has an unambiguously positive effect on welfare in non-havens.*

Havens are only affected by the global minimum tax through its effect on government tax revenue. Absent the global minimum tax, havens compete tax rates down to zero and earn no revenue. When a global minimum tax is introduced, equilibrium tax rates in havens increase up to the global minimum. Unless that rate is so high that profit shifting ends, havens earn positive revenue, which implies that welfare has increased.

5 Concluding remarks

Recently, more than 100 countries have agreed to introduce a new policy measure to combat base erosion and profit shifting: a global minimum tax on profits.

In this paper, I have studied the global minimum tax in a model of international tax competition. The key insight is that introducing a global minimum tax changes the incentives for tax setting in havens radically: in the new policy equilibrium, they raise their tax rate up to the global minimum, which imposes an additional tax cost on profit shifting firms in non-havens.

This mechanism implies that the global minimum tax may reduce welfare in non-havens. By contrast, the welfare effect is unambiguously positive when the global minimum tax is levied at a sufficiently high rate such that profit shifting is abandoned altogether.

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Appendix

Proof of Lemma (1)