The Global Minimum Tax*

Niels Johannesen
(University of Copenhagen, CEBI, CEPR)

November 30, 2021

Abstract

This paper studies how the *global minimum tax* shapes national tax policies and welfare in a formal model of international tax competition with heterogeneous countries. The net welfare effect is generally ambiguous from the perspective of non-havens. On the one hand, the global minimum tax raises their welfare by curbing profit shifting, which boosts government revenue. One the other hand, it lowers their welfare by increasing equilibrium tax rates in havens, which transfers real resources 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.

*Niels Johannesen: niels.johannesen@econ.ku.dk. The activities of CEBI are financed by the Danish National Research Foundation, Grant DNRF134. Declarations of interest: none

1 Introduction

The recent academic literature offers a dismal diagnosis of the global corporate tax system. Multinational firms book a significant share of their profits in tax havens with low effective taxation and governments respond to the increasing cross-border mobility of profits by cutting corporate tax rates in a fierce race-to-the-bottom. Both developments contribute to the erosion of effective tax rates on firm profits with adverse consequences for efficiency and equity (Tørsløv, Wier and Zucman, 2018; Devereux et al., 2020a).

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 more than 100 countries in October 2021, 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 in countries adversely affected by profit shifting. First, it should mechanically increase tax payments from firms that shift profits to low-tax environments. Second, it should induce firms to reduce profit shifting, further boosting government revenue and curbing the wasteful use of resources for tax planning. Third, it should ease the constraints on policy from international tax competition and thus enable countries to tax multinational profits 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, we study how the global minimum tax shapes national tax policies and welfare in a formal 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 international tax system. Our results highlight that precisely the endogenous policy response in tax havens poses a risk from the perspective of other countries: The global minimum tax causes a coordinated tax rate increase in tax havens, which is costly for multinational firms in other countries and may imply that the overall effect on these countries' welfare is negative.

The model includes two types of countries: *non-havens* where multinational firms conduct real economic activity and *havens* where they operate empty shell companies for the purpose of profit shifting. Governments choose tax policies with the aim of maximizing national welfare

while taking as given the international tax architecture, including the global minimum rate. Multinational firms choose where to book profits with the aim of maximizing global after-tax profits. 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 the global minimum tax affects equilibrium welfare.

Absent a global minimum tax, the policy equilibrium involves zero tax rates on profits in havens and non-zero tax rates in non-havens. On the one hand, havens have no domestic tax base and therefore use the corporate tax rate to compete for foreign profits. As firms only shift profits to the haven with the lowest rate, havens compete their tax rates down to zero. On the other hand, non-havens choose the tax rate that balances the social costs and benefits of taxation given the profit shifting opportunities created by havens. A higher rate involves a mechanical transfer from firm owners to the government, a potential equity gain, but also induces more profit shifting, an efficiency loss.

Introducing a global minimum tax, a new policy equilibrium emerges where all havens optimally set tax rates at the level of the global minimum rate. Intuitively, the global minimum tax puts a floor under the race-to-the-bottom because havens with a tax rate below the global minimum are no more attractive from the perspective of profit-shifting firms than havens with a tax rate exactly at the global minimum.[1] When the global minimum rate is not too high, the qualitative policy trade-off remains the same for non-havens and they choose a tax rate strictly higher than the global minimum.

Equipped with this understanding of the policy equilibrium, we show that a marginal increase in the global minimum 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 the decrease in profit shifting represents a gain of public consumption in non-havens, which raises welfare. All other effects on welfare cancel out by application of the envelope theorem.[2] It follows that the net effect of raising the global minimum tax rate on

[1]This is reminiscent of the argument that foreign tax credits can make it optimal for capital-importing countries to tax foreign investment: As higher taxation in the source country is offset by lower taxation in the residence country, it shifts revenue from the latter to the former while leaving total taxation unchanged from the perspective of firms (Gordon, 1992).

[2]Firms' profit shifting response has no first-order effect on after-tax profits (but affects welfare through the government budget as described above) and governments' policy response has no first-order effect on welfare.

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

These results allow for a concrete assessment of the welfare implications of introducing a global minimum tax at a low rate. A recent paper estimates that annual profit shifting 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 of profit-shifting firms by $6 billion, a loss of private consumption for firm owners in non-havens. Firms will respond by reducing profit shifting, creating a revenue gain for governments in non-havens, but 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 private consumption. At one extreme, if the private consumption of firm owners has zero social value, the welfare loss associated with additional tax payments in havens is negligible and the reform improves welfare even if the reduction in profit shifting is small. At the other extreme, if the private consumption of firm owners has the same social value as public funds, the revenue gain associated with the reduction in profit shifting needs to be larger than $6 billion in order for the reform to improve welfare. With a corporate tax rate of 20%, profit shifting needs to fall by at least $30 billion, which requires a semi-elasticity of shifted profits with respect to the lowest tax rate in the world of at least 5.

While these results suggest that the global minimum tax can potentially reduce welfare in non-havens when the rate is relatively low, the analysis also shows 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. First, the sum of private and public consumption is maximized, as firms no longer waste resources on profit shifting. Second, the split between private and public consumption is fully efficient, as the tax instrument is not associated with a marginal deadweight loss.

From a policy perspective, the paper thus highlights the risk of introducing a global minimum tax at a rate that is too low - in which case profit shifting continues and havens capture part of the global revenue gain created by the policy. It is unclear whether the projected 15% rate is high enough to ensure that the overall welfare effect is positive. The key uncertainty concerns the sensitivity of shifted profits to the general level of taxation in havens, a parameter, which is distinct from the parameters estimated in the literature. For instance, recent evidence suggests

that the amount of profits booked in a haven is highly sensitive to the haven's own tax rate (Garcia-Bernardo and Janský, 2021); however, this may simply reflect that havens are close-to-perfect substitutes from the perspective of multinational firms and does not imply that profits booked in havens overall are highly sensitive to the general level of taxation in havens.[3]

The paper contributes to an emerging literature on the global minimum tax, which discusses key questions about institutional design and implementation (e.g. Devereux et al., 2020b; Becker and Englisch, 2021) and makes projections about revenue effects (Clausing, Saez and Zucman, 2021; Barake et al., 2021). The most closely related paper develops a formal model with a low-tax and a high-tax country and shows 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 the focus in this paper is mostly on the welfare consequences for non-havens, the analysis also implies that tax havens benefit from the global minimum tax: It stops the competition for profits and raises their equilibrium government revenue above zero.[4]

The paper proceeds in the following way. Section 2 describes the background for the agreement on the global minimum tax and provides some institutional detail. Section 3 presents the elements of the model: firms, households and governments. Section 4 determines the equilibrium behavior of firms, households and governments with and without a global minimum tax. Section 5 analyzes the welfare implications of a global minimum tax.

2 Background

The policy process

Recognizing that globalization and digitization 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. The resulting 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.

[3]Indeed, in our model, havens are perfect substitutes and the sensitivity of profits booked in one of them with respect to its tax rate is infinite. By contrast, the sensitivity of profits booked in all havens to the equilibrium haven tax rate, is finite and depends on the curvature of the concealment cost function.

[4]The paper builds on a broader theoretical literature on international tax competition in the presence of multinational firms with the ability to shift profits across borders (Slemrod and Wilson, 2009; Hong and Smart, 2010; Johannesen, 2010; Marceau, Mongrain and Wilson, 2010; Johannesen, 2012; Bucovetsky, 2014).

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 concerns that a wave of unilateral and uncoordinated policy efforts would harm 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 at the 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 imposes an additional top-up tax up to the global minimum rate. For instance, if Google books profits in Bermuda that are effectively taxed at 1%, the U.S. can impose an additional tax of 14% to bring the total taxation in line with the global minimum tax rate.[5]

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.

[5]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).

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.[6] 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 profits, is low.[7]

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

[6] Specifically, 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%.

[7] To be precise, jurisdictions are exempt when sales are below €10 million and profits are below €1 million.

firms incur concealment costs in countries where they under-report profits

We introduce the following notation and assumptions. First, we let $\overline{\pi}_{ij}$ denote the gross profits that the firm based in country i derives from its activities in country j. We ignore the possibility of losses and assume that $\overline{\pi}_{ij} \geq 0$ when j is a non-haven and, as there is no real activity in havens, that $\overline{\pi}_{ij} = 0$ when j is a haven.[8] Second, we let π_{ij} denote the profits that the firm based in country i chooses to report for tax purposes in country j. We assume that every dollar of profits has to be reported somewhere so that a firm's total reported profits equal its total true profits.[9] Third, we let $\triangle_{ij}$ denote under-reporting in country j by the firm based in country i, setting under-reporting to zero when there is over-reporting, and let $s(\triangle_{ij})$ denote the associated concealment costs. We assume that the concealment cost function $s(\cdot)$ is convex, implying that it is increasingly costly for firms to under-report, whereas no costly efforts are needed to conceal over-reporting.[10] Finally, we let Π_i^* denote the maximized total profits of the firm in country i net of taxes and concealment costs, which is paid out to shareholders as dividends in proportion to their ownership shares.

3.2 Households

Household preferences are represented by the standard utility function $u(c, G)$ where c denotes private consumption and G denotes public consumption financed out of tax revenue. 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 $f(\cdot)$.[11] 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.

[8] It is common to ignore losses in both theoretical and empirical work on profit shifting. While losses have a tax value, as they are typically allowed to offset taxable profits in other fiscal years under some conditions, this is difficult to incorporate in static models. A couple of recent papers highlight the implications of losses for taxation of multinational firms (Koethenbuerger, Mardan and Stimmelmayr, 2019; Becker, Johannesen and Riedel, 2020).

[9] 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).

[10] Formally, we define $\triangle_{ij} \equiv \max(\overline{\pi}_{ij} - \pi_{ij}, 0)$ and assume that $s(0) = 0$ and that $s'(\cdot) > 0$ and $s''(\cdot) > 0$ throughout the positive domain.

[11] 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).

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 $\Psi(\cdot)$ has standard properties, $\Psi'(\cdot) > 0$ and $\Psi''(\cdot) < 0$.

Intially, 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 with top-up taxes. Specifically, if the firm based in country i reports profits in a country 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 $\sum_j \max(t_M - t_j, 0)\pi_{ij}$.

4 Equilibrium

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).

4.1 Firms

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

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

where the first term is the firm's total gross profits, the second term is the firm's total tax payments 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 $(\pi_{i1}, \pi_{i2}, ..., \pi_{iN})$. In the presence of a global minimum tax, net profits have an additional negative term capturing 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.

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) In each country j where $t_j > t_L$, optimal under-reporting is given by the value $\triangle_{ij}^* \leq \overline{\pi}_{ij}$ satisfying:

$$s'(\triangle_{ij}^*) = t_j - t_L \tag{3}$$

or, if such a value does not exist, the value $\triangle_{ij}^* = \overline{\pi}_{ij}$.
(b) In each country j where $t_j \leq t_L$, the firm optimally over-reports:

$$\frac{\sum_j \triangle_{ij}^*}{H} \tag{4}$$

where 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.[12] 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 such countries.[13]

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

[12] Several recent papers investigate this corner solution empirically by estimating how the propensity to report zero profits varies with tax incentives for profit shifting (Bilicka, 2019; Johannesen, Tørsløv and Wier, 2020).
[13] This assumption is not important for any of the main results.

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).

4.2 Governments

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.

Proposition 1. *In the absence of a global minimum tax, the following policy choices constitute a Nash equilibrium:*
(a) all havens set the tax rate equal to zero
(b) non-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 social value of the public good (i.e. the average of $\Psi'(\cdot)u'_G$ taken over all households) and W'_C is the marginal social value of dividend payouts (i.e. the average of $\Psi'(\cdot)u'_c$ taken over all households weighted by household ownership shares in the firm).[14]

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.[15] As required in a Nash equilibrium, no individual haven can increase its revenue, and thus improve welfare 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

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

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

for the optimal tax rate in a non-haven by differentiating its welfare function with respect to its own tax rate (country indexes omitted for simplicity):

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

A small change in the tax rate affects the private consumption of all households who own shares as well as the size of public good. In the optimum, the net welfare 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 social value of dividend payouts (i.e. the average of $\Psi'(\cdot)u'_c$ over all households weighted by their ownership shares in the firm) and W'_G is the marginal social value of public consumption (i.e. the average of $\Psi'(\cdot)u'_G$ over all households). Dividing by $\sum_j \pi_{ji}$ and applying the definitions of Ω and ϵ yields eq. (5).

To gain intuition, we examine the two terms of eq. (7) 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.[16] 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.[17] 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.[18]

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

[16]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 zero (see Lemma 1). This is an application of the envelope theorem.

[17]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.

[18]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.

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 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.

Proposition 2. *In the presence of a global minimum tax at the rate of t_M that is not too high, the following policy choices constitute a Nash equilibrium:*
(a) all havens set the tax rate equal to t_M
(b) non-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 all other tax rates 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.[19]

Proposition 3. *In the presence of a global minimum tax at the rate of t_M that is sufficiently high, non-havens set the tax rate that satisfies*

$$\frac{W'_G}{W'_C} = \Omega \tag{8}$$

These policy choices constitute a Nash equilibrium together with any choice of tax rates in havens.

The intuition for this result is very simple. When t_M takes a sufficiently high value, multinational firms shift no profits. This implies that the corporate tax base is inelastic with respect to the tax rate ($\epsilon = 0$) so that eq. (5) collapses to eq. (8).

Finally, at intermediate values of the global minimum rate, it is possible that a "mixed equilibrium" emerges where some non-havens choose the tax rate t_M and others choose the interior optimum characterized by eq. (5). This occurs when, evaluated at the policy choices described in Proposition 2, at least one non-haven can increase its welfare by setting the tax rate t_M and receiving shifted profits from other non-havens rather than the interior optimum. This is not possible at low nor at high values of t_M where deviating from the interior optimum generates little or no additional revenue.[20] However, at intermediate values of t_M, mimicking the tax rate choice of havens may be attractive for non-havens because the revenue gain can be significant. Importantly, it is not optimal for all non-havens to adopt t_M at the same time: Each additional non-haven choosing t_M makes this choice less attractive for others, as aggregate shifted profits decreases and the number of countries sharing this tax base between them increases.[21] This suggests a "mixed equilibrium" where some non-havens choose the tax rate t_M, other non-havens choose the interior optimum, and the number of non-havens pursuing each of the two policies is such that welfare levels are equalized between the two groups.[22]

[19] 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.

[20] The revenue gain approaches zero both in the case where t_M approaches zero and where t_M is so high that profit shifting ends.

[21] In the limit, if all non-havens were to choose t_M, there would be no profit shifting and therefore no gain in terms of shifted profits from other non-havens. In this case, the interior optimum would strictly dominate t_M from them perspective of each non-haven.

[22] A similar 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.

5 Welfare analysis

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 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).[23] Moreover, the global minimum tax is explicitly *designed* to address the distortions associated with profit shifting, which makes a model focused on these distortions a natural benchmark.

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.*

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.

$$\frac{dW}{dt_M} = W'_C \underbrace{\left(- \triangle^*_{ii} \right)}_{\partial C/\partial t_M} + W'_G \underbrace{\left(\frac{d\pi_{ii}}{dt_M} t_i \right)}_{\partial G/\partial t_M} \tag{9}$$

[23] 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.

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 2, 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).

This result provides a 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 tax sensitivity of profit shifting as well as the marginal social value of the private consumption of firm owners.[24] 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.*

[24] 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.

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, as shown in Proposition (8). 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 concealment. Second, the split between private and government consumption is fully efficient, as the tax instrument is not associated with a marginal deadweight loss.

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

6 Concluding remarks

Recently, more than 100 countries have agreed to introduce a global minimum tax on profits to combat base erosion and profit shifting. The key policy innovation is top-up taxes in firms' home countries that bring the effective tax rate on foreign profits up to the minimum rate.

In this paper, we have studied the global minimum tax in a model of international tax competition with heterogeneous countries. The key insight is that introducing a global minimum tax at a relatively low rate changes the incentives for tax setting in tax havens radically: In the resulting policy equilibrium, tax havens 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 potentially reduce welfare in non-havens when introduced at a low rate. By contrast, the welfare effect is unambiguously positive when the global minimum tax is introduced at a sufficiently high rate such that profit shifting is abandoned altogether. The analysis thus highlights the risk of introducing a global minimum tax at a rate that is so low that profit shifting continues and havens capture part of the global revenue gain associated with the policy.

References

[1] Arulampalam, W., Devereux, M.P. and Maffini, G., 2012. "The direct incidence of corporate income tax on wages." *European Economic Review* 56(6), p. 1038-1054.

[2] Barake, M., Neef, T., Chouc, P.E. and Zucman, G., 2021. "Collecting the tax deficit of multinational companies simulations for the European Union." EU Tax Observatory, Report No 1.

[3] Becker, J., Johannesen, N. and Riedel, N., 2020. "Taxation and the allocation of risk inside the multinational firm." *Journal of Public Economics* 183, p. 104138.

[4] Bilicka, K. A., 2019. "Comparing UK tax returns of foreign multinationals to matched domestic firms." *American Economic Review* 109(8), p. 2921-53.

[5] Bucovetsky, S., 2014. "Honor among tax havens." *Journal of Public Economics* 110, p. 74-81.

[6] Clausing, K.A., Saez, E. and Zucman, G., 2021. "Ending corporate tax avoidance and tax competition: a plan to collect the tax deficit of multinationals." UCLA School of Law..

[7] Cremer, H. and Gahvari, F., 2000. "Tax evasion, fiscal competition and economic integration." *European Economic Review* 44(9), p. 1633-1657.

[8] Damgaard, J., Elkjaer, T. and Johannesen, N., 2019. "What is real and what is not in the global FDI network?" IMF Working Paper No. 19/274

[9] Devereux, M. P., Auerbach, A. J., Keen, M., Oosterhuis, P., Vella, J., and Schön, W., 2020a. Taxing profit in a global economy. Oxford University Press.

[10] Devereux, M.P., McCarthy, M., Simmler, M., Vella, J., Bares, F., Freedman, J. and Irem, G., 2020b. "The OECD Global Anti-Base Erosion Proposal." Oxford University CBT Working Paper.

[11] Englisch, J. and Becker, J., 2021. "Implementing an international effective minimum tax in the EU." Working Paper.

[12] Faulhaber, L. V., 2019. "Taxing Tech: The Future of Digital Taxation." *Virginia Tax Review*, 39, 145.

[13] Fuest, C., Peichl, A. and Siegloch, S., 2018. "Do higher corporate taxes reduce wages? Micro evidence from Germany." *American Economic Review* 108(2), p. 393-418.

[14] Garcia-Bernardo, J., and Janský, P., 2021. "Profit Shifting of Multinational Corporations Worldwide." ICTD Working Paper 119.

[15] Gordon, R.H., 1992. "Can capital income taxes survive in open economies?" *Journal of Finance* 47(3), p. 1159-1180.

[16] Hardeck, I. and Wittenstein, P.U., 2018. "Assessing the tax benefits of hybrid Arrangements — evidence from the Luxembourg Leaks". *National Tax Journal* 71(2), p. 295-334.

[17] Hebous, S., Keen, M., 2021. "Pareto-Improving Minimum Corporate Taxation". Oxford University Center for Business Taxation Working paper 2021-14.

[18] Hong, Q. and Smart, M., 2010. "In praise of tax havens: International tax planning and foreign direct investment." *European economic review* 54(1), p. 82-95.

[19] Huizinga, H., and Laeven, L., 2008. "International profit shifting within multinationals: A multi-country perspective." *Journal of Public Economics* 92(5-6), p. 1164-1182.

[20] Huizinga, H. and Nielsen, S.B., 1997. "Capital income and profit taxation with foreign ownership of firms." *Journal of International Economics* 42(1-2), p. 149-165.

[21] Johannesen, N., 2010. "Imperfect tax competition for profits, asymmetric equilibrium and beneficial tax havens." *Journal of International Economics* 81(2), pp.253-264.

[22] Johannesen, N., 2012. "Optimal fiscal barriers to international economic integration in the presence of tax havens." *Journal of Public Economics* 96(3-4), p. 400-416.

[23] Johannesen, N., 2014. "Tax avoidance with cross-border hybrid instruments." *Journal of Public Economics* 112, p. 40-52.

[24] Johannesen, N., Tørsløv, T. and Wier, L., 2020. "Are less developed countries more exposed to multinational tax avoidance? Method and evidence from micro-data." *World Bank Economic Review* 34(3), p. 790-809.

[25] Keen, M. and Konrad, K.A., 2013. "The theory of international tax competition and coordination." *Handbook of public economics* 5, pp.257-328.

[26] Kleinbard, E.D., 2011. "Stateless income." *Florida Tax Review* 11, p. 699-774.

[27] Koethenbuerger, M., Mardan, M. and Stimmelmayr, M., 2019. "Profit shifting and investment effects: The implications of zero-taxable profits." *Journal of Public Economics* 173, p. 96-112.

[28] Lipsey, R.G. and Lancaster, K., 1956. "The general theory of second best." *Review of Economic Studies* 24(1), p. 11-32.

[29] Marceau, N., Mongrain, S., and Wilson, J. D., 2010. "Why do most countries set high tax rates on capital?" *Journal of International Economics* 80(2), p. 249-259.

[30] OECD, 2013. "Action Plan on Base Erosion and Profit Shifting", OECD Publishing.

[31] OECD, 2021. "Statement on a Two-Pillar Solution to Address the Tax Challenges Arising from the Digitalisation of the Economy", 8 October 2021.

[32] Slemrod, J. and Wilson, J.D., 2009. "Tax competition with parasitic tax havens." *Journal of Public Economics* 93(11-12), p. 1261-1270.

[33] Tørsløv, T.R., Wier, L.S. and Zucman, G., 2018. "The missing profits of nations." NBER Working Paper No. 24701.

Appendix

Proof of Lemma (1)

The multinational firm based in country i chooses the allocation of reported profits $(\pi_{i1}, \pi_{i2}, ..., \pi_{iN})$ so as to maximize global after-tax profits:

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

subject to two sets of constraints:

(#1) global reported profits equal global true profits: $\sum_j \overline{\pi}_{ij} = \sum_j \pi_{ij}$

(#2) reported profits are at least zero in each country: $\pi_{ij} \leq 0$ for all j.

Letting μ_i and λ_{ij} denote the Langrangian multipliers associated with the constraints (#1) and (#2) respectively, we obtain the following set of first-order conditions:

$$\mu_i + \lambda_{ij} = t_j - s'(\cdot)$$

Consider two countries j and k where $t_j < t_k$. On the one hand, assume the firm over-reports profits in country k. By implication, marginal concealment costs are zero, $s'(\triangle_{ik}) = 0$, and the multiplier associated with the non-negativity constraint is zero, $\lambda_{ik} = 0$; hence, the first-order condition for profits in country k reduces to: $\mu_i = t_k$. Inserting this into the first-order condition for profits in country j, one obtains: $\lambda_{ij} = t_j - t_k - s'(\triangle_{ik}) < 0$. This contradicts that the allocation of profits is optimal, as shadow values cannot take negative values in the optimum. Hence, the firm does not over-report profits in a country if there exists another country with a strictly lower tax rate. On the other hand, assume the firm over-reports profits in country j. By implication, the first-order condition for profits in country j reduces to: $\mu_i = t_j$. Inserting this into the first-order condition for profits in country k, one obtains: $\lambda_{ik} + s'(\triangle_{ik}) = t_k - t_j > 0$. This implies that there is under-reporting in country k. Either, there is an interior solution for reported profits where marginal concealment costs equal the tax differential, $s'(\triangle_{ik}) = t_k - t_j$, with reported profits remaining positive, $\pi_{ik} > 0$, so that

the multiplier on the non-negativity constraint is zero, $\lambda_{ik} = 0$. Or, if such a solution does not exist, there is a corner solution where reported profits are zero $\pi_{ik} = 0$ and the multiplier on the non-negativity constraint equals the positive difference between the tax differential and marginal concealment costs: $\lambda_{ik} = t_k - t_j - s'(\triangle_{ik}) > 0$.

This argument easily generalizes. Let t_L denote the lowest tax rate in the world economy. In the optimum, over-reporting in the country j with $t_j = t_L$ implies that $\mu_i = t_L$. In any country k with $t_k > t_L$, there cannot optimally be over-reporting and the extent of the under-reporting is determined by $s'(\triangle_{ik}) = t_k - t_L$ or the non-negativity constraint $\pi_{ik} = 0$. If more than one country share the lowest tax rate t_L, the firm's allocation of shifted profits across these countries is indeterminate in the model and we assume that they are shared equally.

Proof of Lemma (2)

The multinational firm based in country i chooses the allocation of reported profits $(\pi_{i1}, \pi_{i2}, ..., \pi_{iN})$ so as to maximize global after-tax profits:

$$\Pi_i(\pi_{i1}, \pi_{i2}, ..., \pi_{iN}) = \sum_j \overline{\pi}_{ij} - \sum_j t_j \pi_{ij} - \sum_j s(\triangle_{ij}) - \sum_j \max(t_M - t_j, 0)\pi_{ij}$$

subject to two sets of constraints:

(#1) global reported profits equal global true profits: $\sum_j \overline{\pi}_{ij} = \sum_j \pi_{ij}$

(#2) reported profits are at least zero in each country: $\pi_{ij} \leq 0$ for all j.

The only difference from the problem without a global minimum tax (see proof of Lemma 1) is that the objective function includes an additional term that captures top-up taxes in the home country. With this modification, we obtain the following first-order condition for reported profits in country j:

$$\mu_i + \lambda_{ij} = \max(t_M, t_j) - s'(\cdot)$$

The only change relative to the problem without a global minimum tax (see proof of Lemma 1) is that the marginal tax cost of reporting profits in country j is at least t_M.

In the case where all countries apply a tax rate at least as high as t_M, the term $\max(t_M, t_j)$ simplifies to t_j and the first-order condition is exactly the same as in the problem without a global minimum tax (see proof of Lemma 1). The optimal allocation of reported profits is therefore also identical.

In the case where at least one country applies a tax rate strictly below t_M, we restate the first-order condition as

$$\mu_i + \lambda_{ij} = \tau_j - s'(\cdot)$$

where $\tau_j \equiv \max(t_M, t_j)$ is the *effective* tax rate on profits reported in country j accounting for top-up taxes. With this restatement of the first-order condition, we can apply precisely the same arguments as in the proof of Lemma 1. In the optimum, there is over-reporting in the country, or the countries, with the lowest effective tax rate, i.e. in any country j with a $t_k \leq t_M$, implying that $\mu_i = t_M$. In any country k with $t_k > t_M$, the extent of the under-reporting is determined by $s'(\triangle_{ik}) = t_k - t_M$ or the non-negativity constraint $\pi_{ik} = 0$. If more than one country share the lowest tax rate t_M, the firm's allocation of shifted profits across these countries is indeterminate in the model and we assume that they are shared equally.