Will the Global Minimum Tax Hurt Developing Countries?*

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Abstract

This paper focuses on the effects that the introduction of the Global Minimum Tax (GMT) has from the perspective of developing countries. We introduce a model with two asymmetric host countries for FDI that compete with each other for the location of multinational firms, and simultaneously fight profit shifting to a tax haven. The less-developed country has the weaker enforcement technology to fight profit shifting. It therefore loses more revenue from profit shifting, but also becomes a more attractive location for multinationals. The GMT reduces both profit shifting and the tax-avoidance advantage of the less-developed country. If tax competition for real investment is sufficiently severe, the introduction of the GMT then reduces tax rates and tax revenues in the developing country while tax revenues in the developed country rise. Our results help explaining the increasing resistance against the leading role of the OECD in global tax reform and the push by developing countries to involve the United Nations into designing the international tax charta.

Keywords: Global Minimum Tax; developing countries; tax competition

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1 Introduction

Profit shifting by multinational corporations (MNCs) has long been a primary concern of both academics and policymakers. During the last decade the OECD has stepped up its efforts to curb profit shifting in its 'Base Erosion and Profit Shifting' Action Plan (OECD, 2016), and in particular through the so-called Pillar 1 and Pillar 2 initiatives (OECD 2020a, 2020b). In particular Pillar 2, commonly known as the Global Minimum Tax (GMT), has experienced a surprisingly swift road to implementation. This measure imposes a tax rate of at least 15% on the profits of all large MNCs with annual sales of more than Euro 750 million. The GMT has been agreed upon by a group of more than 130 countries in December 2021, and implementation among the first set of countries (including the members of the European Union) has started in 2024.

Many observers see the GMT as the most ambitious and the most promising measure of international tax coordination to date; Devereux (2023, p. 154), for example, speaks of an "unprecedented form of coordination". At the same time, it is also commonly accepted that the primary beneficiaries of the GMT are the high-income OECD countries. In fact, several observers have criticized the bias towards the developed countries that arises from strengthening the taxing powers of MNC headquarters countries (see Mc Carthy, 2022; Stiglitz and Faccio, 2023). First analyses of the revenue effects of a 15% GMT forecast global revenue gains in the range of 150-200 billion USD (Hugger et al., 2024), most of which accrue to countries in Europe and North America (Baraké et al., 2022). Yet, according to these projections, developing countries will still gain, albeit moderately, from the coordinated introduction of the GMT.

In this paper we argue that developing countries not only gain less than developed countries, but that they may actually lose from the introduction of the GMT. To obtain this result, we broaden the scope of the analysis and incorporate the simultaneous competition for foreign direct investment (FDI), whereas the studies above focus only on the extent of international profit shifting. We show that developing countries are negatively affected by the introduction of the GMT, if the competition for FDI is severe, whereas developed countries still gain. The core argument is that the international competitiveness of less-developed countries for FDI is based, at least in part, on the ability of MNCs to shift their profits earned in these countries to tax havens. The introduction of the GMT reduces firms' ability to shift profits and increases effective tax rates in developing countries from the perspective of globally operating MNCs. Hence it worsens the competitiveness of developing countries vis-a-vis developed ones.

Policy measures in developing countries continue to place a strong emphasis on attracting investment. Throughout the last decade, 80-90% of policy measures in developing countries were aimed at promoting investment, as compared to less than 50%, on average,

in developed countries (UNCTAD, 2024, Figure II.2). In Vietnam, for example, several international investors, including Samsung Electronics, asked for government subsidies to offset the harmful effects that the introduction of GMT represents for investment incentives in this country.[1] The concern of developing countries with the GMT is summarized in the statement of Bahlil Lahadalia, Chair of the ASEAN Investment Area Council: "*The adoption of GMT will affect investment incentives. We decided that it needs to be reviewed to prevent it from only benefiting one particular group of countries.*"[2]

In November 2023, the dissatisfaction of developing countries with the introduction of the GMT culminated in a resolution by the United Nations. In the General Assembly, 125 (mostly) developing countries passed a Nigeria-led draft that calls for an U.N. framework convention on international tax cooperation that seeks to end the dominant role of the OECD in setting the international tax agenda.[3]

Against this background, the present paper adopts a framework with both profit shifting and competition for real investment to analyse the effects that the introduction of the GMT has on developing countries. Our model builds on Janeba and Schjelderup (2023), who show that there may be unexpected side effects from introducing the GMT when homogenous countries simultaneously compete for real investment. Their main argument is that when MNCs are less able to shift profits, and therefore higher tax revenue can be obtained from hosting MNCs, this increases the value of attracting MNCs from abroad and intensifies real tax competition between the potential host countries.[4] As the theoretical analysis of Janeba and Schjelderup (2023) is for symmetric countries, it is best interpreted as applying to the competition between two developed, high-income countries. We extend their analysis along three empirically relevant lines: (i) We simultaneously include less-elastic domestic firms and mobile MNCs, thus creating an argument for governments to impose differentiated effective tax rates on the two tax bases (Hong and Smart, 2010). (ii) We incorporate an intensive investment margin for all firms that constrains the setting of the corporate tax rate. (iii) Most importantly, we introduce two fundamental differences between the two competing countries, which capture a potential conflict between developed and developing countries.

Specifically, a first asymmetry is that the developing country has a production disadvantage, modelled here as a higher cost of capital for producing a given level of output.

[1] See `https://hanoitimes.vn/vietnamese-govt-urged-to-address-impact-of-global-minimum-tax-327327.html`.

[2] See `https://www.pna.gov.ph/articles/1208201`. 20 August, 2023.

[3] See, e.g., the Reuters Daily Briefing newsletter by Leigh Thomas from November 23, 2023, under `https://www.reuters.com/world/un-vote-challenges-oecd-global-tax-leadership-2023-11-23/`.

[4] A related argument made in the popular press is that subsidy competition to attract FDI will intensify when corporate income tax rates are increased through the GMT. See, e.g., Michel (2023).

The higher cost of capital in developing countries can be rationalized as a direct impact of capital market imperfections (Lucas, 1990) or as a shortcut for higher investment costs caused by lower institutional quality (Alfaro et al., 2008). Second, the developing country has the weaker tax enforcement technology, implying that MNCs face lower costs of profit shifting if they operate from the developing country.[5] While this implies higher tax revenue losses from profit shifting, it also gives the developing country a competitive advantage over its developed competitor, compensating for the developing country's investment disadvantage.

In this setting, we first show, that under plausible conditions, developing countries set higher corporate tax rates as compared to their developed counterparts. This is because developing countries are able to discriminate more in favor of mobile MNCs, due to their lower capacity to enforce anti-avoidance regulation. As a consequence, there is more profit shifting from developing countries to the tax haven. This higher corporate tax rate in developing countries is supported by the empirical evidence (Hohmann et al., 2024, Figure 2).[6] We then show that tighter competition for real investment unambiguously harms the developing country, but not the developed country. Finally, we analyze the effects of introducing the GMT, which reduces profit shifting and makes the developing country less attractive as a host for FDI. If real tax competition is sufficiently severe, the developing country will unambiguously lose tax revenue from the introduction of the GMT, whereas the developed country may still gain. These effects, which fundamentally stem from the competition for real investment by MNCs, are not incorporated in the existing projections for the revenue effects of the GMT. Consequently, our analysis offers an explanation for the discontent of developing countries with this major tax policy initiative of the OECD.

Our paper contributes to three different strands of literature. The first is the theoretical literature on the effects of the GMT. Johannesen (2022) analyzes the welfare effects of introducing a GMT in a setting with many non-haven and haven countries. In his model, the welfare effects of introducing a GMT are fundamentally ambiguous for non-haven countries, because tax revenues rise but the profits of MNCs fall as haven countries increase their tax rate to the level of the GMT. Hebous and Keen (2023) model the GMT in an asymmetric tax competition game where two countries differ in terms of their valuation of public spending. The countries only compete for paper profits; all investments are fixed. The authors' calibration indicates that GMT levels up to 17% can constitute strict Pareto improvements, increasing welfare in both high-tax and low-tax

[5]Empirical evidence supporting this assumption is provided, for example, by Johannesen et al. (2020) and Laudage Teles et al. (2023).

[6]More broadly, the Corporate Tax Statistics database (OECD, 2022) reports 2018 revenue from corporate taxation as a share of total tax revenues of 19.2% in Africa, 15.6% in Latin-America, and only 10% in OECD countries. Bachas et al. (2024, Table 1) also document that the ratio of corporate tax revenue over revenue from personal income taxes, is higher in developing countries.

countries. Hindriks and Nishimura (2022) extend the analysis of the GMT to allow for an endogenous enforcement decision, together with the decision on tax rates. They show that in this setup the introduction of the GMT undermines tax enforcement cooperation between the high-tax and the low-tax country, and may make the high-tax country worse off, in comparison to the no-GMT benchmark. None of these studies incorporates tax competition for mobile real investment.

In contrast, Janeba and Schjelderup (2023) study a three-country model where two symmetric countries compete for real FDI while simultaneously competing for profit shifting with a third, tax-haven country. In this setting, the revenue effects of introducing the GMT depend critically on the intensity of competition for real FDI, and on the policy instruments with which countries compete for real investment. Haufler and Kato (2024) focus on the fact that enforcement of the GMT is confined to 'large' MNCs and ask whether tax havens and onshore countries have an incentive to split tax rates for large vs. small MNCs. Relatedly, Bond and Gresik (2024) also analyze this size threshold and show that its level determines whether the number of MNCs' haven affiliates reduces and profit shifting lessens or whether, in contrast, tax havens *reduce* their tax rate further and tax competition intensifies. Finally, Schjelderup and Stähler (2023) argue that the GMT fails to tax MNCs' profits at an effective 15% tax rate, because its tax base is reduced by so-called 'carve outs'. These papers, however, do not consider the implicit tax differentiation that arises when countries tax mobile and less mobile firms at different effective rates. Most importantly, they also do not focus on the different degrees to which developing vs. developed countries are exposed to the competition for FDI.[7]

A second theoretical literature strand deals with the simultaneous tax competition for profit shifting and for real investment. Peralta et al. (2006) and Mongrain et al. (2023) show that countries may adopt deliberately lax policies against profit shifting in order to become more attractive in the competition for real investment. Similarly, in Haufler et al. (2018) countries choose thin capitalization rules and controlled foreign company rules along with the corporate tax rate, in order to optimally trade off the gains from FDI against the losses from profit shifting. Juranek et al. (2023) combine thin capitalization rules and royalty taxes to solve the same trade-off. We apply these insights to developing countries, and to the introduction of the GMT.

Finally, we contribute to the emerging literature on developing countries in an international tax setting. Mardan and Stimmelmayr (2020) model tax competition between countries that differ both in their tax enforcement regulation, and in country-specific risks. They show that when tax enforcement is low, developing and high-risk countries

[7]Different from economics, there has been some discussion in legal studies in recent years on whether the GMT constrains the ability of developing countries to attract FDI, and might therefore harm these countries. See, for example, Titus (2022).

set higher tax rates in equilibrium, as compared to developed countries with lower investment risk. In a similar way, Gordon and Li (2009) show that weak tax enforcement is able to explain several features of developing countries' tax structures, which otherwise are hard to rationalize. Gresik et al. (2024) analyze how optimal tax and regulatory policies depend on the institutional quality of a country and show that it can be optimal for developing countries with low administrative quality to not regulate MNC's profit shifting and only tax domestic firms. The role of developing countries has also been stressed in several studies quantifying profit shifting around the world. Fuest et al. (2011), Crivelli et al. (2016), Jansky and Palansky (2019), and Garcia-Bernardo and Jansky (2024) all find that developing countries suffer more from profit shifting to tax havens than developed countries.[8] We apply the perspective of developing countries to the analysis of the GMT.

Our analysis proceeds as follows. In Section 2, we summarize the main rules of the GMT and outline which ones are important for our analysis. In Section 3, we set up our model of asymmetric tax competition between two host countries and a tax haven. Section 4.1 studies how the intensity of real tax competition affects the two asymmetric countries. Section 4.2 then turns to the introduction of the GMT and analyzes theoretically and numerically how this affects tax rates and tax revenues in the developing vs. the developed countries. Section 5 concludes.

2 The Global Minimum Tax

In 2021, the OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting – which includes all major developed economies, but also many developing countries – approved the implementation of a GMT. The dedicated aim is to prevent aggressive corporate tax avoidance and to end harmful tax practices to attract paper profits. In this section, we briefly summarize the main rules of the GMT agreement.

The basic idea of the GMT is that MNCs with annual global turnover of at least 750 million Euro (so-called 'in-scope MNCs') should face an effective tax rate of at least 15% in each country where they have affiliates. Having a physical presence in a country that ratified the GMT rules is sufficient to trigger their application. To achieve the minimum level, the GMT applies a two-stage process. First, each in-scope MNC needs to calculate and report its effective tax rate for each country in which it is present. This effective tax rate is determined as the ratio of (qualified) tax payments in the country relative to the 'Global Base Erosion' (GloBE) income.[9] If the calculated effective tax rate falls below

[8] One of the few counterexamples is the country study by Wier (2020), who finds that revenue losses from profit shifting in South Africa are comparable to those that arise for highly developed countries. See Hohmann et al. (2024) for a summary and discussion of this empirical literature.

[9] For our analysis and results to come, the details of how the effective tax rate under the GMT is

the 15% limit, the MNC has to pay top-up tax for the affiliates in the respective country, that is, there will be a procedure that ensures a tax burden of at least 15% in all countries with a physical presence.[10]

When the amount of top-up tax is determined, the procedure to collect the tax comes with effectively three mechanisms. They follow a clear order, defining which country has the right to charge top-up tax under which condition. Under the model rules specified in OECD (2021), the first in line will be the country in which the effective tax rate is too low. Under the Qualified Domestic Minimum Top-up Tax (QDMTT) regime, this country (e.g., a tax haven) can charge the difference between its regular corporate income tax burden and the tax burden that the MNC has to pay in that country according to the GMT rule. Tax havens are therefore able to maintain their (low) standard corporate income tax rates, but still charge in-scope MNCs the amount of tax stipulated by the GMT rules. If the host (haven) country does not apply the QDMTT, the next in line is the country where the headquarters of the MNC resides (a developed country, in most cases). Under the qualified Income Inclusion Rule (IIR), the headquarters country is supposed to charge the parent firm the top-up tax due for the affiliate(s) in the low-tax country in question. Finally, if the headquarters country does not impose the IIR, all other countries in which the MNC has a physical presence can apply the qualified undertaxed payments rule (UTPR) to make sure that the MNC pays the top-up tax it is due under the GMT. UTPR taxing rights will be apportioned among interested, eligible countries according to allocation factors based on the number of employees and tangible fixed assets. The UTPR functions as a backstop to prevent MNCs from moving their headquarters to countries that do not participate in the GMT, and thus do not charge IIR.

Many of the GMT rules became active in January 2024. Since then the EU member countries, for example, apply the GMT rules to all in-scope MNCs that have a physical presence in the EU. The QDMTT is embraced by tax havens worldwide. From the point of view of tax havens, not incorporating the QDMTT leaves money on the table without any effect on the global tax payments of the MNCs. Hebous et al. (2024, Table 1) provide an overview of several tax haven countries that have opted for a QDMTT. In our model below, we therefore assume that tax havens adjust their relevant corporate tax rates on in-scope MNCs to meet the GMT requirement.

determined do not matter. See de Wilde (2024) for a detailed legal analysis and discussion.

[10]There is, however, a carve-out rule in place that ensures no top-up tax on a 'normal rate of return', achieved by deducting 5% of the sum over labor costs and the value of tangible assets from the GloBE income. We neglect these carve-out rules in our theoretical analysis below, as they are not core to our analysis. See Schjelderup and Stähler (2023) for details.

3 Model

3.1 Setting

We consider a world with three countries, a highly developed country H, a less developed country L, and a tax haven. There is a mass of n MNCs which can perform their real operations in either H or L. We normalize $n \equiv 1$ and use subscript $i \in \{H, L\}$ to denote the two potential host countries H and L. In addition to the MNCs, there are n_i^D domestic firms in each country i. The location of the domestic firms is fixed, whereas MNCs endogenously choose their production location. We follow Janeba and Schjelderup (2023) in that MNCs are heterogeneous in their location preferences for countries H or L. This heterogeneity is summarized in a fixed cost term to locate in country H (as opposed to country L) equal to $\alpha^m F$. Here α^m is uniformly distributed in the interval $[-0.5, 0.5]$ and the parameter F scales the intensity of location preferences. MNCs with a negative α prefer country H, whereas those with a positive α prefer country L. MNCs are symmetric in all other aspects except for their location preference. One possible interpretation of these location costs is that they represent the capitalized value of the benefit that some MNCs derive from proximity to natural resources and larger unskilled workforce in developing countries, whereas other MNCs gain from better public infrastructure and larger human capital in developed countries. For notational brevity, we omit the index m in the following.

All firms sell their production in the world market at a price normalized to unity. Capital is the only (variable) production factor. Countries H and L are small in the world capital market and firms procure capital at a fixed interest rate r. To capture the lower productivity of capital in country L, we assume that if firms operate in this country, they need to incur an additional capital cost denoted by s_L to produce the same output. Therefore, when domestic and MNCs in country $i \in \{H, L\}$ use k_i^D and k_i amounts of capital to produce output $f(k_i^D)$ and $f(k_i)$, their costs are $(r + \mathbb{1}s_L)k_i^D$ and $(r + \mathbb{1}s_L)k_i$ where $\mathbb{1}$ is a binary variable which takes the value zero if firms operate in country H and the value 1 if they operate in L. Examples for the extra investment costs in developing countries are additional agency costs in imperfect local capital markets (Lucas, 1990), or costs resulting from weaker quality of institutions in developing countries (Alfaro et al., 2008).[11] Firms' technology is assumed to have positive but decreasing returns to investment, $f' > 0 > f''$. The outputs produced by domestic firms and MNCs are perfect substitutes. We assume that capital is fully financed by equity, and following most real-world corporate tax codes, that costs of equity are non-deductible from firms' tax bases.

[11] Both of these arguments can rationalize the 'Lucas paradox' that investment does not flow to the Global South, despite the substantially lower capital-labor ratio in developing countries.

All MNCs have a subsidiary in the tax haven, denoted by the index 1 and we assume that each haven subsidiary sells one unit of an intangible asset to the non-haven affiliate i. This intra-firm transaction allows MNCs to shift profits across countries by manipulating transfer prices. We normalize the true price of the asset sold intra-firm to zero so that any positive transfer price p_i represents profit shifting. However, such profit shifting is costly due to transfer pricing regulation that causes tax planning costs. It is a general result in the literature that the tax enforcement capacity is weaker in developing as compared to developed countries (see Hohmann et al., 2024, Figure 1; Johannesen et al., 2020).[12] Therefore, we assume that the MNCs' marginal cost of manipulating transfer prices is lower in country L. Specifically, letting p_i be the transfer price set by MNCs in country $i \in \{H, L\}$, tax planning costs (or concealment costs) in country i are given as $C(p_i, \delta_i) = \delta_i p_i^2/2$. In this formulation δ_i captures the enforcement level of transfer pricing regulation and we assume throughout our analysis that $\delta_H > \delta_L$ holds.

Governments in the non-haven countries i set their corporate tax rate t_i to maximize tax revenues. Tax revenue maximization is a natural government objective in studies of the GMT, because the main purpose of the GMT is to raise corporate tax revenues, and this is also the ultimate outcome variable in all quantitative studies projecting the effects of the GMT.[13] Analytically, this objective implies that governments do not care about the profits of either domestic firms or MNCs, which is a critical simplifying assumption for our asymmetric three-country analysis. The tax base in each country is composed of domestic firms and MNCs operating in the country. The location of domestic firms is fixed and the tax base resulting from these firms is equal to $D_i = n_i^D f(k_i^D)$. MNCs are mobile across countries, and they also engage in profit shifting. Hence the MNC tax base of country i is $B_i = n_i b_i$, where n_i is the number of MNCs operating in i and $b_i = f(k_i) - p_i$ is the tax base per MNC, where p_i is the level of profit shifting to the tax haven. As we will show, both n_i and b_i depend negatively on the tax rate chosen by country i.

The primary focus of our paper is on the introduction of the GMT. We assume that the tax haven initially imposes a corporate tax rate $t_1 < min\{t_H, t_L\}$. Under the GMT, countries agree on the minimum corporate tax rate $t_M > t_1$, where t_M is effectively binding for the tax haven as it is the dominant choice for them to introduce a QDMTT.[14]

[12] Hohmann et al. (2024) derive this result from a comparison of legal transfer pricing regulations in different countries; see Laudage Teles et al. (2024) for more detail. Johannesen et al. (2020) instead estimate the elasticity of the corporate tax base with respect to the statutory tax rate and find that it is significantly higher in developing countries.

[13] Tax revenue maximization corresponds to a Rawlsian social welfare function when the least well-off individual owns no shares in domestic or multinational firms.

[14] See the discussion at the end of Section 2. Under the specification of the GMT, the tax haven will find it in its own self-interest to raise its tax rate to the level of the GMT. This is because if it does not do so, the headquarters countries of MNCs will instead raise the effective taxation of the profits that their MNCs make in the tax haven country to the level of the GMT. This latter scenario is unambiguously

Therefore, we model the introduction of the GMT as an exogenous shock that increases the tax rate in the haven country to t_M.

We solve the following three-stage game. In the first stage, countries H and L determine their tax rates given the exogenous tax rate in the tax haven country 1. In the second stage, each MNC chooses its location either in country H or in country L. In the third stage, firms determine their investment levels and MNCs also decide the amount of shifted profits. We solve the game by backward induction.

3.2 Firms' decision problems

3.2.1 Capital investments and profit shifting

In the third stage, given MNCs' location in country i, domestic firms and MNCs maximize their post-tax profits,

$$\Pi_i^D = (1-t_i)f(k_i^D) - (r + \mathbb{1}s_L)k_i^D, \tag{1}$$

$$\Pi_i^m = (1-t_i)\left[f(k_i) - p_i\right] - (r+\mathbb{1}s_L)k_i - \frac{\delta_i p_i^2}{2} + (1-t_1)p_i - (1-\mathbb{1})\alpha^m F. \tag{2}$$

The first three terms in eq. (2) give the post-tax profits, net of shifting costs, from operating in country i. The fourth term captures the post-tax profits in the tax haven. The last term gives the firm-specific gains or losses from locating in country H.

By solving the firms' maximization problem with respect to capital investment, the optimal investment levels, k_i^{D*} and k_i^*, satisfy the first-order condition

$$f'(k_i^{D*}) = f'(k_i^*) = \frac{r + \mathbb{1}s_L}{1-t_i}. \tag{3}$$

The responses of optimal investment levels to changes in the tax rates t_i and t_j and the additional investment costs s_L are given by

$$\frac{\partial k_i^*}{\partial t_i} = \frac{r+\mathbb{1}s_L}{(1-t_i)f''(k_i^*)} < 0, \qquad \frac{\partial k_i^*}{\partial t_j} = \frac{dk_i^*}{dt_1} = 0, \qquad \frac{\partial k_i^*}{\partial s_L} = \frac{\mathbb{1}}{(1-t_i)f''(k_i^*)} \leq 0,$$

and analogously for k_i^D. A higher tax in country i reduces the investments of all firms there. As none of the countries can affect the world interest rate, firms' investment decisions are independent of tax rates in another country. Finally, higher extra costs s_L reduce investment in country L, whereas investment in country H remains unchanged.

MNCs' optimal level of profit shifting is determined by maximizing eq. (2) with respect

inferior from the perspective of the tax haven, because it forgoes tax revenues without providing an effective tax relief for the MNCs that shift profits to its jurisdiction. See also Johannesen (2022).

to p_i. This yields[15]

$$p_i^* = \frac{t_i - t_1}{\delta_i}. \tag{4}$$

The optimal transfer price p_i increases in the tax differential between the host country i and the tax haven, and it falls in the profit shifting cost parameter δ_i:

$$\frac{\partial p_i^*}{\partial t_i} = \frac{1}{\delta_i} > 0, \qquad \frac{\partial p_i^*}{\partial t_j} = 0, \qquad \frac{\partial p_i^*}{\partial t_1} = \frac{-1}{\delta_i} < 0, \qquad \frac{\partial p_i^*}{\partial \delta_i} = \frac{-(t_i - t_1)}{\delta_i^2} < 0.$$

Using eq. (2) and the optimal transfer price and capital investment, the optimized post-tax profits of MNCs are

$$\Pi_i^{m*} = (1 - t_i) f(k_i^*) - (r + \mathbb{1} s_L) k_i^* + \frac{(t_i - t_1)^2}{2\delta_i} - (1 - \mathbb{1}) \alpha^m F. \tag{5}$$

3.2.2 MNCs' location decision

The location preferences of MNCs in which country to operate are reflected in α^m. From eq. (5), we can derive the pivotal MNC, with preference parameter $\widehat{\alpha}$, which is just indifferent between locating in H or in L. From $\Pi_H^m(\widehat{\alpha}) = \Pi_L^m(\widehat{\alpha})$, we get

$$\begin{aligned} \widehat{\alpha} = \frac{1}{F} \Bigg[& \left\{ (1 - t_H) f(k_H^*) - r k_H^* \right\} - \left\{ (1 - t_L) f(k_L^*) - (r + s_L) k_L^* \right\} \\ & + \left\{ (t_H - t_1) p_H^* - \frac{\delta_H}{2} (p_H^*)^2 \right\} - \left\{ (t_L - t_1) p_L^* - \frac{\delta_L}{2} (p_L^*)^2 \right\} \Bigg]. \end{aligned} \tag{6}$$

MNCs with $\alpha^m < \widehat{\alpha}$ enter in country H, whereas MNCs with $\alpha^m > \widehat{\alpha}$ locate in country L. Hence, $\widehat{\alpha} > 0$ implies that more than one half of all MNCs locate in country H.

The pivotal MNC is determined by two channels: Differences in the costs of operation (the first line of eq. (6)), and differences in profit shifting (the second line). First, differences in operation costs are determined by tax rate differences t_H, t_L and by the extra capital cost of operating in country L. In general, the sign of this difference is ambiguous. However, when $t_L \geq t_H$ holds, the first line in eq. (6) is clearly positive, implying a larger number of MNCs in country H. Second, MNCs' post-tax profits are also determined by the possibility to save taxes, net of profit shifting costs. The second line in eq. (6) is also ambiguous, in general, but it is certainly negative when $t_L \geq t_H$ holds. In this case, MNCs in country L unambiguously shift more profits out of country L due to both a larger tax differential to the haven country 1, and because of the weaker tax enforcement

[15] To keep the analysis tractable, we follow the vast majority of the literature and assume that the cost parameter δ_i is sufficiently high to ensure an interior solution for the transfer price, that is, a positive tax base $f(k_i^*) - p_i^* > 0$ in the optimum. For analyses how a binding zero-profit constraint affects tax and regulation policies, see Köthenbürger et al. (2019) and Gresik et al. (2024).

in country L, as indicated by the lower shifting cost parameter $\delta_L < \delta_H$. Other things equal, a negative second line implies a higher share of MNCs in the developing country L.

The effects of tax rates t_H and t_L on the pivotal MNC are unambiguous and, from Appendix A.1, are given by

$$\frac{\partial \widehat{\alpha}}{\partial t_H} = -\frac{f(k_H^*) - p_H^*}{F} < 0, \qquad \text{and} \qquad \frac{\partial \widehat{\alpha}}{\partial t_L} = \frac{f(k_L^*) - p_L^*}{F} > 0, \tag{7}$$

where the numerators on the right-hand side of the equations are the tax bases of MNCs in country i, which must be positive. A higher tax rate in country i decreases the number of MNCs that locate in i. This corresponds to a lower level of $\widehat{\alpha}$ if country H raises its tax rate, but to a higher $\widehat{\alpha}$ if the tax rate in country L rises.

Moreover, we also derive the effect of a change in the GMT on the pivotal MNC as

$$\frac{\partial \widehat{\alpha}}{\partial t_1} = \frac{p_L^* - p_H^*}{F} \gtrless 0, \tag{8}$$

see Appendix A.1. If $p_L^* > p_H^*$, the expression is positive and more MNCs move to country H. Conversely, if $p_L^* < p_H^*$, then more firms move to country L after the GMT increase. In sum, therefore, eq. (8) implies that a rising tax rate in the tax haven *reduces* the attractiveness of the location from which more profits are shifted. The intuition is that the GMT triggers a stronger increase in the tax burden of those MNCs that are located in the country from which more profits can be shifted.

Finally, with our normalization $n \equiv 1$, we determine the number of MNCs in each country i as

$$n_H = \widehat{\alpha} - (-0.5) = 0.5 + \widehat{\alpha} \quad \text{and} \quad n_L = 0.5 - \widehat{\alpha}. \tag{9}$$

3.3 Governments' tax policies

We now turn to the first stage where governments H and L determine their tax rates to maximize tax revenues T_i. We assume that countries only have one non-discriminatory corporate tax rate t_i that must equally be applied to MNCs and to domestic firms.[16] In each country i, the non-discriminatory tax rate t_i multiplies both the tax base for MNCs, B_i, and the tax base on domestic firms, D_i. Total tax revenue is given by

$$T_H = t_H(B_H + D_H) = t_H \left\{(0.5 + \widehat{\alpha})(f(k_H^*) - p_H^*) + n_H^D f(k_H^D)\right\}, \tag{10a}$$

$$T_L = t_L(B_L + D_L) = t_L \left\{(0.5 - \widehat{\alpha})(f(k_L^*) - p_L^*) + n_L^D f(k_L^D)\right\}, \tag{10b}$$

[16] This is often a legal constraint in reality and it is a standard assumption in related models; see, for example, Hong and Smart (2010) or Haufler et al. (2018). Note that *effective* tax rates are nevertheless lower for MNCs as compared to domestic firms, as the former can engage in profit shifting.

where $B_i \equiv b_i n_i$. Using eqs. (10a) and (10b), optimal tax rates are defined by:

$$\frac{\partial T_H}{\partial t_H} = n_H b_H + n_H^D f(k_H^D) + t_H b_H \frac{\partial \widehat{\alpha}}{\partial t_H} + t_H n_H f'(k_H) \frac{\partial k_H^*}{\partial t_H} - \frac{t_H n_H}{\delta_H} + t_H n_H^D f'(k_H^D) \frac{\partial k_H^D}{\partial t_H} = 0, \tag{11a}$$

$$\frac{\partial T_L}{\partial t_L} = n_L b_L + n_L^D f(k_L^D) - t_L b_L \frac{\partial \widehat{\alpha}}{\partial t_L} + t_L n_L f'(k_L) \frac{\partial k_L^*}{\partial t_L} - \frac{t_L n_L}{\delta_L} + t_L n_L^D f'(k_L^D) \frac{\partial k_L^D}{\partial t_L} = 0. \tag{11b}$$

The first two terms in (11a)–(11b) give the mechanical effects of a tax increase at unchanged tax bases. The remaining terms are reductions in the tax base that follow from the tax increase. For the MNCs, these are the reduced number of mobile firms, the reduced investment per firm, and the increase in profit shifting to the haven (third to fifth terms). For the domestic firms, only the negative investment effect is present (sixth term).

Using eq. (7), the first-order conditions (11a) and (11b) can be condensed to

$$\frac{\partial T_i}{\partial t_i} = n_i \left[b_i - \frac{t_i}{\delta_i} + t_i f'(k_i^*) \frac{\partial k_i^*}{\partial t_i} \right] - \frac{t_i b_i^2}{F} + n_i^D \left[f(k_i^{D*}) + t_i f'(k_i^{D*}) \frac{\partial k_i^{D*}}{\partial t_i} \right] = 0. \tag{12}$$

From this equation, we immediately get:

Proposition 1 (Equilibrium tax rates)

In the asymmetric tax equilibrium, the tax rates in the developed country H and the developing country L are given by

$$t_i^* = \frac{B_i + D_i}{\frac{n_i}{\delta_i} - n_i f'(k_i^*) \frac{\partial k_i}{\partial t_i} + \frac{n_i b_i^2}{F} - n_i^D f'(k_i^{D*}) \frac{\partial k_i^{D*}}{\partial t_i}} \quad \forall\, i \in \{H, L\} > 0,$$

where the numerator equals the sum of tax bases in country i, and the denominator collects all behavioral tax-base responses to a tax increase.

In the following, we compute two comparative static effects for the tax rates given in Proposition 1. The first one is an increase in the number of domestic firms n_i^D in country i. Totally differentiating the system of first-order conditions (12) for the optimal tax rates t_i in country $i \in \{H, L\}$ leads to (see Appendix A.2)

$$\frac{dt_i}{dn_i^D} = \frac{\left[f(k_i^{D*}) + t_i f'(k_i^{D*}) \frac{\partial k_i^{D*}}{\partial t_i} \right] \left(-\frac{\partial^2 T_j}{\partial t_j^2} \right)}{|H|} > 0, \tag{13}$$

where both $\frac{\partial^2 T_j}{\partial t_j^2} < 0$ and $|H| > 0$ follow from second-order conditions. Furthermore,

the squared bracket in the numerator of eq. (13) must be positive in any tax optimum.[17] Consequently, a larger number of domestic firms n_i^D leads to a higher corporate tax rate t_i^* in the optimum. This is intuitive because the optimal tax weighs the revenue increases from the mechanical effects against the average distortions caused by the tax increase. Since domestic firms can only respond by reducing investment, whereas MNCs additionally choose their location and the level of profit shifting, increasing n_i^D reduces the *average* elasticity of country i's tax base.

The presence of domestic firms is a first important difference between our analysis and that of Janeba and Schjelderup (2023), where all firms are mobile. It implies that both countries will have an incentive to permit some profit shifting as a way to discriminate between the effective taxation of mobile vs. immobile firms (as in Peralta et al., 2006; or Hong and Smart, 2010). Moreover, it follows from eq. (13) that statutory tax rates in our model tend to be higher in both countries in the non-cooperative tax equilibrium. These properties of our model will have important implications for the effects of the GMT.

Our second comparative static result – and our second extension to the model of Janeba and Schjelderup (2023) – is to introduce two asymmetries between countries H and L. We start from an initially symmetric equilibrium, where $s_L = 0$ and $\delta_H = \delta_L = \delta$. In this symmetric benchmark, $\widehat{\alpha} = 0$, $n_i = \frac{n}{2}$, and $t_H^* = t_L^*$ must hold. We then introduce two small, simultaneous changes: an increase in s_L and a reduction in δ_L. We know from eq. (6) that these changes tend to have offsetting effects on the pivotal firm $\widehat{\alpha}$. Therefore, there must be a combined reform $(ds_L, d\delta_L)$ that leaves $\widehat{\alpha}$ unchanged. The following proposition can be derived for such a reform.

Proposition 2 (Asymmetric tax equilibrium)

Starting from a symmetric tax equilibrium, consider an exogenous increase in s_L and a simultaneous reduction in δ_L to keep $\widehat{\alpha}$ constant. If F is sufficiently low and tax competition for FDI is intense, this reform leads to a (weakly) higher tax rate in country L and more profit shifting out of country L in equilibrium, i.e., $t_L \geq t_H$ and $p_L^* > p_H^*$.

Proof: *See Appendix A.3.*

The intuition for Proposition 2 is as follows. Since country L has the weaker tax enforcement, MNCs will be able to shift more profits out of country L as compared to country H when tax rates are equal. These higher tax savings in country L increase the attractiveness of L as a location for MNCs, and this effect tends to compensate the higher

[17] To see that, note from the first-order condition (12) that at least one effect must be positive to offset the negative second effect. Since the bracket in the first term is unambiguously smaller than the bracket in the third term, the third term in (12) must be positive. But the bracketed expression in this third term equals the first term in the numerator of (13).

cost of capital in country L by construction. Appendix A.3 shows that the net effect on country L's tax rate depends on the degree of tax competition for mobile MNCs. If this real tax competition is sufficiently aggressive (F is sufficiently low), then the increased profit shifting opportunities in L dominate the higher costs of capital, and country L's tax rate can rise while keeping $\widehat{\alpha}$ constant. This induced tax differential will further increase the profit shifting incentives for MNCs, as given in eq. (4). Hence $p_L^* > p_H^*$ must necessarily hold in the new, asymmetric Nash equilibrium.

The results summarized in Proposition 2 rationalize empirical findings in the literature. Hohmann et al. (2024, Figure 2) show that statutory corporate income tax rates are highest for developing countries, and fall with the level of economic development.[18] Together with the weaker tax enforcement in developing countries (see the evidence referenced in footnote 12), this implies higher equilibrium shares of profit shifting out of developing countries. Indeed, several studies find that the share of profits shifted out of developing countries is significantly higher than the corresponding share for developed countries (Crivelli et al., 2016; Jansky and Palansky, 2019; Garcia-Bernardo and Jansky, 2024).

4 Tax competition

4.1 Competition for foreign direct investment

To analyze the competition between the two non-haven countries for FDI, we consider a reduction in the cost parameter F that ties firms to one of the two countries. A lower value of F reduces the attachment that firms have to either country H or country L and therefore intensifies competition for FDI. The tax revenue effects of such a change are given by

$$\frac{dT_i}{dF} = \frac{\partial T_i}{\partial F} + \underbrace{\frac{\partial T_i}{\partial t_i}}_{=0} \frac{dt_i}{dF} + \frac{\partial T_i}{\partial t_j} \frac{dt_j}{dF}, \quad i, j,\ i \neq j. \tag{14}$$

The first term on the right-hand side of (14) is the direct effect that a change in F has on tax revenues in country i. The second term is zero because of the Envelope theorem: for optimally chosen domestic tax rates, the governments' first-order conditions (12) imply $\frac{\partial T_i}{\partial t_i} = 0$. The last term multiplies the change in the *other* country's tax rate t_j that results from the change in F with the effect that this tax change in j has on tax revenues in country i.[19]

[18] The opposite result holds for personal income taxes, which are rising with the level of economic development. See Bachas et al (2024) and Hohmann et al. (2024), Figure 2.

[19] The corresponding effect of the change in F on country i's *own* tax rate t_i is multiplied by $\partial T_i/\partial t_i$, which is again zero from the first-order condition for i's optimal tax rate.

Using (10a)–(10b) and (7), the direct effect of a change in F on tax revenues in both countries is

$$\frac{\partial T_H}{\partial F} = -t_H b_H n_H \frac{\widehat{\alpha}}{F} \qquad \text{and} \qquad \frac{\partial T_L}{\partial F} = t_L b_L n_L \frac{\widehat{\alpha}}{F}. \tag{15}$$

This is an intuitive result. A reduction in F, and hence, tighter tax competition, benefits the country that in total is more attractive in the initial equilibrium (i.e., hosts more firms to start with), no matter which location advantages drive firms to this country. If $\widehat{\alpha} > 0$ and country H hosts more countries, a reduction in F will benefit country H and hurt country L by the direct effect. If instead $\widehat{\alpha} < 0$, the direct effect in both countries is reversed.

Empirically, there is little doubt that most of MNCs' real activities are located in highly developed countries. Johannesen et al. (2020, Table 1) report that, in 2010, total assets of MNCs in developed countries were seven times higher and the number of employees was almost six times higher than the corresponding numbers in low- and middle-income countries.[20] Using a different country classification, Hugger et al. (2024) report that high-income countries account for 48.6% of employees and 53.1% of assets (capital) employed worldwide by MNCs, whereas lower middle-income countries (including India) and low-income countries together account only for 14.1% of MNC's worldwide employees and 11.9% of their worldwide assets.[21] As a consequence, we assume $\widehat{\alpha} > 0$ in the following.

The effect of country j's tax rate on tax revenue in country i is obtained by differentiating (10a)–(10b). This gives

$$\frac{\partial T_H}{\partial t_L} = t_H b_H n_H \frac{\partial \widehat{\alpha}}{\partial t_L} > 0, \qquad \frac{\partial T_L}{\partial t_H} = -t_L b_L n_L \frac{\partial \widehat{\alpha}}{\partial t_H} > 0, \tag{16}$$

which is positive for both countries from (7). As usual in tax competition models with tax revenues as the principal objective, each country gains from a tax increase in the other region, because its local tax base rises.

It remains to determine the tax changes in both countries in response to the change in the location preference parameter F. Appendix A.4 shows that these are given by

$$sign\left(\frac{dt_H}{dF}\right) = sign\left[\left(-\frac{\partial^2 T_L}{\partial t_L^2}\right)\left(\frac{\partial^2 T_H}{\partial t_H \partial F}\right) + \left(\frac{\partial^2 T_H}{\partial t_H \partial t_L}\right)\left(\frac{\partial^2 T_L}{\partial t_L \partial F}\right)\right], \tag{17a}$$

$$sign\left(\frac{dt_L}{dF}\right) = sign\left[\left(-\frac{\partial^2 T_H}{\partial t_H^2}\right)\left(\frac{\partial^2 T_L}{\partial t_L \partial F}\right) + \left(\frac{\partial^2 T_L}{\partial t_L \partial t_H}\right)\left(\frac{\partial^2 T_H}{\partial t_H \partial F}\right)\right]. \tag{17b}$$

[20] The differentiation in Johannesen et al. (2020) follows World Bank conventions and classifies countries with a gross national income per capita above USD 12,275 (in 2010) as high-income countries, whereas countries below that threshold are classified as middle- and low-income countries.

[21] The remaining shares of employees and assets in Hugger et al. (2024) are employed in upper middle-income countries, including China. See Hugger et al. (2024), Figure 3 and Table E.1 in Annex E.

The first terms on the right-hand side of (17a)–(17b) are the direct effects that F has on tax rates in each country. Since the second-order own derivatives are negative from the SOC, these terms have the same sign as the cross-derivatives with respect to F. Using (6) and (9), the cross-derivatives are given by

$$\frac{\partial^2 T_H}{\partial t_H \partial F} = \frac{-n\widehat{\alpha}}{F}\,\Gamma_H + t_H n \frac{b_H^2}{F^2}, \qquad \frac{\partial^2 T_L}{\partial t_L \partial F} = \frac{n\widehat{\alpha}}{F}\,\Gamma_L + t_L n \frac{b_L^2}{F^2}. \tag{18}$$

For the best response functions in the second terms on the right-hand side of (17a)–(17b), we get, using (7),

$$\frac{\partial^2 T_H}{\partial t_H \partial t_L} \equiv \frac{\partial t_H}{\partial t_L} = \frac{b_L}{F}\,\Gamma_H \quad \text{and} \quad \frac{\partial^2 T_L}{\partial t_L \partial t_H} \equiv \frac{\partial t_L}{\partial t_H} = \frac{b_H}{F}\,\Gamma_L, \tag{19}$$

$$\text{with} \quad \Gamma_H \equiv \left[b_H + t_H f'(k_H)\frac{\partial k_H}{\partial t_H} - \frac{t_H}{\delta_H} \right] \quad \text{and} \quad \Gamma_L \equiv \left[b_L + t_L f'(k_L)\frac{\partial k_L}{\partial t_L} - \frac{t_L}{\delta_L} \right]. \tag{20}$$

The critical terms in both (18) and (19) are the terms labelled Γ_i in (20). These terms are identical to the squared bracket in the first term of the optimal tax rate condition (12). As we discussed in footnote 17 above, the sign of this bracket is ambiguous, in general. It gives the marginal effect on tax revenues derived from a tax increase on a mobile firm that stays in the country – thus leaving out the extensive margin response of firms relocating to the other country after the tax increase. In the absence of domestic firms, this term must be positive in a tax optimum to offset the negative relocation effect of mobile firms, i.e., the negative second term in (12). When domestic firms are present, however, and a third term is added to eq. (12), we cannot exclude the possibility that the marginal revenue from increasing the tax on mobile firms is negative in the optimum. From the optimal tax condition (12), however, this 'unusual' result will not arise when two conditions are fulfilled: (i) tax competition is relatively severe (F is sufficiently low) so that the negative second term in (12) is large, and (ii) the number of domestic firms n_i^D is not too large, relative to the number of mobile firms, n. In the following, we assume that these conditions are met for both countries. This is stated in:

Assumption 1 *In the tax optimum, competition for mobile firms is sufficiently severe and the ratio of MNCs over domestic firms is sufficiently high in both countries so that* $\Gamma_H > 0$ *and* $\Gamma_L > 0$ *holds in* (20).

With the help of Assumption 1, both best response functions in (19) are unambiguously positive, and therefore upward sloping. Intuitively, an increase in country j's tax rate increases the number of MNCs in country $i \neq j$, and hence country i's tax base. When Assumption 1 is fulfilled and the mobile tax base is a source of positive tax revenues, this will increase the optimal tax rate of country i.

Moreover, using Assumption 1 we can also sign both equations in (18) as being positive, implying that the direct effect of a rise in F is to increase the tax rate in both countries. For country L this follows immediately because Assumption 1, together with $\widehat{\alpha} > 0$, signs the first term in (18) as being positive, while the second term is positive as well. For country H, the two terms in (18) are instead offsetting, as the first term is negative from Assumption 1 and $\widehat{\alpha} > 0$, whereas the second term is positive. The *sum* of these effects must be positive, however, from country H's optimal tax condition (12).[22]

Taken together, these results imply that the overall effects of tax changes in both countries H and L in (17a) and (17b) are positive, implying that tighter competition for FDI (a *fall* in F) reduces Nash equilibrium tax rates in both countries. From (16) we furthermore know that this reduction in each country's tax rate will unambiguously hurt its non-haven neighbor. Hence, both countries lose tax revenues from the indirect effect of tighter competition for FDI, as given in the second terms of (14). For $\widehat{\alpha} > 0$ the direct effect in (15) is positive for a *fall* in F for country H, but negative for country L. This is because tighter tax competition magnifies the existing location advantages of developed countries. Hence, we have the result that tighter tax competition for FDI unambiguously reduces tax revenues in the developing country, whereas the effects on the developed country are ambiguous. This is stated in:

Proposition 3 (Competition for FDI)

When developed countries attract more mobile firms ($\widehat{\alpha} > 0$) and Assumption 1 holds, then tighter tax competition for FDI (a reduction in F) unambiguously reduces tax revenues in country L, whereas the tax revenue effect in country H is ambiguous.

Proposition 3 emphasizes the vulnerability of developing countries to the effects of an increased mobility of MNCs, which intensifies real tax competition. The available evidence shows that there is substantial firm mobility with respect to tax incentives, both internationally (Arkolakis et al., 2018), but also within large countries such as China (Wang, 2020). The high elasticity of multinational production location with respect to tax rates is one of the reasons for why developing countries are highly concerned about attracting FDI. This is the background for the reservations that developing countries express towards the introduction of the GMT.

[22]Recall from footnote 17 that the sum of the first two terms in (12) must be negative, as the third term is unambiguously positive. Country H's expression in (18) corresponds to the *negative* of the first two terms in (12), and is therefore positive.

4.2 The Global Minimum Tax

4.2.1 Theoretical analysis

We now turn to the main question of our analysis, asking whether the introduction of the GMT might hurt developing countries. We analyze the effects of introducing the GMT by exogenously increasing t_1 to t_M. Totally differentiating tax revenues T_i in country i gives the following effects of the GMT on tax revenues in each country, which are analogous to eq. (14):

$$\frac{dT_i}{dt_M} = \frac{\partial T_i}{\partial t_M} + \frac{\partial T_i}{\partial t_j}\frac{dt_j}{dt_M}, \quad i, j,\ i \neq j. \tag{21}$$

Using eqs. (7) and (8) the direct effects of a GMT increase are:

$$\frac{\partial T_H}{\partial t_M} = t_H \left[\frac{n_H}{\delta_H} + \frac{b_H(p_L^* - p_H^*)}{F}\right], \tag{22a}$$

$$\frac{\partial T_L}{\partial t_M} = t_L \left[\frac{n_L}{\delta_L} - \frac{b_L(p_L^* - p_H^*)}{F}\right]. \tag{22b}$$

An exogenous increase in t_M disincentivizes all MNCs to shift profits to the tax haven due to a narrower tax gap. This tends to increase tax revenues in both countries $i \in \{H, L\}$, as shown in the first terms of the brackets in (22a) and (22b). Since the initial situation is asymmetric, however, the introduction of the GMT also induces some MNCs to move from one country to the other. From eq. (8) and Proposition 2, the transfer price of MNCs in country L is higher in the initial equilibrium. Therefore, MNCs in country L lose more from the reduced level of profit shifting that follows the introduction of the GMT. Put differently, the GMT reduces the location advantage of developing countries, which lies in their reduced ability to counter profit shifting. As a consequence, some mobile firms will relocate from country L to country H, if tax rates in H and L remain unchanged. Consequently, the second term in (22a) is also positive for country H, but it is negative in (22b) for country L. In sum, the direct effect of an increase in t_M unambiguously benefits country H, but it has ambiguous effects on country L. If real tax competition between H and L is strong (F is low) then the second term in (22b) dominates the first and the direct effect of the GMT on tax revenues in country L is therefore negative.

The indirect effect of the GMT on tax revenues in each country (the second term in (21) again works through the induced changes in the *other* country's tax rate. Equation (16) from our previous analysis remains valid: each country will gain tax revenues if the other country raises its tax rate. The simultaneous equation system in Appendix A.4 can equally

be applied to the analysis of a change in the GMT, yielding

$$sign\left(\frac{dt_H}{dt_M}\right) = sign\left[\left(-\frac{\partial^2 T_L}{\partial t_L^2}\right)\left(\frac{\partial^2 T_H}{\partial t_H \partial t_M}\right) + \left(\frac{\partial^2 T_H}{\partial t_H \partial t_L}\right)\left(\frac{\partial^2 T_L}{\partial t_L \partial t_M}\right)\right], \tag{23a}$$

$$sign\left(\frac{dt_L}{dt_M}\right) = sign\left[\left(-\frac{\partial^2 T_H}{\partial t_H^2}\right)\left(\frac{\partial^2 T_L}{\partial t_L \partial t_M}\right) + \left(\frac{\partial^2 T_L}{\partial t_L \partial t_H}\right)\left(\frac{\partial^2 T_H}{\partial t_H \partial t_M}\right)\right]. \tag{23b}$$

The second-order conditions in (23a) and (23b) must be negative. Moreover, the best response functions in (23a) and (23b) carry over from our previous analysis and are given by (19). Therefore, if Assumption 1 holds, both best responses will be upward sloping. It remains to analyze the direct effects of the GMT introduction on tax rates in both countries. Using (6) and (9), these effects are given by

$$\frac{\partial^2 T_H}{\partial t_H \partial t_M} = \frac{n_H}{\delta_H} - \frac{2t_H b_H n}{\delta_H F} + \frac{n}{F}\,\Gamma_H(p_L - p_H), \tag{24a}$$

$$\frac{\partial^2 T_L}{\partial t_L \partial t_M} = \frac{n_L}{\delta_L} - \frac{2t_L b_L n}{\delta_L F} - \frac{n}{F}\,\Gamma_L(p_L - p_H), \tag{24b}$$

where Γ_H and Γ_L are given in (20).

The first terms in eqs. (24a) and (24b) are positive as the higher GMT increases tax bases in both countries H and L through reduced profit shifting to the tax haven. Other things equal, this incentivizes higher tax rates. The second terms in these equations are, however, negative. As the tax base from MNCs increases in both countries due to reduced profit shifting, real tax competition for MNCs becomes more aggressive and this isolated effect tends to reduce tax rates in both H and L. The trade-off between the first two terms is known from the symmetric model of Janeba and Schjelderup (2023). If real tax competition is severe (F is low), then the second effect dominates the first, and both countries tend to reduce their tax rates following the increase in t_M. In our asymmetric model, a third effect is added. If $p_L^* > p_H^*$, as we have argued in Proposition 2, then the third effect is positive in country H, but negative in country L (if Assumption 1 holds). As profit shifting is higher in country L, MNCs in this country see their profit-shifting opportunities reduced more when t_M rises. As a result, some MNCs move from L to H, reducing the multinational tax base in L, while increasing it in H.[23]

When Assumption 1 holds and best responses are upward sloping, the total effects dt_H/dt_M and dt_L/dt_M in (23a)–(23b) will follow the partial effects in (24a)–(24b), provided

[23]Note also that the negative second terms in eqs. (24a) and (24b) are multiplied by the domestic tax rates t_i, whereas the positive first terms are not. Therefore, the higher are tax rates in countries H and L, the more likely is it that tax rates fall in response to the GMT. We further know from eq. (13) that the presence of domestic firms increases equilibrium tax rates in both countries. Due to this effect, negative tax responses to the GMT introduction will arise for a larger parameter set in our model, as compared to Janeba and Schjelderup (2023).

that the partial effects are either both positive or both negative. Therefore, we get unambiguous results for the changes in tax rates if F is either very low (severe real tax competition) or very high (weak real tax competition). Together with our discussion of the direct effects of the GMT in eqs. (22a)–(22b), we can then sign the direct and indirect effects of introducing a GMT in these special cases. This is summarized in Table 1.

$(p_L^* > p_H^*)$	direct effect: $\frac{\partial T_i}{\partial t_M}$	indirect effect: $\frac{\partial T_i}{\partial t_j}\frac{dt_j}{dt_M}$	total effect: $\frac{dT_i}{dt_M}$
Case 1: Severe real tax competition (F is low)			
$i = H$	$+$	$-$	$+/-$
$i = L$	$-$	$-$	$-$
Case 2: Weak real tax competition (F is high)			
$i = H$	$+$	$+$	$+$
$i = L$	$+$	$+$	$+$

Table 1: The effects of GMT introduction on tax revenues in H and L

Table 1 shows that the direct effect of introducing the GMT is always beneficial for the developed country H. For the developing country L, in contrast, the direct effect depends on the intensity of competition for real investment, and hence on the level of the parameter F. If F is low, and real competition is intense, then the loss in country L's competitiveness for MNCs is the dominant effect, and country L accordingly loses upon impact from the introduction of the GMT. In contrast, if real tax competition for MNCs is weak (F is high), then revenue in country L rises by the direct effect. The indirect effects that operate through the changes in the competing country's tax rates also critically depend on the intensity of real tax competition. If F is low, then both countries will reduce their tax rates in the new Nash equilibrium with a binding GMT. This causes tax revenue losses for their respective rivals via the isolated indirect effect. If F is instead high, then both countries will raise their tax rates following the introduction of the GMT, leading to mutual revenue increases via the indirect effects. We summarize our results in this section in the following proposition.

Proposition 4 (Effects of the Global Minimum Tax)

Assume an asymmetric tax equilibrium in which Proposition 2 and Assumption 1 hold.
(i) If tax competition for real investment is severe (F is low), then introducing a binding GMT reduces tax revenues in country L and has ambiguous effects on tax revenues in country H.
(ii) If tax competition for real investment is weak (F is high), then introducing a binding GMT increases tax revenues in both countries H and L.

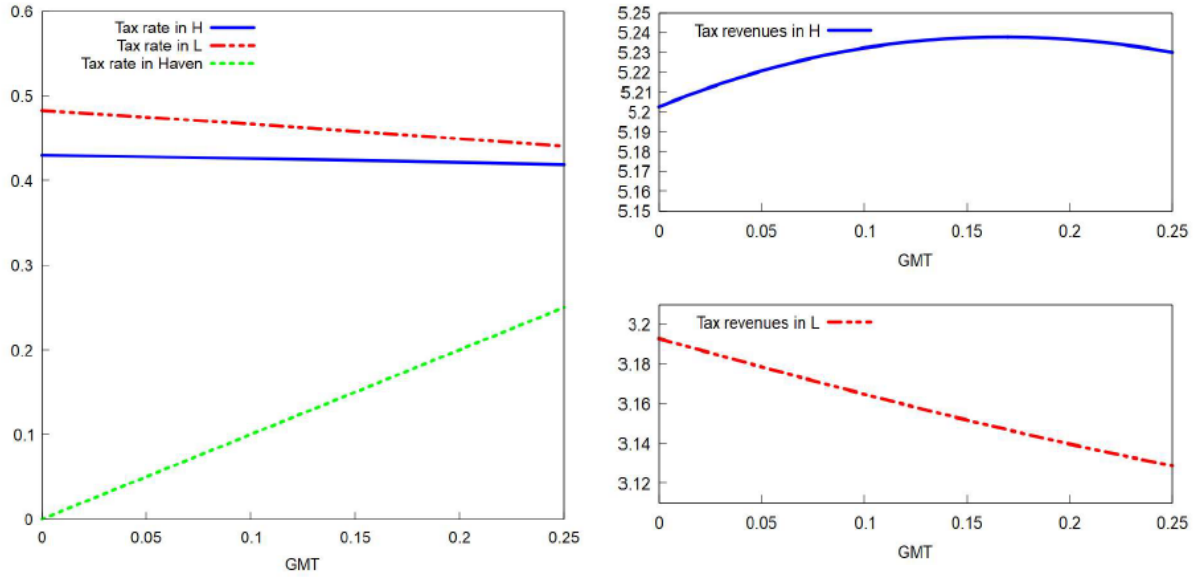

Figure 1: Numerical example: Tax rate and tax revenue effects of the GMT

4.2.2 Numerical analysis

Our theoretical analysis in the preceding section derives clear-cut results only when real tax competition is very strong, or weak. For intermediate cases, we have to resort to a numerical analysis. In line with our previous discussion, we choose $s_L = 0.05$ and $\delta_L = 0.5 < 1.0 = \delta_H$. We further choose the number of domestic firms in both countries H and L to be the same, $n_H^D = n_L^D = 1.5$. Together with the normalization that the total number of MNCs is set to unity this implies that one quarter of all firms in our example are mobile MNCs. This corresponds, for example, to the share of MNCs in the analysis of Egger et al. (2010, Table 1), which matches multinational and national firms using the Amadeus database.[24]

In the benchmark case with a zero GMT, these specifications lead to transfer prices of $p_L^* = 0.96$ and $p_H = 0.43$, consistent with Proposition 2. The endogenous number of MNCs in the two non-haven countries is $n_H = 0.76$ and $n_L = 0.24$. Hence the share of MNCs over national firms is much higher in country H as compared to country L. This matches with the fact that 70-75% of the largest 500 MNCs worldwide are headquartered in OECD countries.[25] Finally, and importantly, we set the parameter $F = 2$, corresponding to an intermediate degree of real tax competition between countries H and L.

Figure 1 shows how tax rates and tax revenues in both countries respond to the

[24]The remaining parameter values are as follows: $f(k_i) = \beta k_i^\gamma$, $\beta = 2$, $\gamma = 0.4$, and $r = 0.1$.

[25]See https://www.oecd.org/en/data/dashboards/oecd-unsd-multinational-enterprise-information-platform.html.

introduction of a GMT with a tax rate of up to 25%. The left panel of Figure 1 shows that tax rates in both countries fall in response to introducing the GMT, and more steeply so in country L. Therefore the indirect effect that a GMT introduction has on tax revenues is negative for both countries (see Table 1). The right panel of Figure 1 gives the tax revenue changes in countries H and L. Tax revenues rise in country H, at least for GMT rates of $t_M \leq 0.18$. Hence, the positive direct effect of GMT introduction dominates the negative indirect effect for country H. For country L, however, tax revenues fall for any level of the GMT. As profit shifting is higher in country L, country L loses attractiveness as a location for MNCs, and this must be offset by a noticeably lower statutory corporate tax rate t_i. Together with the negative tax response in country H, these negative effects dominate the revenue gain from reduced profit shifting by MNCs from the perspective of the developing country L.

5 Conclusion

In this paper, we have studied tax competition between two asymmetric countries, a developed and a developing one, that simultaneously compete for real investment by mobile MNCs and experience profit shifting into a tax haven. The developing country is assumed to have higher unit costs of capital and it has the weaker tax enforcement technology. If real tax competition is sufficiently strong, the optimal tax rate in the developing country is at least as high in our model as that in the developed country. Hence the developing country experiences more profit shifting out of the country in equilibrium, in line with existing empirical studies. In such a setting, introducing a GMT that reduces profit shifting reduces the relative attractiveness of the developing country from the perspective of MNCs. In response, the developing country has to reduce its tax rate and it suffers overall tax revenue losses, even though profit shifting to the tax haven falls. The developed country, in contrast, becomes more competitive as a location for MNCs, and it experiences overall revenue gains from the introduction of GMT.

Our results strengthen the argument that Pillar 2 is primarily in the interest of rich, developed countries. In contrast to existing quantitative studies that project region-specific changes in corporate tax revenues in response to GMT introduction, we show that developing countries not only gain less than developed countries, but may indeed lose from the introduction of GMT. This is because, unlike existing approaches quantifying the effects of the GMT, our model considers real tax competition between potential host countries for MNCs, in addition to the profit shifting to tax havens.

A Appendix

A.1 Comparative-static effects at the location margin

Eq. (6) determines the location choice of MNCs. To identify how changes in the tax rates affect the number of MNCs in each non-haven country, we first differentiate this equation for changes in the non-haven tax rates t_H and t_L, and utilize the facts that $\frac{\partial k_i^*}{\partial t_j} = \frac{\partial p_i^*}{\partial t_j} = 0$. Then, we receive

$$\begin{aligned} \frac{\partial \widehat{\alpha}}{\partial t_H} &= -\frac{f(k_H^*) + [(1-t_H)f'(k_H^*) - r]\,\frac{\partial k_H^*}{\partial t_H} + p_H^* + [(t_H - t_1) - \delta_H p_H^*]\,\frac{\partial p_H^*}{\partial t_H}}{F} \\ &= -\frac{f(k_H^*) - p_H^*}{F} < 0, \end{aligned} \tag{A.1}$$

where the terms in squared brackets in the first line add up to zero from the first-order condition (3) and the optimal transfer price (4).

With the equivalent procedure and for the same reasons, the effect of a tax rate change in country L simplifies to

$$\begin{aligned} \frac{\partial \widehat{\alpha}}{\partial t_L} &= \frac{f(k_L^*) - [(1-t_L)f'(k_L^*) - (r+s_L)]\,\frac{\partial k_L^*}{\partial t_L} - p_L^* + [(t_L - t_1) - \delta_L p_L^*]\,\frac{\partial p_L^*}{\partial t_L}}{F} \\ &= \frac{f(k_L^*) - p_L^*}{F} > 0, \end{aligned} \tag{A.2}$$

Finally, the effect of a tax rate change in the tax haven on the location of MNCs results from differentiating eq. (6) as

$$\begin{aligned} \frac{\partial \widehat{\alpha}}{\partial t_1} &= \frac{-p_H^* + [(t_H - t_1) - \delta_H p_H^*]\,\frac{\partial p_H^*}{\partial t_1} + p_L^* - [(t_L - t_1) - \delta_L p_L^*]\,\frac{\partial p_L^*}{\partial t_1}}{F} \\ &= \frac{p_L^* - p_H^*}{F} \gtrless 0, \end{aligned} \tag{A.3}$$

where we used $\frac{\partial k_i^*}{\partial t_1} = 0$, and where the terms in squared brackets in the first line add up to zero again when one imposes optimal transfer pricing from eq. (4).

A.2 The effect of domestic firms on the optimal tax rate

Totally differentiating the system of first-order conditions in equation (12) leads to

$$\begin{aligned} \frac{\partial^2 T_H}{\partial t_H^2} dt_H - \frac{b_L}{F}\left[f(k_H^{D*}) + t_H f'(k_H^{D*})\frac{\partial k_H^{D*}}{\partial t_H}\right] dt_L + \left[f(k_H^{D*}) + t_H f'(k_H^{D*})\frac{\partial k_H^{D*}}{\partial t_H}\right] dn_H^D &= 0, \\ -\frac{b_H}{F}\left[f(k_L^{D*}) + t_L f'(k_L^{D*})\frac{\partial k_L^{D*}}{\partial t_L}\right] dt_H + \frac{\partial^2 T_L}{\partial t_L^2} dt_L + \left[f(k_L^{D*}) + t_L f'(k_L^{D*})\frac{\partial k_L^{D*}}{\partial t_L}\right] dn_L^D &= 0. \end{aligned}$$

We can rearrange this to

$$\begin{pmatrix} \frac{\partial^2 T_H}{\partial t_H^2} & -\frac{b_L}{F}\left[f(k_H^{D*})+t_H f'(k_H^{D*})\frac{\partial k_H^{D*}}{\partial t_H}\right] \\ -\frac{b_H}{F}\left[f(k_L^{D*})+t_L f'(k_L^{D*})\frac{\partial k_L^{D*}}{\partial t_L}\right] & \frac{\partial^2 T_L}{\partial t_L^2} \end{pmatrix} \begin{pmatrix} dt_H \\ dt_L \end{pmatrix} =$$
$$- \begin{pmatrix} \left[f(k_H^{D*})+t_H f'(k_H^{D*})\frac{\partial k_H^{D*}}{\partial t_H}\right] \\ 0 \end{pmatrix} dn_H^D - \begin{pmatrix} 0 \\ \left[f(k_L^{D*})+t_L f'(k_L^{D*})\frac{\partial k_L^{D*}}{\partial t_L}\right] \end{pmatrix} dn_l^D, \quad \text{(A.4)}$$

and from applying Cramer's Rule follows

$$\frac{dt_i}{dn_i^D} = \frac{\left[f(k_i^{D*})+t_i f'(k_i^{D*})\frac{\partial k_i^{D*}}{\partial t_i}\right]\left(-\frac{\partial^2 T_j}{\partial t_j^2}\right)}{|H|}. \quad \text{(A.5)}$$

The second-order conditions of this maximization problem imply $\frac{\partial^2 T_i}{\partial t_i^2} < 0 \quad i \in \{H, L\}$ and

$$|H| = \frac{\partial^2 T_H}{\partial t_H^2}\frac{\partial^2 T_L}{\partial t_L^2} - \frac{b_L b_H}{F^2}\left[f(k_H^{D*})+t_H f'(k_H^{D*})\frac{\partial k_H^{D*}}{\partial t_H}\right]\left[f(k_L^{D*})+t_L f'(k_L^{D*})\frac{\partial k_L^{D*}}{\partial t_L}\right] > 0. \quad \text{(A.6)}$$

As $f(k_i^{D*}) = f(k_i^*)$, $f'(k_i^{D*}) = f'(k_i^*)$, and $\frac{\partial k_i^{D*}}{\partial t_i} = \frac{\partial k_i^*}{\partial t_i}$ (see Section 3.2.1), it holds that

$$\left[f(k_i^{D*})+t_i f'(k_i^{D*})\frac{\partial k_i^{D*}}{\partial t_i}\right] > \left[b_i - \frac{t_i}{\delta_i} + t_i f'(k_i^*)\frac{\partial k_i^*}{\partial t_i}\right]. \quad \text{(A.7)}$$

Then, a necessary condition for a solution for the optimal tax rates t_H, t_L in condition (12) is

$$\left[f(k_i^{D*})+t_i f'(k_i^{D*})\frac{\partial k_i^{D*}}{\partial t_i}\right] > 0. \quad \text{(A.8)}$$

Putting all pieces together, this unambiguously implies $\frac{dt_i}{dn_i^D} > 0$.

A.3 Derivation of Proposition 2

We start from the first-order conditions for national tax rates in (11a)–(11b). In a symmetric initial equilibrium $\hat{\alpha}$ in eq. (6) must be zero. We then introduce a small increase in s_L and a simultaneous reduction in δ_L that keeps the number of firms in country L constant, implying $d\hat{\alpha} = 0$. Totally differentiating (6) then gives

$$[f(k_L) - p_L]\, dt_L + k_L ds_L + \frac{p_L^2}{2}\, d\delta_L = 0. \quad \text{(A.9)}$$

Note that the simultaneous change in s_L and δ_L leaves all of country H's variables unchanged, i.e., $dn_H = dn_L = 0$, db_H=0, $dk_H = 0$ and dt_H =0.

Next, we differentiate the first-order condition for country L's tax rate in (11b). This gives, after summarizing terms:

$$\frac{f'}{2}\left[\frac{1}{(1-t_L)}-\frac{4b_Lt_L}{F}\right]dk_L+\frac{1}{\delta_L}\left[\frac{(p_L\delta_L+t_L)}{2\delta_L}-\frac{2t_Lp_Lb_L}{F}\right]d\delta_L-\frac{f't_L}{2f''(1-t_L)^2}ds_L$$
$$-\left[\frac{1}{\delta_L}+\frac{[f']^2}{(1-t_L)f''}\left(\frac{(1+t_L)}{2(1-t_L)}\right)+\frac{b_L(b_L\delta_L-2t_L)}{F\delta_L}\right]dt_L=0.$$

Eliminating dk_L using (3) and simplifying gives

$$\varepsilon_1 d\delta_L-\varepsilon_2 ds_L-\varepsilon_3 dt_L=0, \qquad \text{where}$$

$$\begin{aligned}\varepsilon_1 &\equiv \frac{1}{\delta_L}\left[\frac{(p_L\delta_L+t_L)}{2\delta_L}-\frac{2t_Lp_Lb_L}{F}\right]; \qquad \varepsilon_2\equiv\frac{f't_L}{2f''(1-t_L)^2}\left[\frac{(1+t_L)}{(1-t_L)}-\frac{4b_Lt_L}{F}\right]\\ \varepsilon_3 &\equiv \frac{1}{\delta_L}+\frac{b_L(b_L\delta_L-2t_L)}{F\delta_L}+\frac{[f']^2}{(1-t_L)f''}\left[\frac{(2+t_L)}{(1-t_L)}-\frac{4b_Lt_L}{F}\right].\end{aligned} \tag{A.10}$$

An exogenous change of, say, ds_L will lead to adjustments $d\delta_L$ and dt_L that simultaneously fulfill eqs. (A.9) and (A.10). The effect of the reform on the tax rate in country L is given by

$$\frac{dt_L}{ds_L}|_{d\hat{\alpha}=0}=\frac{-k_L\varepsilon_1-(p_L^2)/2\varepsilon_2}{b_L\varepsilon_1+(p_L^2)/2\varepsilon_3},$$

where the denominator $b_L\varepsilon_1+(p_L^2)/2\varepsilon_3\equiv|A|$ is:

$$|A|=\frac{p_L\delta_L(b_L+p_L)+b_Lt_L}{2\delta_L^2}+\frac{p_L^2(2+t_L)[f']^2}{4f''(1-t_L)^2}+\frac{p_Lb_L}{F}\left[\frac{p_Lb_L}{2}-\frac{t_L(2b_L+p_L)}{\delta_L}-\frac{t_Lp_L[f']^2}{f''(1-t_L)}\right] \tag{A.11}$$

and $|A|>0$ must hold from the stability of the equilibrium. This requires that F is not arbitrarily small so that the positive first two terms in (A.11) dominate the ambiguous third term, if the latter is negative.

Inserting expressions for the change in t_L and simplifying gives:

$$\frac{dt_L}{ds_L}|_{d\hat{\alpha}=0}\propto\frac{k_L}{\delta_L}\left[\frac{2b_Lt_Lp_L}{F}-\frac{p_L\delta_L}{2\delta_L}\right]-\frac{p_L^2f'}{4(1-t_L)f''}\left[\frac{4b_Lt_L}{F}-\frac{(1+t_L)}{(1-t_L)}\right]. \tag{A.12}$$

The response of dt_L is definitely positive for $F\to 0$, it is monotonously falling in F and it turns unambiguously negative for $F\to\infty$. Therefore, there must be a critical level of F, labelled F^{crit} such that $d\delta_L/ds_L(F^{crit})|_{\hat{\alpha}}=0$. Then, $F\leq F^{crit}$ will ensure that the response of t_L is non-negative. Since t_H is not affected by the change in s_L and $t_H=t_L$ in the initial, symmetric equilibrium, the condition $F<F^{crit}$ ensures that $t_L\geq t_H$ in the resulting, asymmetric equilibrium. From eq. (A.9) it must then hold that $d\delta_L/ds_L|_{\hat{\alpha}=0}<0$ holds in the range $F<F^{crit}$. Hence a higher investment cost s_L in country L must be

accompanied by lower profit-shifting costs δ_L to keep country L equally attractive for mobile firms. From the profit-shifting equation (4) and $\delta_L < \delta_H$, this is sufficient to ensure that $p_L > p_H$. $\square$

A.4 Comparative static responses of tax rates

We consider the changes in equilibrium tax rates due to the change in an exogenous parameter Φ. The simultaneous equation system is

$$\frac{\partial T_H}{\partial t_H}(t_H, t_L; \Phi) = 0, \qquad \frac{\partial T_L}{\partial t_L}(t_H, t_L; \Phi) = 0. \tag{A.13}$$

Totally differentiating the equation system (A.13) yields,

$$\underbrace{\begin{bmatrix} \frac{\partial^2 T_H}{\partial t_H^2} & \frac{\partial^2 T_H}{\partial t_H \partial t_L} \\ \frac{\partial^2 T_L}{\partial t_L \partial t_H} & \frac{\partial^2 T_L}{\partial t_L^2} \end{bmatrix}}_{=A} \begin{bmatrix} dt_H \\ dt_L \end{bmatrix} = \begin{bmatrix} -\frac{\partial^2 T_H}{\partial t_H \partial \Phi} d\Phi \\ -\frac{\partial^2 T_L}{\partial t_L \partial \Phi} d\Phi \end{bmatrix}, \tag{A.14}$$

$$\text{where} \quad |A| = \frac{\partial^2 T_H}{\partial t_H^2} \frac{\partial^2 T_L}{\partial t_L^2} - \frac{\partial^2 T_H}{\partial t_H \partial t_L} \frac{\partial^2 T_L}{\partial t_L \partial t_H} > 0 \tag{A.15}$$

follows from the second-order conditions of optimal tax rates and stability of the Nash equilibrium. This gives the following optimal tax responses to changes in the exogenous parameter Φ:

$$\frac{dt_H}{d\Phi} = \frac{1}{|A|} \left\{ \left(-\frac{\partial^2 T_L}{\partial t_L^2} \right) \left(\frac{\partial^2 T_H}{\partial t_H \partial \Phi} \right) + \left(\frac{\partial^2 T_H}{\partial t_H \partial t_L} \right) \left(\frac{\partial^2 T_L}{\partial t_L \partial \Phi} \right) \right\}, \tag{A.16}$$

$$\frac{dt_L}{d\Phi} = \frac{1}{|A|} \left\{ \left(-\frac{\partial^2 T_H}{\partial t_H^2} \right) \left(\frac{\partial^2 T_L}{\partial t_L \partial \Phi} \right) + \left(\frac{\partial^2 T_L}{\partial t_L \partial t_H} \right) \left(\frac{\partial^2 T_H}{\partial t_H \partial \Phi} \right) \right\}. \tag{A.17}$$

The analysis of Section 4.1 uses $\Phi = F$, whereas Section 4.2 uses $\Phi = t_M$. This gives equations (17a)–(17b) and (23a)–(23b), respectively, in the main text.

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