The Global Minimum Tax under Pillar II: An economic analysis of the firms' behavioural responses and revenue effects in developed and developing countries

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Abstract

The OECD has launched several tax avoidance rules to solve the remaining BEPS issues, including the global minimum tax (GMT). Previous research suggests that the revenues generated by this policy are unequally distributed among countries. This theoretical analysis also shows that developing countries are relatively worse-off in terms of welfare. There are three underlying mechanisms: the strategic tax-setting effect, the intensive and extensive margin effect. The last two (direct) effects exclude the change in the productive country's tax rate. The indirect effect shows a negative effect of the tax haven rate on the developed (developing) country's rate, reducing the number of firms and revenues in the developing (developed) country. Given the tax rates, the intensive margin effect shows a reduction of profit shifting, increasing the tax base of non-haven countries and its tax revenues. The extensive margin effect shows that profit shifting (developing) countries lose their means to attract MNEs, reducing the number of firms in these countries and increasing the number of firms in developed countries. In total, it remains unclear whether the GMT is beneficial for developed and developing countries.

Keywords: GMT, tax competition, profit shifting, location decisions, developed and developing countries.

Preface

This master thesis analysis the effect of the GMT on welfare in both developed and developing countries. With this research, I aim to carry out important policy implications for the GMT and tax competition literature. Furthermore, this thesis has helped me getting a better and deeper understanding of the international tax landscape, theoretical research and modelling. It took me some time to understand all the mathematical and economic tools, but it was a successful effort and I am more than happy with the final result.

With this thesis I will complete my Master's degree in Policy Economics. This research has inspired me to continue studying Direct taxation at the Erasmus University. I am very appreciative of all the support to study Fiscal and Policy Economics at this esteemed university. Therefore I want to thank my parents and the Erasmus School of Economics for inspiring me and giving me this opportunity.

This work would not have been such a success without other people's assistance. Therefore I would like to use this occasion to thank several people who have been involved in the process of writing and doing research. In the first place, I would like to express my gratitude to my supervisor prof. dr. Schindler for his guidance and many helpful contacts during the writing of this thesis. You have put a lot of effort into this thesis and corrected me whenever I needed it. Additionally, I would like to give special thanks to prof. dr. MF de Wilde for his lecture about this topic. His genuine interest and optimism inspired me to write this thesis about the GMT. Last but not least, I would like to thank my little brother, roommate and fellow students at the Erasmus University for supporting me during the process.

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Contents

Abbreviations

Art	Article
BEPS	Base Erosion and Profit Shifting
CbCR	Country-by-Country Reporting
CFC	Controlled Foreign Companies
CFS	Consolidated Financial Statements
EC	European Commission
ETR	Effective tax rate
EU	European Union
GAAP	Generally accepted accounting principles
GILTI	Global Intangible Low-Taxed Income
GloBE	Global Anti-Base Erosion
G20	Group of twenty (intergovernmental forum comprising 19 countries and EU)
IF	Inclusive Framework
IIR	Income inclusion Rule
MNE	Multinational enterprise
OECD	Organisation for Economic Co-operation and Development
PE	Permanent establishment
SME	Small and medium enterprises
SOR	Switch-Over Rule
STTR	Subject to Tax Rule
UTPR	Undertaxed Payments Rule
VPB	Vennootschapsbelasting 1969 (corporate income tax)

1 Introduction

Last decades, the world has been driven and transformed by innovation in technology and digitalisation. Numerous multinational enterprises (MNEs) have used this transformation as a means to adopt new tax policy strategies that exploit the loopholes in the tax legislation to reduce its global tax liability (OECD, 2021A). The speed and breadth of these digital changes and innovation advancements introduce major policy issues in several areas, including the unilateral and international tax system. The urge to reform the tax system, reestablish the stability and integrity of the tax system and prevent inefficient uncoordinated unilateral tax measures has therefore been the main priority for countries to deliver global consensus about these digital developments (OECD, 2020A). Tax evasion and aggressive tax planning have led to these integrity concerns (Gribnau, 2017). According to Gribnau and many other researchers, these actions are undesirable for society and should therefore be reduced. The Organisation for Economic Co-operation and Development (OECD, 2019) acknowledges that the integrity of the tax system is a vital component of tax morale and should therefore not be neglected. As I will discuss later, the implementation of the Pillar II initiative plays a crucial role in achieving these goals.

MNEs are operating in many countries and are therefore often dealing with tax rate differentials. These differentials incentivise MNEs to re-allocate the accounting profits to those places with a low corporate tax rate (OECD, 2021A). By artificially re-allocating the profits, the MNE can reduce its global tax payment. This tax policy strategy is often referred to as the *profit shifting strategy* (Bernardo and Janský, 2022). The empirical literature shows that MNEs use this strategy to shift a significant share of their profits to low-tax regimes (Tørsløv et al., 2018; Finke et al. 2013). Low-tax regimes observe in this case an increase in tax base while high-tax regimes observe a reduction in tax base. This undesirable effect has been observed by the policymakers leading eventually to the Pillar II initiative. This Pillar II initiative imposes a global minimum tax (GMT) rate of 15 percent for large MNEs to reduce the amount of base erosion and profit shifting (BEPS). These tax-avoiding actions are undesirable for many members of the society: governments, citizens and domestic firms. Governments lose a significant share of taxes, citizens pay higher taxes to compensate for the lower corporate tax revenues and domestic firms experience fierce competition with MNEs (OECD, 2022). This suggests that the society may benefit from the implementation of the GMT.

According to the OECD (2021B), the GMT could also raise additional global government tax revenue by reducing this profit shifting and tax competition incentive. However, Barake et al. (2021) show that the implementation of this policy would lead to more

inequality across countries. The current design of this policy seems to favour the country where the headquarter resides, because that country is cashing in the additional returns. These headquarters are mainly located in high-income countries and will, due to the design of the GMT, obtain more benefits. Inequality issues might therefore arise from this policy. This paper provides information to assess these heterogeneous effects.

Besides, COVID-19 has also increased inequality within and across countries. Poorer countries faced massive job losses, reductions in income, economic contraction and falling investments during the pandemic (Ahmed et al., 2020; Jaeger and Blaabaek, 2020). In times of increasing disparities, implementing this policy may be undesirable from the point of view of developing countries. Modelling the economic mechanism and showing the insights of the GMT is therefore profoundly important for policymaking.

The most important rules of Pillar II, the Model Rules, comprise of two domestic interlocking rules (OECD, 2021A). The primary rule, the income inclusion rule (IIR), is a residence-based rule that may lead to a bias in favour of the countries where the MNE have their headquarters. It allocates the taxing right to the ultimate parent entity (UPE). These headquarters are often located in developed countries while developing countries largely consist of productive affiliates (Barklie, 2021). Many researchers, including Avi-Yonah and Kim (2022), state that Pillar II is therefore possibly flawed since it accords primacy to the country of residence by giving priority to the IIR over the source rules, the undertaxed payment rule (UTPR) and subject to tax rule (STTR). It is therefore questionable whether the implementation of the GMT finds its purpose in achieving the social optimum or whether it tries to generate benefits for the key players behind the global agreements. This thesis will give a brief overview of the (institutional) design of Pillar II and draws more attention to the behavioural responses and revenue effects in developed and developing countries. Therefore, this study aims to answer the following research question:

"How does the Global Minimum Tax affect welfare in both developed and developing countries?"

In the profit shifting literature there are three fundamental profit shifting channels recognised: the debt shifting channel, the location of intangible assets channel and the strategic transfer pricing channel (Janský and Palanský, 2019; Auerbach et al., 2017). These three planning devices are being used to reduce the global tax payment for the MNE, because taxes are non-deductible costs. This means that these costs are a burden for the MNE. This thesis focuses on the third channel of profit shifting: the strategic transfer pricing channel. This mechanism artificially inflates or deflates prices between MNE affiliates to

minimise the global tax payment (Bartelsman and Beetsma, 2003). As will be discussed in more detail in section 2, MNEs shift a significant share of their profits to low-tax regimes by using these types of practices. The countermeasure to these practices is the arm's length principle. Most tax legislations prescribe arm's length prices for intra-group payments meaning that an intra-firm price must coincide with the price that would be charged for an unrelated comparable third party (Jacob, 1995). In addition, the OECD has implemented comparability analyses in article (art) 9 OECD Model Tax Convention. Even with the implementation of several transfer pricing rules, in reality, the MNE could still shift some proportion of the income due to information asymmetry (Chen et al., 2018). The asymmetry makes the comparison difficult, specifically the application to intangible assets are notorious (Auerbach et al., 2017). From this leeway, socially undesirable profit shifting opportunities can arise. As a reaction, the OECD has launched an Action Plan to address these remaining BEPS issues linked to technology and digitalisation, finally leading to the Pillar II initiative. These effects are incorporated into the theoretical model.

The model also incorporates tax competition incentives. The tax competition literature distinguishes two types of competition: the competition for real investments and the competition for paper profits. According to Zambuhal-Oliveira (2012), real tax competition influences the behavior of MNEs. The paper of Zambuhal-Oliveira shows that tax-lowering strategies may have a significant impact on location decisions. However, these business decisions depend on various factors (not only tax rates) such as quality of infrastructure, cost of labor and level of education. This tax-lowering strategy is mainly used by developing countries to attract mobile MNEs (Dietsch and Rixen, 2014). These countries have often a worse investment climate and should therefore compensate MNEs for these losses. Furthermore, countries could also attract paper profits by using various techniques such as transfer pricing manipulation. This form of competition does not attract and relocate real business activities.

Thus to answer the research question, a theoretical model is set up. In this thesis, I depart from Janeba and Schjederup's (2022) model. However, I make an important distinction between developed and developing countries. The model consists of a continuum of MNEs that differ in their location costs, but are homogenous otherwise. The MNE has either one productive affiliate in a developing country or one productive affiliate in a developed country. Furthermore, it consists of one non-productive affiliate in a tax haven. The countries with productive affiliates differ in the level of institutional effectiveness and the level of location fixed costs. Profit shifting in countries with ineffective institutions is relatively easy and therefore less costly. These countries might use profit shifting incentives to attract mobile MNEs (tax competition). The productive affiliates may have the incentive to reduce the global tax payment by using an intangible asset, which is owned

by the affiliate in the tax haven. To determine the GMT effects, I assume that the GMT can be interpreted as if there is an exogenous increase in the tax haven rate. Next to that, I assume that all countries have implemented the GMT, which makes profit shifting less attractive. Next to the profit shifting behaviour (intensive margin), the firm-specific location decision behaviour (extensive margin) will also be incorporated in this model. In the end, the model incorporates the profit shifting effect, location decision effect and governmental decision effect.

This theoretical analysis shows that developed countries experience both a positive intensive margin effect and a positive extensive margin effect. This means that the total direct effect is positive. However, developing countries experience a positive intensive margin effect and a negative extensive margin effect. Developing countries are losing an important incentive to attract mobile MNEs, reducing its tax base and tax revenues (extensive margin effect). Given the tax rates, both developing and developed countries experience a reduction in profit shifting, increasing the tax base and its tax revenues (intensive margin). Furthermore, this thesis finds a negative effect of the tax haven rate on the developed (developing) country's rate (strategic substituting tax rates), reducing the number of firms and revenues in the developing (developed) country. The indirect is therefore negative in both countries. From this thesis, I can conclude that developed countries will obtain larger welfare benefits compared to developing countries. However, it remains unclear whether the benefits of the direct effect outweigh the negative indirect effects.

This thesis gives an overview of the current tax landscape and GMT plans. Previous studies have almost exclusively focused on addressing the key problems, providing awareness of the policy and giving insights into the institutional design of this policy (Becker, 2021; de Wilde, 2021). Many researchers, including De Wilde (2021), addressed some of the main issues of the GMT. At the time, the blueprint of the system's technical design was prone to gaming. Strategically using the qualification of financial instruments could have enabled tax planning opportunities. The OECD has therefore made several adjustments to solve these challenges. However, these adjustments have often not yet been discussed. Hence, this thesis gives an updated version of the GMT plans and its implication for developed and developing countries. The measures of the GLoBE rules focus on different countries, some rules apply to residence countries and others to source countries. The rules will therefore impact developed and developing countries differently. For that reason, I will focus extensively on the main rules of the GMT.

This thesis also contributes to the literature on tax competition between developed and developing countries. One of the main reasons for the OECD to implement a GMT is

to adjust the tax competition environment, thereby reducing inefficient unilateral tax incentives and incentivising competition via other channels, e.g. resource and development. Mardan and Stimmelmayr (2020) analyse tax competition between countries, which differ in country-specific risks. Their model explains the different corporate tax rate policies with countries varying in the level of development. They show that country's optimal tax rate setting crucially depends on the ability and capacity to shift profits. Furthermore, they recognize two underlying effects: the investment incentive effect and the profit shifting effect. These effects show that governments in developed countries have greater capabilities to curb profit shifting and are in this matter less sensitive to profit shifting, low-risk countries set in this case higher tax rates. The opposite holds for developing countries. In their model, the risk component consists of the risk of default on bonds, the risk of losing direct investment, and the risk to global business relations. This thesis does not make the distinction between high-risk and low-risk countries. I only distinguish countries by the level of development. Besides, this thesis also incorporates profit shifting and tax competition incentives. Some countries, mostly developing countries, will use profit shifting incentives.

Moreover, this research is the first to model the revenue effects of the GMT for both developed and developing countries in a theoretical model. However, some papers have already discussed the main revenue effects of the policy. Titus (2022), for example, argues in his paper that Pillar II has negative implications for the corporate income tax policy in Africa. Therefore, Titus recommends that developing countries should be exempted from the Pillar II when they are engaged in real tax competition. Both developed and developing countries should cease competition over paper profits. According to Barake et al. (2021), developed countries gain relatively more additional tax revenues than developing countries. In general, the literature suggests that developed countries gain from the implementation of the GMT. On the other hand, it suggests that developing countries face ambiguous effects. Yet, these heterogeneous effects are not modelled therefore I incorporate these effects by including institutional quality parameters and location fixed costs.

Johannesen (2022) studies how the GMT impacts the tax-setting incentives by governments and how it affects welfare. This tax competition model also accounts for firm behaviour (reporting profits) and national tax policies. He shows that tax havens are most likely raising their effective tax rate to the minimum tax rate of 15 percent. The implementation of the GMT would lead to less marginal tax saving benefits of shifting, keeping the marginal costs of profit shifting constant, and thus increasing the tax liability of the MNE. Furthermore, it reduces profit shifting and could therefore raise the tax base in non-haven countries. Both effects determine the total net welfare effect. This

thesis also assumes that the exogenous increase in the tax haven rate can be interpreted as if the GMT is implemented. This is the most fundamental assumption in my model. Besides, this thesis also focuses on the welfare effect. However, I define tax revenue as the welfare function. Hebous and Keen (2022) explore in a two-country framework the strategic responses on the introduction of the GMT. They show with their model that the implementation of the GMT would lead to a welfare gain for the low-taxed country, under the assumption of strategic complementarity. This means that the implementation of the GMT (higher tax haven rate) leads to a higher tax rate in the non-haven country. In this thesis, the indirect effect will be calculated by using comparative statics. The steps are given in Appendix A4.1 and A4.2.

As mentioned previously, the model of Schjelderup and Janeba (2022) has been taken as the starting point. They incorporate endogenous tax adjustments, profit shifting decisions and location decisions based on firm-specific fixed costs. These effects are real responses to taxation. They find that the revenue effect depends on the type of competition. They have focused on two types of competition: the competition via subsidies and the competition via corporate tax rates. The results show that competition via lump-sum subsidies will exactly offset the gains of the reduction of profit shifting. On the other hand, competition via corporate tax rates might increase or decrease the non-haven country's revenues. The tax revenue of the non-haven country increases, if the non-haven tax rate rises with the haven's tax rate indicating a strategic complementarity effect. This is in line with Hebous and Keen's results (2022). With this thesis, I will extend the literature by accounting for heterogeneous effects and giving more insights into the strategic tax-setting, extensive margin and intensive margin effect of the GMT. Moreover, this thesis focuses on the competition via corporate tax rates, other tax incentives are for simplicity excluded. From a policy perspective, this thesis highlights the benefits and costs of introducing a GMT for both developed and developing countries and gives a better understanding of the underlying mechanisms.

This thesis proceeds as follows. Section 2 provides a brief overview of the tax landscape. This includes a paragraph about separate accounting, the profit shifting problem, the scope of the GMT, the rule of order and the main rules of the GMT. Section 3 presents the basic framework of the theoretical model to illustrate how the GMT fits into the model. Section 4 analyses the firm's behavioural decisions and location decisions. Section 5 presents the government's behavior, revenue effects and the implication of the GMT for both developed and developing countries. Finally, Section 6 concludes.

2 Tax landscape

Addressing concerns related to BEPS turned out to be profoundly important for policy-makers to set efficient tax policies. Before looking at the effects of the implementation of the GMT, I will therefore first give a brief overview of the concerns, the tax landscape and the general rules of the GMT. This institutional setting will be implemented later into the theoretical model. The first subsection clarifies the most commonly used tax principle, separate accounting. The second subsection quantifies the profit shifting problem focused on transfer pricing manipulations. Finally, the GMT will be discussed.

2.1 Separate accounting

Countries can calculate the global tax liabilities for MNEs by using the separate accounting approach or the formula of apportionment approach. The separate accounting approach is the most commonly used approach in the international taxation environment (Nielsen et al., 2010). This concept argues that the sales, cost of sales, expenses and profits of the affiliates should be taxed and reported by a separate entity in that particular country (Riedel and Runkel, 2007). This means that each entity of an MNE is treated individually and has to calculate its tax liability separately according to domestic tax laws. Thus, the entity is taxed in each active jurisdiction. In the case of intra-group payments (in MNE situations), one receiving affiliate must then report the benefits of the transaction and the other affiliate must report the costs to determine the allocation of profits between different jurisdictions. MNEs can take advantage of the separate accounting approach since countries do not apply a global tax framework, but instead use a separate tax framework. This encourages MNEs to create efficient tax-avoiding structures to ensure that they can exploit the loopholes in the tax system. Separate accounting can therefore be vulnerable to tax-avoiding and tax-evading actions (Bersani, 2004). One of the most commonly used tax-avoiding actions is the profit shifting mechanism.

2.2 Transfer pricing and the profit shifting problem

A substantial part of the total international trade consists of intra-group payments (Nielsen et al., 2014). Parent entities and their related affiliates make various forms of intra-group payments, e.g. transfers of goods, services, transactions of tangible and intangible assets. These intra-groups payments for goods and services are in the empirical literature often referred to as *transfer pricing*. By over-invoicing or under-invoicing the transfer price the MNE can shift a substantial amount of profits from a high-tax regime to a low-tax regime. This term is also depicted in art. 9 OECD Model Tax Convention. From this article, it follows that these internal prices of goods and services should follow the arm's length

principle. This principle deals with profit adjustments that have been made to reduce the global tax payment (BEPS issues). As described before, the arm's length principle means that an intra-firm price must coincide with the price that would be charged for an unrelated comparable third-party transaction. In this way, the price-setting marge and the profit shifting opportunities will be reduced. However, this arm's length principle has some leaks in the implementation and is therefore under attack- both conceptually, politically and legally (Schön, 2013). Thus, the strategic transfer pricing channel shows that by over-invoicing or under-invoicing, the MNE can shift a proportion of its profits from a high-tax regime to a low-tax regime. These MNEs are often hierarchical business organisations that are superior in efficiency terms relative to comparable domestic firms. Even a small adjustment in the transfer price can with these efficient business structures have a substantial effect on the MNE's tax savings. Assuming that countries differ in corporate tax rates, some MNEs have thus both the incentive and the means to shift some profits from a high-tax regime to a low-tax regime (Bernardo and Janský, 2022). Note that the ability of profit shifting differs between MNEs.

Moreover, the transfer pricing manipulation concept is not only about making price (mis-pricing) decisions. MNEs also make decisions about the allocation of intangible assets and (re)structuring businesses (Musselli and Fusaro, 2013). These decisions are often based on the national transfer pricing rules. Countries can differ in the level of regulation. Mismatches in the international tax system arise from these differences and potentially create leaks in the tax system (Meneses, 2018). Solving these transfer pricing leaks could be a complex business.

The current accounting standards leave in some cases room for subjective interpretation allowing MNEs to shift even more profits. This occurs when there are no comparable unrelated transactions (Beer et al., 2020). This strategic transfer pricing mechanism takes often place with intangible assets because identifying the true arm's length price for tangible assets is relatively easy compared to identifying the arm's length price for intangible assets. The market value of the intangibles are often missing because the value lies in their unique qualities, e.g. brand and patents. Manipulating the tax system is thus easier with intangible assets. This partly explains why the investment share of intangible assets has increased substantially (McKinsey, 2021). By using intangibles and optimally (re)locating the intangible assets to places with a beneficial tax regime, MNEs can shift substantial amounts of profits (Karkinsky and Riedel, 2012). Karkinsky and Riedel also argue that intangible assets are an important driver of MNE's profits. These intangible profits will, by allocating the intangible asset to a low-tax regime, be taxed in this low-tax regime. These intangible assets may easily be separated from the production units allowing MNEs to re-allocate the intangible assets. Furthermore, distorting intangible asset

prices enables MNEs to shift profits between high and low-taxed affiliates. The MNE forces the affiliates in high-tax countries to pay an over-invoiced price for this intangible asset to the intangible asset owner in a low-tax country. This transfer pricing manipulation mechanism becomes more attractive for MNEs when the tax differential increases. Consequently, high-tax countries lose a substantial amount of tax base to the low-tax countries. This effect encourages countries to compete via corporate tax rates to attract and keep these profits, because MNEs locate its intangible assets in low-tax regimes to shift a larger proportion of the profits (Karkinsky and Riedel, 2012). As a result, countries set inefficient low corporate tax rates, also known as the *race to the bottom*. One should be aware that competition is not only via corporate tax rates but also via other (non)-tax incentives. The theoretical model in section 3 will therefore use intangible assets to incorporate the profit shifting mechanism (via transfer pricing manipulation) and will only include tax competition via corporate tax rates. As I mentioned previously, the transfer pricing manipulation channel is only one of the three recognised profit shifting channels.

The empirical evidence indicates that the profit shifting mechanism takes place. Bernardo and Janský (2022) estimated, with country-by-country reporting (CbCR) data, that MNEs shifted around 1 trillion dollars in 2016. This corresponds to a 200-300 billion corporate tax revenue loss. Tørsløv et al. (2018) found comparable results. They show that almost 6 percent of the total profits and 37 percent of the total MNEs' corporate profits are being shifted. This estimate is equivalent to a corporate tax revenue loss of around 10 percent (125 billion revenue loss). Furthermore, Finke et al. (2013) find that German affiliates of MNEs pay significantly less taxes compared to similar domestic firms. These firms vary in shifting capabilities. This comparison is also examined in Sweden by Hansson et al. (2018), they find similar evidence indicating that MNEs engage in extensive profit shifting activities. Hence, some countries are losing a noteworthy portion of their tax base. Yet, the scale of overall total tax revenue losses remains questionable due to challenges in measuring and determining the true tax avoidance. Not every intra-group transaction focuses on reducing the global tax payment. These results have caught the policymakers' attention leading to new international tax reforms, e.g. the GMT.

In short, it shows evidence for the presence of strategic transfer pricing and profit shifting. Furthermore, MNEs are having an additional benefit compared to similar domestic firms leading to inequality between types of firms. Intangible assets are being used to enable the profit shifting mechanism. Relocating intangible assets to low-tax regimes enables MNEs to shift even more profits to these countries. This makes high-tax countries more prone to profit shifting and thus, a decline in the non-haven tax base is expected. To protect the tax base and discourage inefficiently low tax rates, the OECD has implemented several tax rules to address these BEPS issues. Maybe the most important rule is the GMT.

2.3 The global minimum tax

Last decades, MNEs that were located in high-tax countries avoided a significant part of taxation by shifting (paper) profits to low-tax countries. To address these BEPS issues, the OECD and the Group of 20 (G20) leaders developed an Action Plan. This initial Action Plan was established in September 2013 and was aimed at introducing coherence in the corporate income taxation, reinforcing substance requirements to restore the intended benefits of international standards (nexus) and creating more transparency by exchanging information (OECD, 2021C). 15 measures were identified to reduce inefficient international tax avoidance actions. Two years later, these measures were finally consolidated into a BEPS package which led to a renovation of the international tax rules and tax landscape. This deal has contributed to more collaboration between the G20 and OECD countries and realised a more consistent and efficient implementation of the BEPS recommendations making this BEPS project more inclusive. Essentially, these members settled on an inclusion framework (IF) which allows interested jurisdictions to work on an equal footing to directly shape standard settings and monitoring processes (Christians and Apeldoorn, 2018).

Until 8 October 2021, the new BEPS package was considerably influencing the international tax environment, however, tax challenges emerging from technology and digitilisation remained often unsolved (OECD, 2021A). The large digital MNEs were often able to bypass these new rules. In October 2021, 136 out of 140 IF members, had finally agreed on a Two Pillar Solution that would attack three remaining BEPS issues facilitated by digitalisation- scale without mass, reliance on intangible assets, and the centrality of data (OECD, 2022). To solve these main issues, the consensus-based solution is comprised of two Pillars: Pillar I re-allocates taxing rights towards market jurisdictions, and Pillar II imposes a GMT rate of 15 percent for large MNEs (European Commission, 2021). Thus, considerable progress has been made in the form of Pillar I and Pillar II to address these different, but related remaining BEPS issues. On October 24th 2022, the Dutch government presented a draft for the GMT. The Netherlands is one of the first countries that are taking the next step in the implementation phase of the minimum tax (Conceptvoorstel Wet minimumbelasting 2024, 2022). However, the GMT is not expected until the beginning of 2024. In the next years, it will be important for policymakers to determine the underlying mechanisms. This thesis helps policymakers by clarifying the mechanisms. In the remainder of this thesis, only Pillar II will be considered.

Now that I have explained briefly the foundation of Pillar II, I can focus on the main

problem of the current tax landscape. This problem lies in the tax competition environment. According to the OECD (2021A), jurisdictions used various types of incentives to attract mobile MNEs, including tax-lowering incentives. These tax-lowering incentives pressurised the international tax system with fierce undesirable tax competition. Not every country used this undesirable type of incentive to attract MNEs. The IMF (2015) shows that developed and developing countries often differ in the type of tax incentives. Developed countries provide more tax credits and favor the tax treatment of research and development. According to the OECD (2021A), this type of competition is beneficial. On the other hand, developing countries rely relatively more on reducing corporate tax rates and providing special taxation zones. Developing countries reduce in this case its tax rate to attract foreign direct investments (FDI). Other non-tax incentives are often not available to them. This tax-lowering behavior has been considered unfavorable. To discourage tax competition over corporate tax rates, the GMT was invented.

Under the GMT, every large MNE will effectively face a minimum tax rate of 15 percent. If the country sticks to the minimum tax, its corporate tax rate will increase accordingly. On the other hand, MNEs that are located in countries that do not join this Pillar II initiative will be enforced to pay an additional top-up tax when a country's corporate tax rate is below the required effective minimum tax rate. When the low-taxed country is not willing to increase its tax haven's rate, the IIR will give the first taxing right to the jurisdiction of the headquarter. This (residence) jurisdiction would tax the low-taxed affiliate up to the effective minimum level of taxation. However, this is inefficient for the tax haven. It loses both its tax incentive and its taxing right. The tax haven will therefore react by increasing its own tax rate. Thus, this enforcement rule ensures that MNEs pay either sufficient taxes in the tax haven or in the non-haven country. Attracting profitable, mobile business activities with low corporate tax rates becomes with the implementation of the GMT inefficient. Hence, the top-up tax reduces the fierce tax competition via corporate tax rates (Johannesen, 2022). Next to that, the implementation of the GMT encourages jurisdictions to incentivise firms on other bases, e.g. investing in human capital, infrastructure network and research and development (Rappeport, 2021). Encouraging MNEs on these bases would improve the global economy by creating a fair tax landscape for MNEs.

Moreover, the COVID-19 pandemic has also led to a bigger incentive for governments to discourage profit shifting. Next to the inequality issues, the governments are currently facing huge deficits and are budget strained. Reducing profit shifting with the GMT may contribute to additional tax revenues, which would aid economic recovery post-COVID. Furthermore, the public perception against profit shifting MNEs worsens in times of increasing inequality. Good governance and fairness can contribute to the integrity of the

tax system as a whole (Gribnau, 2017). This indicates that both the government and the MNE might benefit from changing the tax environment into a more socially responsible tax environment. In short, COVID-19 might give support for a GMT.

So far I have mainly talked about the upsides. However, there are also a few downsides with respect to this policy. For instance, the negotiation table is mainly dominated by the most developed G20 and OECD member countries (most bargaining power), resulting in bargaining between these giant countries, instead of finding a global agreement that could lead to a social optimum (Cobham et al., 2022). Gaspar et al. (2022) show that by establishing a GMT rate of 15 percent, the reduction of tax competition and the increase in corporate tax revenue could raise global government revenues by almost 14 percent. The OECD (2021B) also expects that this policy will generate 150 billion dollars in additional global tax revenues annually. These results seem to be in favour of the GMT. However, Barake et al. (2021) show that these revenues would lead to more inequality, developed countries seem to gain relatively more from the implementation of the GMT compared to developing countries. According to their benchmark estimates, the European Union (EU) can increase its tax revenue by more than 80 billion euros, the United States by 57 billion euros, and China by only 6 billion euros a year. This indicates that large undesirable inequality issues may arise. Moreover, substance-based carve-outs can substantially reduce these revenues. In the long run, they expect a reduction of 12 billion euros annually taking into account the progressively decreasing carve-outs. In addition, Alvarez-Martinez et al. (2021) argue that the reduction of profit shifting would also lead to different effects within the EU. They find positive effects in most EU countries, but not in Ireland, Cyprus, Croatia, and Bulgaria. Thus, it is not a given that all countries benefit from this policy. This paper highlights the benefits and costs of introducing a GMT and asses the heterogeneous effects in both developed and developing countries.

Now that I have given a general overview of the history, the potential benefits and the potential costs of the GMT. I will focus on the main rules of the GMT. The OECD aims to ensure that large MNEs are subject to a minimum effective level of taxation regardless of the country of residence. MNEs that are located in low-tax regimes and meet the requirements might experience, under the GMT, a higher tax expense. This agreement would impose a top-up tax on some of the largest MNEs such as Apple and Google (Brody, 2021). To achieve these goals, one can distinguish four important measures: the IIR, the UPTR, the Switch-over Rule (SOR) and finally, the STTR. The IIR requires the entity at the top of the ownership chain (UPE) to pay a top-up tax on its proportionate share of the income of any low-tax Constituent entity. As a backstop, the UTPR imposes the UTPR taxpayer to tax the low-taxed entity up to the minimum level whenever these entities make intra-group payments to low-tax entities. The SOR removes treaty obstacles from

the application of the IIR. This particular rule applies only when an income tax treaty obligates a Contracting state, the jurisdiction of a parent entity, to exempt the income of a permanent establishment (PE) in a low-taxed regime. The SOR allows countries to switch from an exemption method to a credit method. The STTR allows source countries to deny specific treaty benefits for covered payments made to low-taxed jurisdictions. The theoretical model incorporates the effects of the GloBE rules. The GLoBE rules comprise of two domestic rules: (i) the IIR and (ii) the UTPR (OECD, 2021A). Countries are not obligated to introduce these GLoBE rules, but these rules functions as a guide and template for adoption in domestic law. On the other hand, the STTR and SOR are treaty-based rules, adjustments in the domestic law are therefore not necessary. These measures differ in many more aspects and will therefore be explained separately.

2.3.1 Relevant definitions

Since understanding several recurring terms is essential for further explanation of the GMT, the following terms will be highlighted: UPE, MNE Group and Constituent entity.

The *Ultimate parent entity* (UPE) is defined as an entity or substance that owns (in)directly a controlling interest in another entity of the same MNE Group; and is not possessed by any other entity with a controlling interest (OECD, 2021A). A shareholder or entity has a controlling interest in another entity when it owns the majority of the shares, that is more than 50 percent of the shares. The entity is then required to consolidate its liabilities, assets, income and expenses. The controlling of interest works only in one direction, from the parent entity to another entity.

The term UPE is highly important for the GLoBE rules since the IIR, which is described as the most important rule of the GLoBE Rules, gives priority to the residence jurisdiction of the UPE. Without a UPE, the entity would not fall within the scope of the GLoBE rules (OECD, 2020A). In reality, MNEs often consist of a UPE.

The term *MNE Group* is also necessary for the determination of the scope.[1] Only operating entities may fall within the scope of the GLoBE rules, because profit shifting only occurs in international-oriented firms. A *Group* in terms of Pillar II means a collection of associated companies with businesses establishments in two or more countries that are related through ownership or control such that the assets, liabilities, income, expenses and cash flows of those entities: (i) are included in a Consolidated Financial Statements (CFS) of the UPE or (ii) are excluded from the CFS of the UPE solely on size or materiality grounds, or because the entity is held for sale (OECD, 2021A). The determination

[1] The scope of the GLoBE rules will be elaborated in subsection 2.3.2

of a Group is based on the accounting consolidation test. A Group will turn into an MNE Group if the Group has at least one other entity or PE, that is not located in the jurisdiction of the UPE.

The term *Constituent entity* means in the context of Pillar II: a) any entity that is included in a Group, as I specified previously, and b) any PE that is part of the main entity. A Constituent entity does not consists of excluded entities as will be described in section 2.3.2.

2.3.2 The scope of the GMT

The main objective of Pillar II is to address the remaining BEPS issues linked to innovation and technology. These issues are mainly caused by large MNEs. The Pillar II's Model Rules are therefore designed to ensure that large MNEs pay their 'fair' share. These rules apply- in view of administration and compliance costs- to all Constituent entities that belong to an MNE Group, owned by the same UPE, with a global group turnover of at least 750 million euros (OECD, 2021A). According to the OECD (2021E), the compliance costs and administration costs are designed in such a way that both the cost and complexity for MNEs and tax authorities are minimised. The similarity in the computation of the UTPR and IIR contributes to the simplicity of the GLoBE rules. These GLoBE rules show that MNEs that do not exceed this consolidated 750 million euro revenue threshold are not in the scope of these GLoBE rules. This automatically excludes the domestic-oriented, small and medium enterprises (SMEs). A large proportion of businesses will thus not be affected by the GMT. However, the OECD (2021A) shows that the MNE Groups that are within the scope of the rules earn over 90 percent of the total global corporate revenues. It suggests that big-size enterprises will fall under the scope of the GMT, hence the rules are in line with the goals of the GMT. Next to the administration costs and compliance costs, the OECD has also taken into account the synergy effect and adverse impacts on SMEs to determine the appropriate threshold level. Concluding, the use of the CbCR threshold will exclude all SMEs and most (small) MNE Groups. The big MNEs will fall under the GLoBE rules.

Moreover, the GLoBE rules apply to the MNE Groups that surpass the threshold of 750 million euros in the immediately preceding fiscal year regardless of whether their consolidated revenue is below or above the threshold in the year for which it is applying the rules (OECD, 2021A). The consolidated revenue test is based on two of the four fiscal years immediately preceding the tested fiscal year. MNEs should be aware of this time frame.

In addition, provided that the MNE would have met the conditions, certain entities might still be excluded from the GLoBE rules. The UPEs investment fund, pension fund, international organisation, governmental entity or real estate investment vehicle (that are UPE companies) will not be treated as a Constituent entity of an MNE Group and will therefore not meet the requirements of the GLoBE rules. These entities will be referred to as the *excluded entities*.

2.3.3 Rule of order

Before explaining the measures individually, I would first like to pay attention to Pillar Two's ranking rule. The Pillar II provides a rule of order in the application of its four fundamental rules, these rules are often interlocked. It ensures that these rules cannot be applied arbitrarily. The rule of order determines that the STTR must be applied first, followed by the IIR in combination with the treaty-based SOR. As I will discuss later, the SOR enables jurisdictions to overturn treaty obligations from the application of IIR to certain branch structures. Finally, the UTPR will function as a safety net or backstop for the IIR, the MNEs that would not fall under the IIR might then fall under the UTPR and consequently under the GMT. Besides, the IIR and UTPR use the same computation steps for determining the GLoBE. This contributes to the simplicity of the GLoBE rules. The OECD (2021A) argues that the primacy of the IIR is largely driven by its simplicity and lower compliance costs. Cobham et al. (2022) argue that this argument is unjust because source countries have a rightful claim to tax such low-taxed income. They state that the primacy of the IIR reflects the point of view of OECD countries. The design of the GMT suggests that the OECD prioritises the residence countries over the source countries. Nevertheless, the OECD (2021A) argues that the UTPR remains of great importance. I will keep the order of the ranking rule throughout the thesis.

2.3.4 Subject to tax rule

Two of the four main measures of Pillar II are standalone treaty-based rules, one of them is the STTR. This rule specifically focuses on the risk to source jurisdictions made by efficient BEPS structures relating to intra-group payments (OECD, 2021A). These MNEs take with efficient business structures advantage of the low- or no-tax rate of the other contracting jurisdiction. The STTR allows source countries to deny specific treaty benefits for certain deductible intra-group payments (covered payments) made to low-taxed jurisdictions. The benefit would otherwise be taxed against a low tax rate and the cost of the intra-group payment deducted against a high tax rate leading to a reduction in the MNE's tax payment. The rationale of the STTR is based on the fact that source

jurisdictions have ceded taxing rights in the context of an income tax treaty, however, the other contracting (residence) jurisdiction might not exercise their taxing right to the full minimum. By re-establishing and allocating the taxing right to the source jurisdiction, the jurisdictions can protect their own tax base by implementing a withholding top-up tax up to the minimum STTR rate. The implementation of this rule discourages MNEs from (re)structuring themselves in a tax-efficient way. The tax saving incentive is hereby reduced. In this scenario, (re)structuring the business will only be costly for the MNE.

The STTR functions as a complement for the IIR and the UPTR (GLoBE rules) because it incorporates the GMT top-up tax calculations for the purposes of the GLoBE rules. No alterations in the OECD's articles are therefore necessary. Compared to the domestic-based GLoBE rules, this rule can only be applied through adjustments in the existing bilateral tax treaties. This means that these rules may override bilateral treaties and that jurisdictions might have to implement these rules individually with other contracting states.

The taxing right is limited to the difference between the minimum rate for the STTR and the nominal tax rate on the payment in the receiving state. Without this limitation, it would lead to excessive taxation. As described before, this rule ensures that source countries protect their tax base, specifically those countries with lower administrative capacities. According to the IF members, the STTR plays an important role in achieving an agreement on Pillar II for developing countries. These countries have often inefficient administrative abilities and will therefore be affected by this rule. This rule ensures that MNEs cannot abuse the tax treaties between developing countries and countries with a low corporate tax rate. Consequently, it reduces tax-avoiding actions and thus contributes to an increase in the tax base of developing countries.

Moreover, the STTR applies to payments between connected parties of two contracting countries. This requirement is designed to focus on those intra-firm cross-border arrangements that enable profit shifting (strategic transfer pricing).[2] These parties are connected if one party has (in)directly more than 50 percent interest in the other party (majority ownership requirement). The definition of *closely related* persons and enterprises is depicted in art. 5(8) and 5(9) of the OECD and UN Model Tax Conventions (OECD, 2021A). Besides, the STTR will also not apply to the excluded entities. Furthermore, for this rule the consolidated revenue threshold of 750 million euros is not a requirement. The STTR can therefore also apply to smaller MNE groups.

Categories of payments that present a greater risk of base erosion are defined as *covered*

[2]Profit shifting between unrelated parties is unlikely

payments. The OECD (2021A) mentions that these covered payments consist of interest, royalty and other payments that present greater BEPS-risk. The latter payments are at greater risk if the payment is functioning primarily as compensation for capital, assets or risk that are owned by the person entitled to the payment. Thus, the STTR may apply in the following scenarios: franchise fees, insurance or reinsurance premiums, financing fees, rent or other payments for the use of or the right to use moveable property. This rule is mainly focused on high-return payments. Payments that generate less return are less inclined to generate a risk of base erosion because of the marginal effect on profit shifting. These low-return payments are falling within the categories but are excluded from the STTR rule.

Next to that, this rule proposes a materiality threshold for the application of the STTR. This threshold ensures that the rule is based on those business structures that produce the most material profit shifting risk. Below this materiality threshold, the OECD assumes that profit shifting is unlikely. Without the materiality threshold, the STTR might apply to all payments leading to a high administrative burden. Three possible approaches of the materiality thresholds have been proposed by the OECD; (i) a threshold based on the size of the MNE, (ii) a threshold based on a tiered value of covered payments made to connected persons, and (iii) a threshold based on a ratio, i.e. the total amount of covered payment over the payer's total expenditures (OECD, 2021A). These approaches could be used separately or applied together. The use of this threshold contributes to the effectiveness of the STTR.[3] Both the exclusion of specific entities and the materiality threshold ensure that the rules are addressed to specific MNEs.

2.3.5 Income Inclusion Rule

As I examined at the beginning of this section, the primary mechanism to achieve the main goals of the OECD are the GLoBE rules. The GLoBE rules consist of two interlocking domestic-based rules: (i) an IIR and (ii) a UTPR. As mentioned previously, the GLoBE rules use the SOR as a complement. The IIR, the primary rule of Pillar II, operates by requiring a parent entity to pay a top-up tax on its proportionate share of the income of any low-tax Constituent entity in which it has a (in)direct majority ownership. The residence country taxes that low-taxed income with an additional top-up tax to bring the initial overall tax on profits up to the minimum rate of 15 percent (OECD, 2021A). This means that the parent only has to pay a top-up tax whenever the effective tax rate (ETR) in a jurisdiction, is below the minimum effective tax rate. Besides, the IIR follows a top-down approach meaning that the jurisdiction of the Constituent entity that is at

[3] An extensive discussion of the three approaches is not within the scope of this thesis.

the top of the business structure has the first taxing right, most of the time the UPE. The UPE should be located in a jurisdiction that has implemented the GLoBE rules. If it is not located in a GLoBE jurisdiction, the next intermediate entity down the chain of ownership is required to pay the top-up tax in respect of their low- or no taxed affiliates. Essentially, one of the entities will pay the additional top-up tax. In short, the IIR gives initially the additional taxing right to the country of the headquarters (residence country).

The GMT, especially the IIR, is in some aspects comparable to the traditional controlled foreign company (CFC) scheme and the US GILTI (Global Intangible Low-Taxed Income). The IIR is due to the similarity often referred to as a super CFC rule that picks up any income, active and passive income, of an MNE Group that experience an ETR of less than 15 percent (Theophilou, 2022). Both CFC rules and the GMT subject a domestic taxpayer to tax on its proportionate share of the foreign low-taxed income of any controlled affiliate. However, the term *controlled* is defined differently. The CFC rule defines this term based on domestic law while the IIR defines this term based on accounting principles, e.g. the International Financial Reporting Standard (IFRS) and the generally accepted accounting principles (GAAP). Furthermore, both rules include a minimis threshold. The CFC rule provides additional anti-fragmentation rules. The IIR does not include these fragmentation rules because the IIR uses jurisdictional blending whereas CFC's calculations are often based on a per entity basis (Theophilou, 2022). The IIR and the CFC rules can be implemented together because these rules follow different policy objectives.

On the other hand, the US GILTI imposes a global minimum tax on the foreign income that is earned by U.S. CFCs (part of the MNE group). This tax is focused on movable intangible assets, e.g. intellectual property rights. One of the biggest differences between the GILTI and the GLoBE rules is that the GILTI is using a global blending approach. Every income and loss will be distributed to the parent before calculating the tax. This allows affiliates to offset the losses against the gains of other affiliates. However, the GLoBE rules use jurisdictional blending. This offsetting losses mechanism does therefore not apply. Moreover, the minimum rate of the GILTI is currently set at an effective rate of 13 percent and will increase in the coming years up to 16 percent. The GLoBE tax rate will be set at 15 percent. So there are many similarities and differences between these rules.[4]

The GLoBE rules follow the same computations for both the IIR and the UTPR. First, one should identify if the MNE Groups are within the scope of the GLoBE rules. These conditions are given in subsection 2.3.2. Second, one should determine the GLoBE in-

[4] An extensive discussion is not within the scope of this thesis.

come or losses of each Constituent entity, here separate accounting will be used. The GLoBE income is determined by the financial accounting net income (or loss) for the constituent entity for the fiscal year. Then, adjustments in dividends, disallowed expenses (tax expense), equity gains, stock-based compensation and currency are made. Finally, the income or loss is allocated to the PEs or the main entity. The adjusted covered taxes is determined by identifying the Constituent entity's current tax expense for the fiscal year, adjusted by temporary differences to reduce the volatility of the ETR. Then, the jurisdictional ETR is calculated by dividing the adjusted covered taxes by the adjusted GLoBE income in such jurisdiction. When the ETR is below the critical value of 15 percent, the GMT might kick in. The top-up tax percentage must then be calculated. This equals the difference between the two rates. This top-up tax percentage is then multiplied by the excess profit, the GLoBE income minus the substance-based income exclusion, to finally obtain the jurisdictional top-up tax (OECD, 2021A).

Concluding, the implementation of the IIR rules ensures that other non-haven countries can apply a top-up tax to obtain an equal playing field. Tax havens lose in this way their incentive to attract mobile MNEs by setting the corporate tax rate inefficiently low. If the IIR works perfectly and the tax havens consider these effects, the tax haven will increase its tax rate up to the effective minimum tax rate of 15 percent. In the remainder of this thesis, I assume that this assumption holds.

2.3.6 Switch-Over Rule

Since the IIR would apply as a matter of domestic law, the IIR may experience treaty obstacles when it applies to certain branch structures. For these implementation issues, countries need some complemented rules to solve these treaty issues. The SOR enables jurisdictions to overturn these treaty obligations. This particular rule applies only when an income tax treaty obligates a Contracting state, the jurisdiction of a parent entity, to exempt the income of a PE (art. 23A OECD Tax Convention) (OECD, 2021A). In this scenario, the SOR allows countries to switch from the exemption method to the credit method (art. 23B OECD Tax Convention). The SOR removes this treaty barrier so that the IIR may still be applied to low-taxed PE profits. The residence country will levy, according to the IIR, a top-up tax up to the minimum effective level of taxation.

2.3.7 Undertaxed Payments Rule

The UTPR is aimed at the same objective as the IIR, however, this rule specifically protects jurisdictions from base erosion by deductible intra-group payments to low- or no-tax

group entities. The UTPR leaves room for a deduction limitation on the UTPR taxpayer or makes an equivalent adjustment (e.g. withholding top-up tax) related to intra-group transactions if these payments are not subject to a minimum effective level of taxation. The UTPR does not provide a prescription for this equivalent adjustment. The OECD (2020A) leaves sufficient room for the UTPR jurisdiction to make efficient and appropriate legislation. This allows them to coordinate the UTPR rules with the existing domestic rules. Furthermore, it is important to note that this rule specifically focuses on deductible payments, e.g. rent and royalties. These payments are taken into account on an accrual basis. The deduction limitation is somewhat similar to art. 10a Vennootschapsbelasting (VPB) 1969 in the Dutch tax system.

This rule can be seen as a secondary rule and applies only when a Constituent entity is not already taxed under the primary rule, the IIR. The UTPR is nevertheless of great importance because it functions as a back-stop and reduces the incentives for tax-driven inversions that might otherwise arise. However, it remains questionable whether this backstop will actually be used in practice. As we have seen previously, the IIR follows a top-down approach. The UTPR will therefore only be applicable if there is no entity in the whole ownership falling under the IIR. The scope for the application of the UTPR is therefore expected to be relatively narrow. The main difference between the two rules is that the additional tax under the UTPR does not take place at the level of the UPE (IIR), but at the level of the entities that make the intra-group payments to the low-tax entities. The UTPR has compared to the IIR not a clear bias toward developed countries.

The UTPR and IIR follow the same computational GLoBE rules making the compliance and administration costs rather low. They use the same mechanisms for determining the jurisdictional ETR and the amount of top-up tax. These calculations can be seen in section 2.3.5. The scope of the rules is also applicable under the UTPR, e.g. the application of any substance-based carve-out. Both rules can be implemented through changes in domestic laws. The UTPR provides a correction for the levied IIR top-up tax. In this way, double taxation is prevented.

Constituent entities will be denied a deduction expense or face an equivalent adjustment when these payments are not subject to a minimum effective level of taxation. Hereby it is important to define the UTPR taxpayer. A UTPR taxpayer is defined as '*any Constituent entity that is located in a UTPR jurisdiction*' (OECD, 2020A, p.123). The total top-up tax will be allocated among these different UTPR taxpayers within the MNE Group. The total amount of UTPR top-up tax for each UTPR taxpayer is calculated by multiplying the total UTPR top-up tax amount by the jurisdiction's UTPR percentage. The first term equals the sum of the top-up tax of all the low-taxed Constituent entities of the

MNE group. The second term, the UTPR percentage, is based on a two-factor allocation key: the employee factor and the net book value of tangible assets. This means that the allocation among the UTPR jurisdiction is based on the UTPR percentage. This allocation formula can be written as follows:

$$50\%\frac{the\,number\,of\,employees\,in\,the\,particular\,UTPR\,country}{number\,of\,all\,employees\,in\,all\,UTPR\,countries}+50\%\frac{total\,net\,value\,of\,tangible\,assets\,in\,UTPR\,country}{total\,net\,book\,value\,of\,tangible\,assets\,in\,all\,UTPR\,countries}$$

These factors account by fiction for the location of substance. The number of employees and the net book value of the tangible assets are divided by the total amount (for all the UTPR jurisdictions). Both are provided with equal weights (50 percent). Without these allocation keys, the required tax for a group entity would be fully taken into account by all the UTPR taxpayers leading to excessive taxation.

Thus, this Pillar II initiative imposes a GMT rate of 15 percent for large MNEs to reduce the amount of BEPS. The GLoBE rules, give additional taxing rights to non-haven countries. Tax havens will, in this case, have the incentive to increase its tax rate up to the effective minimum, otherwise the GMT will allow other countries to implement a top-up tax. The benefits of a tax rate reduction is diminished. Effectively, this would mean that the GMT can be interpreted as if the tax havens rate increases up to the minimum effective tax rate of 15 percent. In the remainder of this thesis, I will therefore mainly focus on the comparative statics of the tax haven rate. The next section introduces the theoretical model. This model will be used to study the behavioral and welfare effects in both developed and developing countries.

3 Model of income shifting in developed and developing countries

This section gives a representation of the current international taxation system where MNEs use strategic transfer price manipulations to reduce their global tax liabilities. As mentioned previously, the model will be used to identify the profit shifting, location, and revenue effects under the implementation of the GMT. These results are important for the current policy debate on international taxation and tax competition. In this section, I start with a brief overview of the institutional design and implement this design into a theoretical model. In the next sections the profit shifting mechanism, the location decision mechanism and finally, the revenue effects of the GMT will be examined.

The model of Janeba and Schjelderup (2022) has been taken as the starting point for the evaluation of the revenue effects. They endogenize the profit shifting and location decisions in a three-country framework. I consider the same tax framework as Janeba and Schjelderup, however, this model makes a distinction in the level of development. In this model, developed countries differ from developing countries in the level of regulation (profit shifting) and the level of fixed costs. The model consists of a continuum of MNEs that differ in their location costs, but are homogenous otherwise. The MNE has either one productive affiliate in a developing country (indexed by subscript a) or one productive affiliate in a developed country (indexed by subscript b). These countries are non-haven countries. Furthermore, it consists of one non-productive affiliate which is located in a haven country (indexed by h). The non-productive affiliate can be interpreted as a shell company, this means that the affiliate does not perform any real activity and does not own significant tangible assets or capital (no physical presence). The non-productive affiliate is being used for tax-avoiding purposes and its existence is only confined in documents. The productive affiliate engages in costly efforts to shift profits into the non-productive affiliate (if $t_i > t_h$). The subscripts denoted in this thesis describe whether the equations apply to the global MNE group (MNE) or the individual affiliate (i).

Let the developing country a and developed country b levy a corporate income tax with tax rates denoted by t_a and t_b. The tax haven levies a corporate income tax with tax rate t_h. The affiliate in the tax haven owns an intangible asset, i.e. goodwill, contracts or patents. The productive affiliate is using this intangible asset to enable production in its country, it is a fixed common input for production. This intangible asset is not traded with third parties. This makes it difficult for tax authorities to determine a corresponding and correct arm's length price (Schön, 2013). There are also no comparable transactions between unrelated parties, so tax authorities cannot apply a comparability test. This allows MNEs to set a different transfer price. The marge between the true price and the

adjusted price (over-invoicing) enables MNEs to shift some profits from a high-tax regime to a low-tax regime. The MNE has therefore the incentive to reallocate this intangible asset to the most beneficial tax regime. This ensures that the MNE obtains the highest amount of tax savings. By re-allocating the asset, one can optimally use this tax differential effect to reduce its global tax payment.

Furthermore, I assume that the initial tax rates of $t_h < t^{min}$ and $t_i > t^{min}$, where t^{min} is the GMT rate of 15 percent (OECD, 2021A). In this thesis, the GMT will be modelled as an exogenous increase in t_h. This assumption is in line with the approach of Janeba and Schjelderup (2022) and will be explained and used in the revenue section. The tax rate of the developing country can be higher or lower than the tax rate of the developed country. Besides, the tax rates in the productive affiliates are significantly higher compared to the tax haven rate ($t_i > t_h$). Here, the corporate tax rate is only slightly positive ($t_h > 0$). Ortiz-Ospina and Roser (2016) find that developed and developing countries have comparable statutory rates. However, in this thesis I allow for different levels of tax rates because countries differ in many characteristics. Countries are therefore most likely setting different tax rates. I discuss the differences in the Nash equilibrium tax rates in section 5.

Moreover, our model assumes a best-case scenario where all the countries implement a GMT. On November 4, 2021, 137 out of 195 countries adhered to the statement on a Two-Pillar solution. Although not every country adhered to the rules, many large states agreed to these new Pillar rules (OECD, 2021D). Assuming a best-case scenario will therefore not impact the reliability or validity of this research. From this assumption, it follows that the GMT (higher t_h) reduces the profit shifting incentive because the main determinant of profit shifting, the tax differential $t_i - t_h$, decreases in all countries. Besides, this thesis focuses on the induced effects of the GMT via tax-setting incentives t_i, directly incorporating tax competition behavior. Both profit shifting and tax competition will affect the tax revenues of countries and will provide us with sufficient information to answer the research question: "How does the implementation of the Global Minimum Tax affects welfare in both developed and developing countries?"

This model follows the same approach as Janeba and Schjelderup (2022). They use an endogenous profit shifting and location choice model, which can be divided into three stages. In the first stage, governments are setting the optimal tax rates. These tax-setting decisions are not only based on profit shifting decisions, but will also take into account the location decisions of firms. In the second stage, the MNE is determining whether it will locate its affiliate in the developed or the developing country given its firm-specific fixed costs (extensive margin). In the third stage, the MNEs determine the

optimal transfer price (intensive margin), conditional on the location decision of the firm and the tax rate decision of the government. These mechanisms will also affect the tax base and tax revenue. The decisions will be discussed in the revenue effect section. One can solve this three-stage game by using backward induction. Hence, this thesis starts with the calculations of the optimal profit shifting price followed by the location effects and the governmental decision effect.

The location decisions are based on a few factors: the tax rates, the related profit shifting incentive and the level of fixed costs. As I will discuss later, locating in developing countries gives additional fixed costs. These fixed costs negatively affect the investment climate of the developing country. The tax rate also influences the location decision. Increasing tax rates lead to a higher tax expense for MNEs. The MNE is therefore inclined to locate its affiliate in a lower-taxed country. Tax-lowering policies may arise from the behavior of firms. Besides, an increase in the tax rate leads to an increase in the tax rate differential and thus increases the tax savings of profit shifting. Profit shifting allows MNEs to reduce its global tax payment. MNEs are therefore inclined to locate its affiliates in beneficial profit shifting countries. In this model, countries can attract mobile MNEs by offering tax-lowering policies. The profit shifting variable will not be a choice variable. Developing countries can thus compensate MNEs for the additional fixed costs by reducing its tax rate.

Now that I have given a brief overview of the institutional design, I can start building the model and specifying the main concepts and mechanisms. As I mentioned previously, the MNE owns either one affiliate in a developed country or one affiliate in a developing country. To simplify the analysis, I assume that both countries would produce a homogeneous good, earning profit s (i.e. sales revenue) by selling the homogeneous good on the world's market. All the affiliates earn s regardless of the size of the company and the location of the market (no price discrimination). The productive affiliates in country i $[a, b]$ use the intangible asset to enable their production and pay a fee g_i for one unit of intangible assets, which are by assumption owned by the affiliate in tax haven. This overpricing mechanism enables MNEs to shift profits from a high-tax regime toward a low-tax regime. The arm's-length price of the intangible asset is normalised to zero. There is also a cost of profit shifting. According to Haufler and Schjelderup (2000) and Göx and Schiller (2006), deviations from the true arm's-length price are often costly for the MNE because effort is required to conceal the mispricing of the intangible asset (Juranek et al., 2018). Furthermore, the OECD (2010) and tax authorities implement policies to increase these concealment costs to curb tax avoidance. Higher detection efforts by the tax authorities or tighter transfer pricing regulation directly increase the detection probability (reducing the leeway) and make concealment more expensive. Bypassing the arm's length

rules becomes more difficult for MNEs and result in increasing (consultancy) costs. MNEs react by reducing their concealment effort leading to less tax avoidance and less waste of resources on concealment, e.g. tax planning costs (Nielsen et al., 2014). This mechanism is incorporated in the total shifting cost function, see equation (1).

It should be noted that developed and developing countries differ substantially in the amount of transfer pricing regulation. According to Mooij and Liu (2018), it can be very costly for tax authorities to set tighter regulations. They state that verifying the appropriate transfer price takes time and is often difficult. Some countries are therefore reluctant to set tighter transfer pricing regulations. Furthermore, tax administrators in developing countries are often less educated and have less trained staff. Without sufficient money for wages and equipment, it will not lead to an efficient and effective tax administration. The economy of developing countries is also built around a big informal economy generating reliable data and results is often difficult. Governments in developing countries take therefore often the path of having less strict (transfer pricing) laws (Cooper et al., 2017). MNEs will then experience a lower probability of getting detected and thus experience marginally less concealment costs. The incentive to engage in transfer pricing manipulations are therefore in developing countries higher compared to developed countries. To incorporate these heterogeneous effects I have made some adjustments to the total shifting cost function used in Janeba and Schjelderup's (2022) model.

The total shifting cost function can be written as follows

$$C(g_i, \beta, \eta_i) = \frac{\beta}{\eta_i} \cdot g_i^2. \tag{1}$$

This cost of profit shifting function is a quadratic function with the parameter β for the general shifting cost and the parameter η for capturing the ineffectiveness of the institution. The quadratic cost function is frequently used in the profit shifting literature to explain why developed countries prevent more profit shifting than developing countries (Janeba and Schjelderup, 2022). A quadratic cost function tells us that if a company deviates a larger amount from the arm's length price, the higher the risk of detection and penalties will be and hence leading to higher costs. Shifting larger amounts of profits also requires more complicated and expensive business structures. This explains why deviations from the arm's-length price result in convex concealment costs. As I discussed before, this thesis will not differentiate between firm sizes. However, it may be the case that large firms can shift profits more easily relative to small firms. Large firms make more transactions and experience therefore more profit shifting opportunities. This model focuses on large MNEs. I assume that the difference in profit shifting opportunities is relatively small between these large MNEs.

The parameter β is the same for both developed and developing countries ($\beta > 0$). On the contrary, η differs between the two countries because developed countries have in general better institutions than developing countries. This parameter is therefore indexed by i. η_b takes the value of 1 in developed countries and $\eta_a > 1$ in developing countries. This institutional quality parameter depends both on the element regulation and law enforcement (Baumann et al., 2017). In our context, the elements show that a more efficient tax administration (lower η) increases the probability of getting detected by the tax administrators and getting a fine (Azemar, 2010; Johannesen et al., 2020). These fines are non-tax deductible and will therefore discourage MNEs to shift profits (lower optimal g_i^*). The cost of profit shifting is higher for firms in developed countries than for firms in developing countries because the ability to curb base erosion is higher. This corresponds to Johannesen et al.'s (2020) empirical evidence. They show that developing countries appear to be significantly more exposed to tax avoidance.

According to Haufler and Schjelderup (2000), the shifting cost function would be even more realistic to treat at least some part of the concealment costs as tax-deductible costs. This would strengthen the incentive for MNEs to shift even more profits because then the MNE only bears a fraction of its gross concealment costs. The level of profit shifting differs between these scenarios, but the qualitative results remain the same. In my thesis, I assume for simplicity that the concealment costs are non-deductible, e.g. fines. I also exclude size-related determinants of the concealment costs, e.g. affiliate assets (Soerensen, 2004).

Given the cost of profit shifting $C(g_i, \beta, \eta_i)$, sales revenue s and transfer price g_i, the after-tax profit of a non-haven affiliate can be written as

$$\pi_i = (1 - t_i)(s - g_i) - C(g_i, \beta, \eta_i). \tag{2}$$

The first term of this equation represents the after-tax profits of a non-haven affiliate accounted for intra-group payments (g_i). The productive affiliates deduct these payments at the affiliate's corporate tax rate t_i. The second term represents the concealment costs of overpricing the intangible assets.

The non-haven affiliates pay for the intangible goods to enable their production. On the other side, the tax haven's non-productive affiliate receives these payments. This is their only income flow. Hence, the profits of the tax haven's affiliate are solely determined by these intra-group payments. The after-tax profit of the affiliate in the tax haven can therefore be written as

$$\pi_h^i = (1 - t_h) \cdot g_i. \tag{3}$$

This formula indicates that the after-tax profits of the affiliate in the tax haven depend both on its own tax rate and on the intra-group payment of the affiliate (g_i), which either is located in country a or country b. The location decision of the MNE affects the optimal transfer price g^*, and thus the after-tax profit of the affiliate in the tax haven. Locating in a country with less transfer pricing regulation allows MNEs to shift even more profits to tax havens. Besides, the higher the marginal benefits of profit shifting, the higher g_i^* and the tax base.

In this model, the MNE has to make a location decision based on the tax rates t_a, t_b and t_h. The MNE will decide between locating in either the developing (a) or the developed country (b). They make their decision based on the consolidated after-tax profits. The potential MNE consolidated after-tax profit function can be defined as the sum of the after-tax profit of the affiliate in the tax haven and the after-tax profit of one of the productive affiliates. This can be written as follows

$$\pi_{MNE} = \pi_h^i + \pi_i.$$

Substituting the after-tax profit functions of equation (2) and (3) gives

$$\pi_{MNE} = \pi_h^i + \pi_i = (1 - t_h) \cdot g_i + (1 - t_i)(s - g_i) - C(g_i, \beta, \eta_i). \tag{4}$$

Substituting the cost of profit shifting (equation (1)) into the formula gives the consolidated after-tax profits of the MNE

$$\pi_{MNE} = (1 - t_h) \cdot g_i + (1 - t_i)(s - g_i) - (\frac{\beta}{\eta_i} g^2),$$

rearranging gives

$$\pi_{MNE} = (1 - t_i)s + g(t_i - t_h) - \frac{\beta}{\eta_i} g^2. \tag{5}$$

The first term reflects the after-tax profits conditional on location i. The second term shows the MNE's benefits of profit shifting. This consists of a tax differential part. Finally, there are costs related to profit shifting. As I already discussed, these costs are known as the concealment costs. The MNE will make a trade-off between the benefits and costs of profit shifting.

4 Firm behavior and allocation

This section analyses the optimal firm behavior which consists of two choices: the profit shifting choice and the location choice. First, I determine the optimal profit shifting amount by using the consolidated after-tax profit function. Then, I carry on with the location choice.

In the previous section, I have determined the consolidated after-tax profit function. The MNE cares about maximising these after-tax profits. To obtain the optimum the MNE chooses the optimal profit shifting price. This means that the MNE decides the level of g_i, not the individual affiliates.

The profit-maximization problem of the MNE can be defined as follows

$$\max_{g_i} \pi_{MNE} = \pi_h^i + \pi_i. \tag{6}$$

This equation shows that the MNE maximises the global profits conditional on the location i. To obtain the optimal transfer price one should take the derivative of the global consolidated after-tax profits with respect to the transfer price g_i. Then, I obtain the following first-order condition (FOC)

$$\frac{\pi_{MNE}}{g_i} = (t_i - t_h) - \frac{2\beta g_i}{\eta_i}$$

In the optimum this effect equals zero. Rearranging gives the following equation

$$(t_i - t_h) = \frac{2\beta g_i}{\eta_i}$$

This equation shows the trade-off between the marginal tax-saving benefits $(t_i - t_h)$ from profit shifting and the marginal (concealment) cost of profit shifting $(\frac{2\beta g_i}{\eta_i})$. The optimal profit shifting amount is achieved if the marginal cost of profit shifting equals the marginal benefit (Nicolay et al., 2017). Rearranging this equation gives the optimal transfer price (g_i^*), for the intangible asset provided by the affiliate in the tax haven to countries a and b

$$g_i^* = \frac{t_i - t_h}{2\beta} \cdot \eta_i. \tag{7}$$

As long as the condition $t_i > t_h$ holds, the MNE will be induced to shift profits from the productive affiliates (country i) to the affiliate in the tax haven. In this model, η_i and β are by definition positive. Overpricing the intangible asset reduces the taxable profit in the productive affiliates while increasing the taxable profit in the non-productive affiliate (see equation (3)). However, the MNE faces in the tax haven a lower tax rate which reduces the global tax payment (equation (8)). If $t_i = t_h$, there will be no additional tax

savings from profit shifting (Nielsen et al., 2010). In this scenario, the marginal costs of profit shifting are higher than the marginal benefits. The MNE will not have the incentive to shift profits from the productive affiliates to the non-productive affiliates ($g_i^* = 0$).

Equation (7) reveals that in the case of less regulation (higher parameter η), the marginal concealment costs are lower. Given that developed countries have a better tax administration environment (low η) and assuming identical tax rates, affiliates in developed countries will shift initially less profits to tax havens than affiliates in developing countries (initial $g_a > g_b$). This profit shifting condition is in line with the empirical evidence (Bernardo and Janský, 2022). I assume for now that developing and developed countries have identical tax rates. To clarify, this does not automatically mean that in reality developed and developing countries set identical tax rates. Countries differ in many characteristics and it is thus likely that they set different tax rates. In section 5, I examine the differences in tax rates between the two countries and determine the corresponding optimal profit shifting amount. From these calculations and the empirical literature, it follows that MNEs in developing countries set a lower tax rate. On the other hand, researchers find a bigger profit shifting incentive in these countries. This means that η_a should compensate for the lower t_a, otherwise, the condition $g_a > g_b$ would not hold.

Equation (7) also indicates that an increase in t_h reduces the tax differential of both countries (reduction marginal tax savings) leading to less profit shifting and thus raising the tax bases. This will have a positive effect on the total after-tax profit function, this can be seen in equation (8). This profit shifting (intensive margin) effect features prominently when we are discussing the GMT since the GMT reflects in our model an exogenous increase in the haven's tax rate. This will further be described in section 5. Moreover, there might also be a change in the domestic tax rate. An increase in the domestic tax rate of the non-haven country (t_i) increases the tax differential between the tax rate of the productive affiliate and the tax rate of the non-productive affiliate leading to more profit shifting. By assumption we have positive parameters and $t_i > t_h$, both productive affiliates have a positive tax differential and thus an overpriced intangible asset. This means that MNEs have the incentive to shift a proportion of their profits to low-taxed affiliates ($g_i > 0$). Furthermore, there might also be an increase in the costs of profit shifting, as measured by the parameter β. This parameter reduces the net gains of shifting because an increase in β makes the marginal costs relatively high compared to the marginal benefits, and hence the optimal shifting amount should be reduced. In short, the MNE has to trade-off the marginal benefits of profit shifting against the marginal concealment costs to find the right profit shifting optimum.

Substituting the optimal transfer price (from equation (5)) into the consolidated profit

function gives

$$\pi_{MNE} = (1 - t_i)s + (\frac{t_i - t_h}{2\beta} \cdot \eta_i)(t_i - t_h) - \frac{\beta}{\eta_i} \cdot (\frac{t_i - t_h}{2\beta} \cdot \eta_i)^2. \tag{8}$$

Rearranging the second and third term gives

$$\pi_{MNE} = (1 - t_i)s + \frac{(t_i - t_h)^2 \eta_i}{4\beta}.$$

Proposition 1. *When MNEs make profit shifting decisions based on the marginal benefits and marginal costs of profit shifting, the following holds:*
(i) When t_i increases, marginal tax savings increases and thus the optimal profit shifting amount increases.
(ii) When t_h increases, marginal tax savings decreases and thus the optimal profit shifting amount decreases.
(iii) When the general shifting costs increases, marginal costs increases and thus the optimal profit shifting amount decreases.
(IV) With a more (in)efficient institution, the marginal costs (decreases) increases and thus the optimal profit shifting amount (increases) decreases.

So far, I have mainly focused on the profit shifting effect. However, the location effect should also be included to obtain a representative presentation of the GMT effects. The location decisions also adjust to changes in corporate tax rates. Rathelot and Sillard's (2008) study indicates that corporate taxation is one of the most important factors when it comes down to plant location decisions. They show that setting a significantly high marginal level of taxation has a negative effect on the attractiveness of a country (FDI) because it leads to a lower net return on investments. Countries set therefore the corporate tax rates not too high or set even inefficiently low corporate tax rates. To incorporate these location decisions, I follow the same approach as Janeba and Schjelderup (2022). In addition, I include an additional parameter that accounts for the heterogeneity between MNEs.

In this model, the MNEs face an additional fixed costs (F) for locating in the developing country relative to locating in the developed country. The general idea behind the additional costs is that locating in a developing country is less efficient and therefore more costly for MNEs. These additional costs discourage MNEs to locate in the developing country and encourage MNEs to locate in the developed country. In the literature, 4 main factors justify this investment climate idea: political, economic, social and legal factors. For instance, political instability in developing countries lowers the trust of MNEs in the government leading to an insecure environment for MNEs in which they want to

invest less and report less profits (Bilicka and Seidel, 2020). Furthermore, the threat of expropriation is higher (Reuter, 2012), the job skills are lower and the legal framework might not incentivise investment activities (Nuriddin, 2021). Moreover, there are costs of worse infrastructure, higher start-up costs (Doruk and Söylemezoglu, 2014), worse education (UNESCO, 2018), economic instability (globaleconomy, 2022) and many more additional costs. Thus, empirical literature shows that locating in developing countries causes additional costs. In the remainder of this thesis, I assume that this condition holds. The parameter F lies between $(0, \bar{F})$ meaning that locating in developing countries is less productive and is therefore more costly for MNEs. Locating in developed countries will not cause additional costs. If the general costs F are too high, firms move to the developed countries. Here, they will experience a lower amount of costs and thus higher profits.

However, the general location cost (F) matters differently to MNEs. In other words, the level of fixed costs is heterogeneous. Some MNEs are more efficient than others and can therefore effectively carry more fixed costs. The efficient MNEs can bypass the inefficiencies and are therefore able to locate in the developing country, but for some MNEs it can be very costly to locate in the developing country. For instance, some MNEs experience less costs from a lower degree of education. These 'efficient' MNEs might provide on-the-job training or need less well-educated employees. A lower degree of education matters in this case less for the MNE. Furthermore, some MNEs need less infrastructure than others because of the proximity to the sales market. In this specific case, the disadvantage of locating in a developing country is rather small. The parameter α_j captures the type (efficiency) of the MNE and incorporates hence the heterogeneity in the exposure. In short, α_j measures how efficient an MNE in country $i(a, b)$ is and how much of the general level of fixed costs (F) it faces. Firms with a high α are more exposed to the fixed costs relative to the firms with a low α. When we put α_j and F together, we obtain the effective fixed costs for MNE type j. This depends both on the efficiency of the MNE and the general level of fixed costs. The parameter α_j lies between $\alpha \in [0, 1]$ and is uniformly distributed.

Now that the general fixed costs, the efficiency parameter and the effective fixed costs are determined, we can derive the location decisions. We determine the effect of the location decisions by looking at the marginal firm. The marginal firm is indifferent between locating in country a and b if the following equation holds

$$\pi_h^a + \pi_a - \bar{\alpha}F = \pi_h^b + \pi_b.$$

This equation shows us that the MNEs base their location decision on the after-tax profits of the non-haven country and the after-tax profits of the haven country. Locating in a developing country gives an additional effective fixed cost, consisting of the fixed costs and

the parameter that accounts for the heterogeneity in the exposure. This reduces the total profits of the MNE in country a (developing country). The developing country needs to provide additional benefits to overcome these additional cost. In this model, benefits can be given by not enforcing anti-avoidance rules or by providing tax-lowering policies. As η is no choice variable in my model, we are left with the tax-lowering policy. Country a can thus provide additional benefits to compensate for the general fixed costs. This improves the investment climate of country a compared to country b. In total, the left-hand side equals the right-hand side.

Rewriting the previous equation gives

$$\bar{\alpha} = \frac{\pi_h^a - \pi_h^b + \pi_a - \pi_b}{F}. \tag{9}$$

Substituting the individual profit functions (see Appendix A1) gives the effective fixed costs.

The critical alpha can thus be written as

$$\bar{\alpha} = \frac{(t_b - t_a)s + \eta_b(\frac{t_b t_h)}{2\beta} - \frac{t_b^2 + t_h^2}{4\beta}) + \eta_a(\frac{-t_a t_h)}{2\beta} + \frac{t_a^2 + t_h^2}{4\beta})}{F},$$

This equation can be simplified by using the optimal transfer price $g_i^* = \frac{t_i - t_h}{2\beta} \cdot \eta_i$

$$\bar{\alpha} = \frac{(t_b - t_a)s + g_a^* \frac{t_a - t_h}{2} - g_b^* \frac{t_b - t_h}{2}}{F}. \tag{10}$$

The critical value $\bar{\alpha}$ functions as a cut-off value for location decisions. The MNE that is indifferent between locating in either country a or b is defined by this cut-off point. The total mass of firms is normalised to one and will only be divided between the productive affiliates, the tax haven has no physical presence. The total number of MNEs in country a is determined by $\bar{\alpha}$ and respectively 1-$\bar{\alpha}$ in country b. With MNE type α_j below the critical value ($\alpha_j < \bar{\alpha}$), the firm will operate in a developing country. These types of firms are not that vulnerable to the additional fixed costs and are more efficient compared to the marginal firm. The firms are less exposed to the fixed costs making developing countries relatively more attractive. If the critical value increases, as I will discuss in the next paragraph, more MNEs move to the developing country. Firms with α above this critical value ($\alpha > \bar{\alpha}$) will locate in a developed country. These types of firms are vulnerable to the additional fixed costs, therefore forced to locate the affiliate in country b.

Equation (10) shows that the critical value depends on t_h, the level of η and β (in g), the initial level of t_i and finally, the tax differential between t_b and t_a. In section 3, I showed

that $t_i s$ indicates the amount of taxes in that particular country. The tax differential $(t_b - t_a)$ shows therefore how much tax savings the MNE can save by locating in the developing country compared to the developed country. This means that by offering a low corporate tax rate, one can increase its mass of firms. In addition, equation (10) also shows that in absence of profit shifting, country a needs a lower tax rate to compensate for the additional costs. This difference will be explained more extensively in section 5. When t_a increases, country a becomes relatively less attractive for MNEs and hence we observe a reduction in $\bar{\alpha}$. This mechanism will be explained later in equation (13). Some countries may therefore have the incentive to implement tax-lowering policies to obtain a bigger mass.

Next to that, the profit shifting incentive, denoted by the second and third term of the numerator (g), plays also an important role in determining the location decision. An increase in the domestic non-haven tax rate t_i will also impact the location decision of the firm via the profit shifting effect, i.e. an increase in t_i makes profit shifting relatively more important (higher tax savings) and fixed costs relatively less important for investments. In this model, MNEs can save more taxes in the developing country for each fixed cost they face. The critical value $\bar{\alpha}$ increases and thus more MNEs, even those that suffer a bit more from the fixed costs, move from the developed countries to the developing countries. The increase in tax savings enable MNEs to compensate for the fixed costs. The condition $g_a > g_b$ also holds when $t_a < t_b$ and the institutional quality parameter of country b is sufficiently low (η). Also in this case, this leads to $g_a > g_b$ and thus an increase in $\bar{\alpha}$. Note that β is negatively related to g_i.

On the other hand, if the fixed costs (denominator) become relatively more important compared to profit shifting (F higher), MNEs need a lot of profit shifting to save enough taxes to compensate for these additional fixed costs. This implies that only the efficient MNEs, that do not fully face and bear the fixed costs (low α_j) are still locating in developing countries because for them the fixed costs matter less and profit shifting relatively more. The effect of the fixed costs on $\bar{\alpha}$ can be shown formally by equation (11)

$$\frac{d\bar{\alpha}}{dF} < 0. \tag{11}$$

This equation shows formally that higher fixed costs decrease the number of firms in the developing country and will therefore harm the developing countries by a loss in tax base. This effect will be described in the revenue section.
In short, the higher the critical value $\bar{\alpha}$, the higher the mass of firms in country a. Firms that are suffering effectively less from the fixed costs stay in the developing country. Firms that suffer a lot from the fixed costs move to the developed country.

Now that we have determined the critical alpha (equation (10)), we can calculate the effect of the tax haven rate on $\bar{\alpha}$. We obtain this effect by taking the derivative with respect to t_h. These comparative statics will also pop-up in the next section.

To determine this effect, the extended critical value function can be used

$$\bar{\alpha} = \frac{(t_b - t_a)s + \eta_b(\frac{t_b t_h)}{2\beta} - \frac{t_b^2 + t_h^2}{4\beta}) + \eta_a(\frac{-t_a t_h)}{2\beta} + \frac{t_a^2 + t_h^2}{4\beta})}{F}.$$

Taking the derivative with respect to t_h gives

$$\frac{d\bar{\alpha}}{dt_h} = \frac{\eta_b(\frac{t_b}{2\beta} - \frac{2t_h}{4\beta}) + \eta_a(\frac{-t_a}{2\beta} + \frac{2t_h}{4\beta})}{F}.$$

The optimal transfer price was determined in equation (7), $g_i^* = \frac{t_i - t_h}{2\beta} \cdot \eta_i$. Rewriting the formula gives

$$\frac{d\bar{\alpha}}{dt_h} = \frac{g_b^* - g_a^*}{F} = \frac{\frac{(t_b - t_h)\eta_b}{2\beta} - \frac{(t_a - t_h)\eta_a}{2\beta}}{F}. \tag{12}$$

This comparative static shows that an increase in the tax haven rate harms that country that features larger profit shifting (country with larger g). The profit shifting incentive in that country reduces most by an increase in the tax haven rate and becomes therefore relatively less attractive for MNEs. This worsens the investment climate of that country. Whether the increase in the tax haven rate harms or benefits the developing country depends on the values t_a, t_b, β and η. These values determine the amount of profit shifting and thus the difference in profit shifting ($g_b - g_a$). Given that $\eta_a > \eta_b$ and assuming identical tax rates ($t_a = t_b$), affiliates in developing countries shift initially more profits than affiliates in developed countries ($g_a > g_b$). In this particular scenario, the increase in the tax haven rate harms the developing country's investment climate more than the developed country. Furthermore, an increase in t_h makes the fixed costs relatively more important compared to the profit shifting incentive (g_i reduces). MNEs that are located in the developing countries need in this case a lot of compensation for the fixed costs. However, due to the increase in t_h compensating for the fixed costs is more difficult. Only the efficient firms (low α_j) are exposed to low effective fixed costs and can therefore carry the additional fixed costs in the developing country. MNEs that are relatively inefficient are not able to compensate for the additional fixed costs and move in this case toward the developed country. Note that developing countries might set different tax rates compared to developed countries. From section 5, we can argue that the scenario described above is the most realistic scenario. However, I do not want to rule out the other scenario ($g_b > g_a$). In the scenario where t_b is sufficiently high and is compensating for

the type of institution ($\eta_a > \eta_b$), country b features more profit shifting than country a ($g_b > g_a$). In this scenario, an increase in the tax haven rate harms the developed country and automatically benefits the developing country. MNEs will in this case locate in the developing country. Concluding, this equation shows an ambiguous effect. An increase in the tax haven rate can harm or benefit the developing country based on the location effect. The increase in the tax haven rate harms that country that features most profit shifting. According to section 5, the developing country features most profit shifting.

In the next formula the effect of t_i on the location decision is given. The calculations can be seen in Appendix A2. It shows that tax rates affect the marginal firm ($\bar{\alpha}$).

$$\frac{d\bar{\alpha}}{dt_a} = \frac{\frac{\eta_a(t_a - t_h)}{2\beta} - s}{F} = \frac{-B_a}{F}, \tag{13}$$

$$\frac{d\bar{\alpha}}{dt_b} = \frac{-\frac{\eta_b(t_b - t_h)}{2\beta} + s}{F} = \frac{B_b}{F}. \tag{14}$$

This could also be derived by the definition of the tax base, which is $B_i = s - g_i$. This is equivalent to $B_i = s - (\frac{t_i - t_h}{2\beta} \cdot \eta_i)$ and thus $B_i = s + (\frac{t_h - t_i}{2\beta} \cdot \eta_i)$.

This formula indicates that an increase in t_i reduces the incentive for MNEs to locate in that particular country. Consequently, this negatively affects the tax base of that country. This is in line with the theory of tax competition (Konrad and Schjelderup, 1999). The higher the tax expense for MNEs in that specific country, the less firms will locate in that country. In our model, this will also ultimately mean that the firms will locate in the other (productive) country. The government will not set the corporate tax rate too high because it will account for this negative tax base effect. The tax bill is non-deductible for firms and is therefore a tax burden for taxpayers. The tax rate plays therefore an important role in the location decision. Moreover, the higher the cost of profit shifting (β), the higher the tax base in non-haven countries. MNEs are less inclined to shift profits to tax havens. The more ineffective a country is to curb tax avoidance, the more tax base they lose due to extensive profit shifting.

Proposition 2. *When MNEs decide between locating in a developed or developing country, including the additional fixed costs and tax-lowering incentive in developing countries, the following holds:*
(i) an increase in the tax haven rate harms the investment climate of that country that features larger profit shifting.
(ii) an increase in its own tax rate (t_a or t_b) reduces the incentive for MNEs to locate in that particular country.

5 Government behavior, revenue effects and implication of the GMT

The previous section was focused on addressing the decisions of the MNE, which consists of the profit shifting decision and the location decision. We observe that the MNE's decisions respond to changes in the tax system, therefore this section incorporates the governmental tax-setting decisions. The governments use the corporate tax rates t_a and t_b as endogenous instruments to maximise tax revenues.

Until now we have calculated the optimal profit shifting amount, the mass of the firm in each country and the tax base (dependent on the tax rates). These factors are essential for the tax revenue calculations and help us determine whether the GMT helps or harms developing and developed countries in revenue terms. To answer the research question, we determine the effect of the tax haven rate on the individual revenue per non-haven country. This must be examined to explain why more than 136 IF members agreed on this Two Pillar Solution. According to Devereux and Hubbard (2003), governments maximise national welfare and thus not global welfare. This means that these 136 countries must have some valid (national) arguments to implement such a policy. One of the most important arguments is that the individual benefits should be larger than the costs of implementing the policy, otherwise there would be no global agreement. This section helps policymakers by examining the benefits and costs of this policy. The effect of the tax haven rate on the total revenues and tax revenues of the tax haven will not be discussed in this thesis.[5]

From section 2, we can derive that the implementation of the GMT can be interpreted as if there is an exogenous increase in the tax haven rate ($dt_h = dt^{GMT}$). Again, by not increasing the effective tax rate up to the effective minimum, it would leave free tax money on the table for the developed and developing countries (non-havens). Tax havens will react by increasing their own tax rate. Therefore, this thesis will mainly focus on the comparative statics of the tax haven rate.

Besides, to simplify the analysis this model defines the tax revenue function as the welfare function. This tax revenue function reflects the desire for governments to maximise tax payments from MNEs. This assumption might be short-sighted, other governmental goals are usually also taken into consideration to maximise national welfare. However, Janeba

[5]This is beyond the scope of the thesis.

and Smart (2003) argue that, when the underprovision of public goods is severe, the maximisation of governmental tax revenues reflects the same results as we would expect with welfare maximisation. This is because taxes are a necessary part of any functioning society. According to Johannesen (2022), the members of the society derive satisfaction from the provision of public goods. In the scenario of severe underprovision, taxation and the provision of goods may therefore be welfare-increasing. Furthermore, taxation reallocates resources to the worse-off. Considering the law of diminishing marginal utility, governments can have a positive impact on achieving the social optimum. This ensures that I can talk about maximising welfare instead of maximising tax revenue.

As I discussed in the previous section, countries used tax-lowering incentives to attract profits. In reality, governments may also use other instruments to attract firms.[6] To get a better understanding of the impact of subsidies, I refer to the study of Janeba and Schjelderup (2022). For simplicity, I exclude non-tax incentives. The model remains a simplified, yet realistic representation of the expected GMT effects.

This model makes use of the non-cooperative Nash game theory. The Nash equilibrium theory is defined as a decision-making theorem that assumes that players (in our case countries) know the equilibrium strategies of other parties (Nash, 1951). Developing and developed countries maximise their own tax rate given the actions of the other parties. Policymakers will therefore incorporate both the direct effects and the indirect effects of the GMT for policymaking. In this model, the policymakers in the developing and developed countries maximise their tax revenues simultaneously given the tax policies in the other country.

Now that we have a good overview of the model and its setting, we can derive the individual and total revenue function to obtain a clear understanding of the determinants. Afterwards, we determine the tax choice of countries. Finally, we can derive the effect of t_h (GMT) on the individual tax revenues to determine whether the GMT harms or benefits the non-haven countries. The strategic tax-setting effect, intensive margin and extensive margin effect will be explained extensively to clarify the underlying mechanisms.

The tax revenue of the developed and developing countries depend on the mass of firms in that country, the domestic tax rate (t_i) and its tax base (B_i). Note that $\bar{\alpha}$ is the mass of firms in country a and $1 - \bar{\alpha}$ in country b. The tax revenue functions of the non-haven

[6] This is also beyond the scope of this thesis.

countries i= a,b are given by

$$R_a = \bar{\alpha} t_a B_a, \tag{15}$$
$$R_b = (1 - \bar{\alpha}) t_b B_b.$$

The tax revenue of the tax haven is determined by the tax rate of the haven, the mass of firms in either country a or country b, and the optimal shifting price in both countries

$$R_h = t_h(\bar{\alpha} g_a^* + (1 - \bar{\alpha}) g_b^*),$$

where g_i^* is the optimal transfer price (equation (7)). Substituting the optimal g_i^* into the haven's tax revenue function gives

$$R_h = t_h((\bar{\alpha}) \frac{t_a - t_h}{2\beta} \cdot \eta_a + (1 - \bar{\alpha}) \frac{t_b - t_h}{2\beta} \cdot \eta_b). \tag{16}$$

This formula indicates that when MNEs can shift profits more easily (g_i high), more tax revenues accrue to the tax haven. From equation (2), we also know that a relatively high g_i leads to less tax revenues in non-havens (after-tax profits). As I have discussed previously, η is positively related to g_i and β negatively related to g_i.

The next equation gives the global revenue function. As described at the beginning of this section, policymakers base their decisions on national welfare (revenue), not on total welfare (revenue). However, the global revenue formula gives a better understanding of how location decisions and profit shifting decisions affect tax revenue. Therefore, these determinants will be clarified.

The global world tax revenues consist of the revenues in all three countries (a,b,h), $R_{total} = R_a + R_b + R_h$. Substituting the individual revenue functions[7] into the global revenue function gives

$$R_{global} = \bar{\alpha}(t_a s - \frac{(t_a - t_h)^2}{2\beta} \cdot \eta_a) + (1 - \bar{\alpha})(t_b s - \frac{(t_b - t_h)^2}{2\beta} \cdot \eta_b). \tag{17}$$

This equation shows that the global tax revenue depends on the tax rates in combination with the number of firms (mass) in that particular country. The term $t_i s$ shows that the tax revenue depends on the level of corporate taxes. Levying a higher corporate tax leads to more tax revenue, ceteris paribus. Second, the tax differential $(t_i - t_h)$, institutional quality (η_i) and the general shifting costs (β) influence the level of profit shifting. Profit shifting reduces the global tax payment of the MNE, instead of paying in a high-tax country firms pay now a lower tax in a low-tax country. In other words, less global tax

[7] Derivations of this equation can be found in Appendix A3.

revenue R_{global} results for governments. An increase in t_i leads thus to an increase in the level of corporate tax (given investments) and an increase in the tax differential $t_i - t_h$. This means that there is both a positive and a negative effect on global tax revenue. The latter effect incentivises firms to shift profits from a high-tax regime to a low-tax regime. This profit shifting effect reduces the tax base in non-haven countries and increases the tax base in haven countries. This effect can be seen in the following non-haven tax base formula

$$B_i = s - (\frac{t_i - t_h}{2\beta} \cdot \eta_i). \tag{18}$$

Here, an increase in t_i leads to a decline in the tax base of a non-haven country (B_i). It also appears that countries with better institutions (lower η) experience a higher marginal cost of profit shifting, face lower incentives to shift profits, and thus consist of a higher tax base. Given identical tax rates, the second term of this equation is more negative in developing countries than in developed countries. This corresponds to Johannesen et al.'s (2020) results, tax avoidance seems to be more common in developing countries than in developed countries. A substantial reduction in the developing's tax base is expected if there is little to no regulation.

We can now continue with the effect of the developing country's tax rate on the developing country's revenue. This will show the developing country's tax choice. First, I define the revenue-maximization problem. This problem can be defined as follows

$$\max_{t_a} R_a = R_a(t_a, t_b, t_h). \tag{19}$$

This equation shows that the developing country maximises its revenues. Note that $R_a = \bar{\alpha} t_a B_a = R_a(t_a, t_b, t_h)$. To obtain the optimal tax choice one should take the derivative of the developing country's revenue function with respect to its tax rate. We obtain the following FOC

$$\frac{dR_a}{dt_a} = \frac{d\bar{\alpha}}{dt_a} t_a B_a + \bar{\alpha} B_a + \bar{\alpha} t_a \frac{dB_a}{dt_a} = 0. \tag{20}$$

We know from equation (13) that $\frac{d\bar{\alpha}}{dt_a} = \frac{-B_a}{F}$. Furthermore, $B_a = s - (\frac{t_a - t_h}{2\beta} \cdot \eta_a)$. By taking the derivative of the tax base with respect to t_a, we also obtain $\frac{dB_a}{dt_a} = -\frac{\eta_a}{2\beta}$

Simplifying and substituting these equations gives

$$\frac{dR_a}{dt_a} = -t_a \frac{B_a^2}{F} + \bar{\alpha}(B_a - \frac{t_a \eta_a}{2\beta}) = 0.$$

Substituting $B_a = s - (\frac{t_a - t_h}{2\beta} \cdot \eta_a)$ into this equation

$$\frac{dR_a}{dt_a} = -t_a(\frac{(s - \frac{(t_a - t_h)\eta_a}{2\beta})^2}{F}) + \bar{\alpha}(s - \frac{(t_a - t_h)\eta_a}{2\beta} - \frac{t_a\eta_a}{2\beta}) = 0. \tag{21}$$

Simplifying the last term gives

$$\frac{dR_a}{dt_a} = -t_a(\frac{(s - \frac{(t_a - t_h)\eta_a}{2\beta})^2}{F}) + \bar{\alpha}(s - \frac{t_a\eta_a}{\beta} + \frac{t_h\eta_a}{2\beta}) = 0. \tag{22}$$

The first term of equation (21) reflects the effect of t_a on the location decisions ($\frac{d\bar{\alpha}}{dt_a}$). Firms leave the country due to an increase in the marginal corporate tax rate (t_a), the investment climate worsens in that country (a). As described in the end of section 4, this effect negatively affects the tax base and hence the tax revenue of country a. The second term reflects the revenue effect (B_a or $s - \frac{(t_a - t_h)\eta_a}{2\beta}$). Given profit shifting (without behavioral adjustments), an increase in tax rate t_a leads to more revenues in country a. The third term reflects the profit shifting effect. An increase in tax rate t_a leads to an increase in the tax differential and gives rise to profit shifting. This profit shifting effect reduces the tax base (B) by $\frac{t_a}{2\beta}\eta_a$. Janeba and Schjelderup (2022) capture only two effects: the location effect and the tax base effect. The revenue and profit shifting effect can be seen in their tax base effect.

The final equation (22) simplifies the last term even further and will be used for the comparative statics, see Appendix A4.1 and A4.2. The effects given in this equation differ in magnitude from the FOC in country b and therefore lead to different optimal tax rates. These heterogeneous effects will be explained next.

At any Nash equilibrium, the developing and developed country chooses a tax rate such that $\frac{dR_i}{dt_i} = 0$. Ideally one would determine the Nash equilibrium tax rates explicitly and then compare the tax rates to observe the differences. However, in this complex setting this method will not work. Therefore, I compare the FOC of country a with the FOC of country b and investigate under which conditions the developing country should offer a lower or higher tax rate compared to the developed country.

The FOC of country a is already given, see equation (21). So when I maximise the tax revenues of country b with respect to t_b, I also obtain the FOC of country b.[8] The FOC

[8]The same steps are taken to determine the FOC of country b.

of country b can be written as follows

$$\frac{dR_b}{dt_b} = -t_b\left(\frac{(s - \frac{(t_b - t_h)\eta_b}{2\beta})^2}{F}\right) + (1 - \bar{\alpha})(s - \frac{(t_b - t_h)\eta_b}{2\beta} - \frac{t_b\eta_b}{2\beta}) = 0. \tag{23}$$

These FOCs consist of the following effects: the location effect, the tax revenue effect and the profit shifting effect. As I described previously, the first term reflects the effect of t_i on the location decisions. Keep in mind that this term can also be written as $t_a\frac{B\cdot - B}{F}$. A relatively high η_a will in this case lead to more profit shifting (g_i). The developing country has a higher η_a, so given tax rates, the developing country initially faces more profit shifting. An equal increase in tax rates (t_a and t_b) will therefore have a bigger negative effect in developed countries compared to developing countries. MNEs in developing countries do not really bear the cost of having a high tax rate. Developing countries lose therefore relatively less firms compared to developed countries. This is a reason for developing countries to implement a relatively high tax rate.

The second term shows the effect on the tax base, also known as the revenue effect. η is negatively related to the tax base (equation (18)) meaning that developing countries lose a larger amount of tax base from an increase in tax rate (t_i) than developed countries (ceteris paribus). The benefits of having a higher tax rate are therefore lower in developing countries compared to developed countries ($s - \frac{(t_a - t_h)\eta_a}{2\beta} < s - \frac{(t_b - t_h)\eta_b}{2\beta}$). With equal tax rates, the tax base of the developed country is higher than the tax base of the developing country. The developed country may therefore have the incentive to implement a relatively high corporate tax rate. For them, a higher tax rate can be more beneficial even if they lose some MNEs (reduction tax base) to the developing country. The lower tax base benefits in developing countries indicate that developed countries should implement a relatively high tax rate compared to developing countries.

Finally, the last term of equation (23) reflects the profit shifting effect (intensive margin effect). Given identical tax rates, the developing country observes more profit shifting due to its low institutional quality (high η_a). This profit shifting effect reduces the revenues of country a by a larger amount than country b ($\frac{t_a}{2\beta}\eta_a > \frac{t_b}{2\beta}\eta_b$). To reduce this negative effect, country a should therefore reduce its tax rate by a larger amount than country b. These results show that MNEs in developing countries respond strongly to profit shifting incentives, increasing the tax rates generate little to no additional government revenue. Using low tax rates may be the best feasible policy given the profit shifting constraint in developing countries.

So when we focus on the location effect, MNEs in developing countries do not really bear the negative effect of a tax increase. Developing countries should, by looking only at this

mechanism, implement a relatively high tax rate. However, developing countries have less tax base benefits and experience more profit shifting. The last two results indicate that developing countries should be more in favour of a lower tax rate compared to the developed country. Thus, this shows us contradicting results. The final two results correspond to the empirical literature. As I already mentioned in the introduction of this thesis, Dietsch and Rixen (2014) showed that developing countries provide more tax-lowering policies compared to developed countries. Goodspeed (2006) finds the same result. He shows that 55 percent of the developing countries used tax exemptions or tax holidays to attract FDI compared to only 20 percent of the OECD countries. Developing countries are also more likely to reduce their tax rates to attract additional FDI. I must confess that the ratio might have changed over time, however, the tax rates in developing countries are still relatively low compared to the tax rate in the developed country. In the remainder of this thesis, I will therefore assume that the tax rate of the developing country is lower than the tax rate of the developed country ($t_a < t_b$).

Now that we have determined the tax choice, we can optimise the profit shifting amount. The optimal profit shifting amount is given by $g_i^* = \frac{t_i - t_h}{2\beta} \cdot \eta_i$. In this model, the developing country is most likely providing a lower tax rate. However, this does not ultimately mean that firms in developed countries have a bigger profit shifting incentive. The optimal shifting amount also depends on the institutional quality parameter η. This model shows us that the institutions in developed countries are significantly better compared to developing countries making profit shifting more difficult in developed countries ($\eta_a > \eta_b$). The empirical literature suggests that affiliates in developing countries shift more profits than developed countries (Bernardo and Janký, 2022). The parameter η compensates thus for the tax-lowering incentive in the developing country. This is a plausible explanation given the impact of regulation on the optimal profit shifting amount. Therefore, I argue that affiliates in developing countries will indeed shift more profits to tax havens than developed countries ($g_a > g_b$). These profit shifting results will help us explain the underlying mechanisms of the GMT.

Before calculating the welfare (revenue) effect, I should explain how the implementation of the GMT affects the setting of tax rates. Countries are most likely adjusting their tax rates to obtain the maximum amount of national revenues. There are two tax-setting possibilities: the tax rates are strategic complements or strategic substitutes. A positive sign in equation (24) means that the tax rates are strategic complements. This means that if one country increases its tax rate (tax haven), the best response of the other country is to also increase its tax rate. A negative sign indicates that the tax rates are strategic substitutes. In this scenario, it is optimal to decrease the tax rate. Empirical research suggests, on average, that statutory corporate tax rates are strategic complements

(Hebous and Keen, 2022; Kanbur and Keen, 1993). For this reason, many researchers ruled out the possibility of substitutability. The presumption that the tax rates are always strategic complements is not always supported by the literature (Leibrecht and Hochgatterer, 2012). Therefore, this thesis does not rule out this possibility and uses comparative statics to determine the sign of this effect. To derive the comparative statics, I have made the following steps. First, I calculate the FOCs for both the developed and developing country. Second, I totally differentiate the entire FOC with respect to t_a, t_b and t_h. Here, t_a and t_b are endogenous and t_h exogenous. The implementation of the GMT triggers t_h. In the optimum, this total derivation will be equal to zero. By using the Cramer's Rule, I obtain $\frac{dt_a}{dt_h}$ and $\frac{dt_b}{dt_h}$. These steps are given in Appendix A4.1 and A4.2.

From Appendix A4.1.1, I derive the comparative static of the developing country

$$\frac{dt_a}{dt_h} = -\frac{\partial H_a}{\partial t_h} \cdot \frac{\partial H_b}{\partial t_b} + \frac{\partial H_b}{\partial t_h} \cdot \frac{\partial H_a}{\partial t_b}. \tag{24}$$

Each term consists of a number of variables. Calculating this effect explicitly becomes almost impossible due to the extensive formulas and the multiplication in this equation. On the other hand, one can sign the terms and interpret in this way the effect of the tax haven rate on the tax rate of the developing country. In Appendix A4.1, the four terms are signed individually.

From the results in Appendix A4.1, I can conclude that, when s is sufficiently large and $g_a > g_b$, the tax rate of the developing country tends to be a strategic substitute. When these conditions hold, the first term (Appendix A4.1.2), second (Appendix A4.1.3) and third term (Appendix A4.1.4) are negative. The last term (Appendix A4.1.5) shows a positive effect. This result corresponds to the result of Leibrecht and Hochgatterer (2012) and shares the intuition of Janeba and Schjelderup's model. However, this outcome does not correspond to the statement of Franzese and Hayes (2009) and many other researchers. Janeba and Schjelderup (2022) find that when the cost parameter β is very small, the tax base goes to zero and the non-haven tax rate tends to increase. On the other hand, if β becomes very large and s is sufficiently large, they find strategic substitutes. It is important to keep in mind that the model of Schjelderup and Janeba uses more assumptions, e.g. symmetric equilibrium. Using more and different modeling assumptions may lead to different outcomes, however, in this case they find the same outcome. Furthermore, Hebous and Keen (2022) make an important note. They argue that strategic complementing tax rates are, in the profit shifting literature, not theoretically assured. So there remains a possibility of strategic substituting tax rates. It is also important to keep in

mind that my model only finds clear (strategic substituting) results when s and η_a are sufficiently large. This means that the institutional quality in developing countries should be relatively low compared to the institutional quality of the developed country. This result is in line with the empirical literature (Bernardo and Janský; 2022). When this condition does not hold, the tax-setting effect is ambiguous. In that case, there remains a possibility of strategic complementing tax rates. In the remainder of this thesis, I assume that the tax rates are strategic substitutes.

Now that we have discussed the sign of the developing country ($\frac{dt_a}{dt_h}$), we can follow the same steps to determine $\frac{dt_b}{dt_h}$. This effect is slightly different from the previous equation but can also be determined by the two-by-two matrix

$$\frac{dt_b}{dt_h} = \frac{\partial H_a}{\partial t_a} \cdot -\frac{\partial H_b}{\partial t_h} + \frac{\partial H_b}{\partial t_a} \cdot \frac{\partial H_a}{\partial t_h}.$$

Appendix A4.2 shows that the first, second and fourth term of this equation are negative. The third term shows a positive outcome. In that case, there will be a negative sign meaning that the tax rates are strategic substitutes. Again, showing different results as many researchers (de Mooij and Vrijburg, 2016). These researchers focus on different (model) assumptions and therefore obtain different results. This thesis uses reliable and verifiable profit shifting assumptions that lead to realistic outcomes. Therefore, these results give a simplified, yet good representation of the reality.

With all the building blocks derived, we can continue with identifying the effect of the tax haven rate t_h on the tax revenues in country a and b. We maximise the revenues in these countries with respect to t_h. The effect of t_h can be written as

$$\frac{dR_a}{dt_h} = \frac{dR_a}{dt_a} \cdot \frac{dt_a}{dt_h} + \frac{dR_a}{dt_b} \cdot \frac{dt_b}{dt_h} + \frac{dR_a}{dt_h}. \tag{25}$$

This equation consists of a direct effect and an indirect effect. These effects will be explained extensively in the next paragraphs. I first give a brief overview of the general formula, afterwards I will compare the effects between the two non-haven countries.

We start by explaining the last term of this equation ($\frac{dR_a}{dt_h}$), this is the direct effect of an increase in the tax haven rate. This term shows the effect of a change in the tax haven rate on the revenues of country a keeping all other corporate tax rates constant. The terms $\frac{dR_a}{dt_b} \cdot \frac{dt_b}{dt_h}$ show the strategic indirect effect via the tax rate of country b (developed). The

first part ($\frac{dR_a}{dt_b}$) is known as the cross-effect (Janeba and Schjelderup, 2022). It reflects the effect of the developed country's tax rate on the revenues in the developing country. The second part shows the change in the developed country's tax rate due to a change in the tax haven rate. This tax-setting effect is discussed in Appendix A4.1 and A4.2. Countries make adjustments in their tax rate when the tax rate of other countries changes. The total indirect effect shows that there is an effect of t_h on t_b which then influences the number of firms and revenues in country a. Finally, the first term of the general equation ($\frac{dR_a}{dt_a}$) corresponds to equation (21). From the envelope theorem, it follows that this term equals zero. If the developing country has chosen the optimal tax rate such that the tax revenue in the developing country (a) is optimised, a slight change in the tax rate (t_a) will not affect the tax revenue in this country (approaching zero). If we observe large changes in tax revenue, the domestic corporate tax rate is not optimised.

This means that the envelope theorem will cancel the first two terms out. We end up with the following equation

$$\frac{dR_a}{dt_h} = \frac{dR_a}{dt_b} \cdot \frac{dt_b}{dt_h} + \frac{dR_a}{dt_h}. \tag{26}$$

The cross-effect can be determined by taking the derivative of the revenue function of country a ($\bar{\alpha} t_a B_a$) with respect to the tax rate of country b. Only $\bar{\alpha}$ depends on t_b. Equation (14) shows this effect. Multiplying this equation by $t_a B_a$ gives the following cross-effect $\frac{dR_a}{dt_b} = \frac{s - \frac{(t_b - t_h)\eta_b}{2\beta}}{F} \cdot t_a B_a$. Furthermore, the result of the strategic tax-setting effect is given in Appendix A4.1.6. $\frac{dt_b}{dt_h}$ shows a negative sign when $g_a > g_b$ and s is sufficiently large. Finally, the direct effect can be calculated by taking the derivative of the revenue function of country a ($\bar{\alpha} t_a B_a$) with respect to the tax haven rate. The tax haven rate pops up in $\bar{\alpha}$ and in the tax base of the developing country (B_a). The effect of t_h on $\bar{\alpha}$ is given in equation (12). The effect of the tax haven rate on the tax base equals $\frac{\eta_a}{2\beta}$. Combining both results gives $\frac{dR_a}{dt_h} = \frac{g_b - g_a}{F} t_a B_a + \alpha t_a \frac{\eta_a}{2\beta}$.

Substituting these results into equation (26) gives

$$\frac{dR_a}{dt_h} = (\frac{s - g_b}{F} \cdot t_a B_a) \cdot \frac{dt_b}{dt_h} + (\frac{g_b - g_a}{F}) t_i B_i + \bar{\alpha} t_a \frac{\eta_a}{2\beta}. \tag{27}$$

From the remaining formula three mechanisms can be recognised: (i) the strategic tax-setting effect, (ii) the intensive margin effect and (iii) the extensive margin effect. We start with the term $\frac{dR_a}{dt_b}$, this term reflects the indirect effect. By taking the derivative with respect to t_b, the tax rate t_b only pops up in the parameter $\bar{\alpha}$ in the revenue function of the developing country. This implies that a change in the developed tax rate only

affects the location decision of the MNE. This location decision affects the tax bases of both countries. An increase in the marginal level of taxation (t_b) makes country b less attractive for FDI. This leads to a reduction in the number of firms in country b and thus also in the tax base (B_b). This ultimately means that country a becomes relatively more attractive for MNEs, this corresponds to the theory of tax competition (Konrad and Schjelderup, 1999). The tax bases (B_a and B_b) and t_a are by definition positive. The cross-effect has therefore a positive sign which implies that developing countries gain revenue by an increase in t_b ($\frac{dR_a}{dt_b} > 0$). The second part of the indirect effect depends on the effect of the tax haven rate on the tax rate of the developed country. From the comparative statics in Appendix A4.1 and A4.2, it follows that the tax rate of the developed country is negatively affected by the increase in the tax haven rate. Thus, the tax rates are strategic substituting tax rates. This indicates that the implementation of the GMT (higher tax haven rate) leads to a lower tax rate in the non-haven country. Note that s and η_a should be sufficiently large to obtain this negative outcome. Other researchers find strategic complementing tax rates (de Mooij and Vrijburg, 2016). These researchers often rely on different assumptions, therefore their outcome differs from the outcome in this thesis. This thesis also focuses on the intensive and extensive margin effect, therefore this thesis may obtain different results. Combining the results of the cross-effect and the tax-setting effect gives us a negative effect. The indirect effect shows us that there is a negative effect of t_h on t_b which then negatively affects the number of firms and revenues in country a. In short, the revenues of the developing country decrease due to this tax-setting effect. Strategic tax responses are thus crucial for understanding tax competition and welfare effects.

Now that we derived the indirect (strategic) effects of the policy, we can start focusing on the direct effects. The direct effect consists of an intensive and an extensive margin effect. These effects exclude the change in tax rate (t_a or t_b). So given these tax rates, the extensive margin effect shows the effect of the GMT on location decisions. The intensive margin effect is about, given the MNE investment (locate) occurs and given tax rates, how much the MNE decides to shift profits. The implementation of the GMT affects these MNE's decision and will therefore lead to different levels of tax revenues.

The last term of this equation represents this intensive margin effect ($\bar{\alpha} t_a \frac{\eta_a}{2\beta}$). The intensive margin effect shows that an increase in t_h, due to the implementation of the GMT, reduces the tax differential. The MNE obtains a new equilibrium with a lower optimal amount of profit shifting because of the reduction in tax savings. The tax base of non-haven countries increases and the tax base of tax havens decreases consequently. On a global level, we observe thus a distribution of reported profits from tax havens to non-haven countries. The adjustment in behavior raises revenues by $\frac{\eta_i}{2\beta}$ per firm. The total

intensive margin effect is calculated by multiplying $\frac{\eta_i}{2\beta}$ with the mass of firms ($\bar{\alpha}$) and the tax rate (t_a). As we can derive from the positive sign of this intensive margin term, the reduction in profit shifting has a positive effect both in the developed and the developing country.

Furthermore, the higher η, the higher the intensive margin effect. A higher η leads, in the pre-GMT scenario, to more profit shifting because of the lower marginal cost of shifting ($\eta_a > \eta_b$). This can be seen in equation (7). The implementation of the GMT is for these countries more beneficial because it increases the reported profits by a larger amount. According to the results, I can argue that developing countries (high η) shift initially more profits than developed countries. Developed countries had initially a more efficient institution or tax administration. This implies that MNEs in developed countries face higher costs of profit shifting and therefore shift initially a lower amount to tax havens. The implementation of the GMT has therefore less effect on the profit mechanism in developed countries compared to developing countries. The same explanation holds for β. The higher the initial general costs of profit shifting, the lower the benefits of the intensive margin effect. So the more developed countries gain less additional tax base because, in the pre-GMT scenario, there was already less profit shifting. In short, the model shows a positive intensive margin effect in both developed and developing countries. According to these intensive margin results, we can state that developing countries are gaining relatively more additional revenues by the implementation of the GMT.

In section 4, the location decisions were discussed extensively. These location decisions play in the GMT literature an important role and are often referred to as the extensive margin effect (Janeba and Schjelderup, 2022). These location decisions are based on the tax rate, the related profit shifting incentive and the general fixed costs. The GMT affects the importance of these determinants and thus the location and revenue effects. The first term of the direct effect (equation (27)) reflects the extensive margin effect ($(\frac{g_b - g_a}{F})t_i B_i$). This location effect shows, given the tax rates, where the MNEs will locate. This location effect depends on the difference in profit shifting ($g_b - g_a$).

The total extensive margin term $(\frac{g_b - g_a}{F})t_i B_i$ shows that an increase in the tax haven rate harms that country that features larger profit shifting (country with larger g). The profit shifting incentive in that country reduces most by an increase in the tax haven rate and becomes therefore in terms of investments relatively less attractive. I argue that the developing country faces larger profit shifting ($g_a > g_b$). This assumption is in line with the empirical literature (Bernardo and Janský, 2022). The GMT will make it harder for developing countries to attract mobile MNEs. These countries already experience a worse investment climate, because the MNEs face in the developing country additional

fixed costs F. In this scenario, they cannot compensate MNEs for the additional fixed costs by offering profit shifting incentives. The fixed costs have become relatively more important compared to the profit shifting incentive. If the fixed costs are relatively high, the extensive margin becomes very sensitive. Inefficient MNEs will in this case locate in the developed country, reducing the tax base and tax revenue in the developing country. This is also in line with the empirical literature (Davies et al., 2021). Moreover, a reduction of t_b or an increase in t_a shows also a negative extensive margin effect (decline in revenues developing country). When t_a is sufficiently high (g_a is higher), it would mean that developing countries are losing more tax revenues. This result implies that governments should not set their tax rates too high, one should incorporate tax competition decisions. This extensive margin effect can, compared to the intensive margin effect, thus also show negative results. Policymakers will take this extensive margin effect into account when they are determining the optimal tax rate to limit the tax revenue reduction.

In the previous paragraph, I have made a strong assumption. Affiliates in developing countries would shift more profits to tax havens than affiliates in developed countries ($g_a > g_b$). However, it may be the case that this assumption will not hold. In this scenario, the extensive margin effect becomes positive in country a and negative in country b. Both the extensive margin and the intensive margin (direct effect) are positive for the developing country ($\frac{\partial R_a}{\partial t_h} > 0$). However, this scenario is unlikely. There is sufficient evidence showing that developing countries feature more profit shifting than developed countries (Bernardo and Janský, 2022).

From equation (27), we can also derive that if the initial costs of profit shifting are high, being lenient on profit shifting does not influence firm's behavior. The extensive margin term takes in this scenario a relatively low value. MNEs will not have the profit shifting incentive, the channel of being lenient is then rather small. In this case, the GMT provides mostly benefits with hardly any costs. The implementation of the GMT will in this particular case raise additional tax revenues and the loss of wasteful tax incentives is only small. On the other hand, if the valuation of profit shifting (by MNEs) is sufficiently high, an increase in the tax haven's rate may have negative results for developing countries. They lose their means to attract mobile MNEs (extensive margin effect). In this scenario, the net welfare effect may not be positive. Keep in mind that the negative indirect effect should also be included in the total net welfare effect.

Thus, it is interesting to see which of the two direct effects is most dominating, the intensive versus the extensive margin effect. We observe that developed countries have both a positive intensive and extensive margin effects. Developing countries observe an increase in tax base (intensive margin), however, these countries lose potentially their

means of attracting mobile firms (extensive margin). This would lead to business relocation. Whether the negative effect exceeds the positive effect depends on the sensitivity and efficiency of MNEs. It also depends on the tax-setting effects of governments.
The total indirect effect depends on the cross-effect and this tax-setting effect. These tax-setting effects are highly important for determining the total indirect effect because the cross-effect turns out to be positive. The tax rates tend to be strategic substitutes when s is sufficiently large and $g_a > g_b$. This intuition corresponds to the results of Janeba and Schjeldrup (2022). An increase in the tax haven rate will decrease the tax rate of the developed (developing) country's tax rate, which then reduces the tax revenue of the developing (developed) country. When the tax-setting effect turns out to be a strategic complement, the total indirect effect changes in sign (positive). An increase in the tax haven rate will increase the tax rate of the developed (developing) country's tax rate, which then increases the tax revenue of the developing (developed) country. De Mooij and Vrijburg (2016) argue that the weight of evidence suggests that statutory corporate tax rates are strategic complements. The magnitude of the tax-setting effect, however, has not been tied down with precision. This indicates that the tax-setting effect might also be a strategic substitute. Strategic complementing tax rates are the more instinctive assumption, but is in the GMT literature not theoretically assured. Janeba and Schjeldrup use a similar model framework and find also strategic substituting tax rates. The results from Appendix A4.1 and A4.2 may therefore be reliable.

It remains unclear whether the developing and developed countries obtain positive welfare effects. The magnitude of the negative indirect effect may be larger than the positive intensive margin effect. Developing countries have an additional negative extensive margin effect. We can conclude that developing countries are relatively worse off. Inequality issues might therefore arise. In the next couple of years, countries will observe the total revenue effect. Whether the intensive margin or the extensive margin effect is the dominating force in developing countries can in later stages be determined. The underlying mechanisms are given in this model.

My results are in line with the results of Mardan and Stimmelmayr (2020). Developing countries have less abilities to curb profit shifting and are therefore more sensitive to the profit shifting effect (intensive margin effect). Furthermore, the implementation of the GMT is as if the tax haven rate increases. According to my and Johannesen's (2022) results, the profit shifting incentive declines and the tax base of non-havens are likely to increase. Furthermore, location effects are likely to exist. These effects increase revenues in developed countries and decrease tax revenues in developing countries. Hebous and Keen (2022) and Schjelderup and Janeba (2022) all tend to find the same result. The tax revenue of the developed country tends to increase. The intensive margin and the

extensive margin show positive results. Developing countries obtain a positive intensive margin effect and a negative extensive margin effect. The indirect effect is negatively influencing the tax revenues when s is sufficiently large and $g_a > g_b$. The total sign is ambiguous.

This study suggests that the implementation of the GMT will be more beneficial for the developed countries, particularly the key players behind these global agreements, at the expense of the inequality in developing countries. The results suggest that inequality issues might arise from the implementation of the GMT. In times of increasing disparities, the introduction of this policy might therefore be less beneficial from the point of view of developing countries. However, this model is only a simplified model of the GMT. In the coming years, the results can be calibrated to indicate the degree of accuracy. Furthermore, the model focuses on the tax competition that arises from corporate tax rates. There are however still other incentives possible to attract FDI. These tax competition incentives were not within the scope of this thesis but are highly important for policy-making. Moreover, I assume a best-case scenario where all countries implement the GMT and where this policy works perfectly according to the rules. In reality, loopholes are a likely outcome of this policy. Besides, this model assumes, for simplicity, that governments maximise revenues only. However, Gawanda et al. (2009) show that governments maximise national social welfare. Maximising revenues may not lead to a Paretian social optimum. I also assume that locating in developing countries is always more costly than locating in developed countries (fixed costs). This assumption does not always hold, however, empirical evidence suggests that the assumption will most likely hold. Finally, the location decision is also simplified. There are other factors influencing the location choice which are not included in this model. Including these factors would however complicate the intuition and analyses. This gives room for thoughts for further research.

6 Conclusion and policy recommendation

Last decades, digitalisation has been a major driving force for the world's economy. However, these changes have also led to mismatches in the national and international tax system. MNEs have used tax planning strategies to exploit these loopholes to reduce their global tax liability. Empirical evidence indicates that MNEs shifted a significant share of their profits to low-tax countries. As a reaction, the OECD has new tax reforms. Maybe one of the most important tax reforms is the GMT rule.

This rule focuses on reducing inefficient tax competition, improving the integrity of the tax system and reducing tax-avoiding actions. Furthermore, the OECD also expects additional global tax revenues. However, many researchers argue that these revenues will be unequally distributed among developed and developing countries. These heterogeneous effects are not yet modelled. Therefore, this thesis attempts to analyse how the GMT affects welfare in both developed and developing countries.

To derive these results, I introduce a model that consists of a continuum of MNEs that differ in their location costs, but are homogenous otherwise. The MNE has one non-productive affiliate in a tax haven and is located either in a developing country or in developed country. These productive affiliates over-invoice the transfer price to shift profits from the productive affiliates to the tax haven. The GMT is modelled as an exogenous increase in the tax haven rate and incorporates tax competition via corporate tax rates. This model consists of three stages to incorporate the existing effects of taxation: profit shifting optimisation, location optimisation and governmental decision optimisation.

The model shows a few remarkable results. First, the GMT generates in general positive outcomes if the location decision (extensive margin) effects, the profit shifting (intensive margin) and indirect effects summed over both developed and developing countries are positive. The developed and developing country's revenues differ in magnitude. The developed country experiences both a positive intensive margin effect and a positive extensive margin effect. However, developing countries experience a positive intensive margin effect and a negative extensive margin effect. Developing countries are losing an important incentive to attract mobile firms, reducing its tax base. On the other hand, developed countries gain from this effect. If the initial costs of profit shifting are high, the profit shifting incentive does not influence firm's behavior. In this case, the GMT provides mostly benefits with hardly any costs. The negative effect of the developing country is rather small. On the contrary, if the costs are low the opposite happens. This paper finds, under conditions, for developed and developing countries a negative indirect effect. De Mooij and Vrijburg argued that the weight of evidence suggests that statutory corporate

tax rates are strategic complements. The results of this paper show the opposite. It is uncertain whether the positive effects outweigh the negative effects (extensive margin and indirect effect). This means that this thesis finds ambiguous results.

The implementation of the GMT will be more beneficial to developed countries than developing countries. The key players behind these global agreements benefit at the expense of the developing countries. This policy can therefore not be seen as an Paretian optimum agreement. The model is a realistic, yet simplified version of the reality. Moreover, the answer to this research question depends on many characteristics, i,e. the sensitivity of firms to locate in other countries and the valuation of investment climate characteristics. These questions must be answered first to get a clear and deeper understanding of the final results. In the next couple of years, the GMT will hopefully generate the actual total revenue effect. This thesis will contribute by explaining the underlying mechanism.

7 Appendix A

Appendix A1 Formula critical value

We start with the MNE consolidated after-tax profits of country a or country b. Including the effective fixed costs $\bar{\alpha}F$ that an MNE of type j faces.

$$\pi_a + \pi_h^a - \bar{\alpha}F = \pi_b + \pi_h^b$$

From equation (2) and (3), we obtained all relevant after-tax profit functions. Substituting the after-tax profits gives

$$\bar{\alpha}F = ((1-t_a)(s - \frac{t_a - t_h}{2\beta}\eta_a) - (\frac{\beta}{\eta_a} \cdot (\frac{t_a - t_h}{2\beta}\eta_a)^2)) - ((1-t_b)(s - \frac{t_b - t_h}{2\beta}\eta_b) -$$

$$(\frac{\beta}{\eta_b} \cdot (\frac{t_b - t_h}{2\beta}\eta_b)^2)) + ((1-t_h) \cdot \frac{t_a - t_h}{2\beta}\eta_a) - ((1-t_h) \cdot \frac{t_b - t_h}{2\beta}\eta_b).$$

The left hand side equals

$$\pi_a + \pi_h^a - \bar{\alpha}F = s + \frac{t_h}{2\beta}\eta_a - \frac{t_a}{2\beta}\eta_a - t_a s - \frac{t_a t_h}{2\beta}\eta_a + \frac{t_a^2}{2\beta}\eta_a - \frac{(t_a - t_h)^2\eta_a}{4\beta} + \frac{t_a}{2\beta}\eta_a - \frac{t_h}{2\beta}\eta_a - \frac{t_a t_h}{2\beta}\eta_a + \frac{t_h^2}{2\beta}\eta_a - \bar{\alpha}F.$$

The right hand side equals

$$\pi_b + \pi_h^b = s + \frac{t_h}{2\beta}\eta_b - \frac{t_b}{2\beta}\eta_b - t_b s - \frac{t_b t_h}{2\beta}\eta_b + \frac{t_b^2}{2\beta}\eta_b - \frac{(t_b - t_h)^2\eta_b}{4\beta} + \frac{t_b}{2\beta}\eta_b - \frac{t_h}{2\beta}\eta_b - \frac{t_b t_h}{2\beta}\eta_b + \frac{t_h^2}{2\beta}\eta_b.$$

Rewriting and cancelling out the same numbers on both sides gives

$$\bar{\alpha}F = (t_b - t_a)s + \frac{\eta_b t_b t_h}{2\beta} - \frac{\eta_a t_a t_h}{2\beta} + \frac{\eta_a(t_a^2 + t_h^2)}{4\beta} - \frac{\eta_b(t_b^2 + t_h^2)}{4\beta}.$$

Dividing this equation by F shows the critical alpha

$$\bar{\alpha} = \frac{(t_b - t_a)s + \frac{\eta_b t_b t_h}{2\beta} - \frac{\eta_a t_a t_h}{2\beta} + \frac{\eta_a(t_a^2 + t_h^2)}{4\beta} - \frac{\eta_b(t_b^2 + t_h^2)}{4\beta}}{F},$$

substituting the optimal transfer price (g_i^*) from equation (7)

$$\bar{\alpha} = \frac{(t_b - t_a)s + g_a\frac{t_a - t_h}{2} - g_b\frac{t_b - t_h}{2}}{F}.$$

This corresponds to equation (10).

Appendix A2 Derivation of the critical value

First, the critical value must be calculated. This is shown in Appendix A1.

$$\bar{\alpha} = \frac{(t_b - t_a)s + \eta_b(\frac{t_b t_h)}{2\beta} - \frac{t_b^2 + t_h^2}{4\beta}) + \eta_a(\frac{-t_a t_h)}{2\beta} + \frac{t_a^2 + t_h^2}{4\beta})}{F},$$

Second, one should take the derivative of the critical alpha function with respect to t_a

$$\frac{d\bar{\alpha}}{dt_a} = \frac{-s + \frac{\eta_a \cdot (-t_h)}{2\beta} + \frac{\eta_a(2t_a)}{4\beta}}{F}.$$

Rewrite the term $\frac{\eta_a(2t_a)}{4\beta}$ as $\frac{\eta_a t_a}{2\beta}$. Combining the terms in the numerator shows the final result

$$\frac{d\bar{\alpha}}{dt_a} = \frac{\frac{\eta_a(t_a - t_h)}{2\beta} - s}{F} = -B_a.$$

The same steps hold for the effect of t_b. The effect of t_b on the critical value shows the following result

$$\frac{d\bar{\alpha}}{dt_b} = \frac{s + \frac{\eta_b \cdot (t_h)}{2\beta} - \frac{\eta_b(2t_b)}{4\beta}}{F}.$$

Again, rewrite the term $\frac{\eta_b(2t_b)}{4\beta}$ as $\frac{\eta_b t_b}{2\beta}$. Combining the terms in the numerator

$$\frac{d\bar{\alpha}}{dt_b} = \frac{\frac{\eta_b(t_h - t_b)}{2\beta} + s}{F} = B_b.$$

See equation (13) and (14).

Appendix A3 Calculation total revenues

The model consists of three countries, country a, b and h. The total amount of revenues can therefore be denoted by the sum of these three countries

$R_{total} = R_a + R_b + R_h$

$$R_a = \bar{\alpha} t_a (s - \frac{t_a - t_h}{2\beta}\eta_a),$$
$$R_b = (1 - \bar{\alpha}) t_b (s - \frac{t_b - t_h}{2\beta}\eta_b),$$
$$R_h = t_h((\bar{\alpha})\frac{t_a - t_h}{2\beta} \cdot \eta_a + (1 - \bar{\alpha})\frac{t_b - t_h}{2\beta} \cdot \eta_b).$$

Substituting the individual revenue functions into the total revenue function gives

$$R_{total} = \bar{\alpha}(t_a s - \frac{t_a^2}{2\beta}\eta_a + \frac{t_a t_h}{2\beta}\eta_a) + \bar{\alpha}(\frac{t_a t_h}{2\beta}\eta_a - \frac{t_h^2}{2\beta}\eta_a) + (1-\bar{\alpha})t_b(s - \frac{t_b - t_h}{2\beta}\eta_b) + (1-\bar{\alpha})t_h\frac{t_b - t_h}{2\beta}\eta_b.$$

Combining the two $\bar{\alpha}$ terms together, followed by the combination of the $1 - \bar{\alpha}$ terms. This shows the total revenue function

$$R_{total} = \bar{\alpha}(t_a s - \frac{(t_a - t_h)^2}{2\beta} \cdot \eta_a) + (1 - \bar{\alpha})(t_b s - \frac{(t_b - t_h)^2}{2\beta} \cdot \eta_b).$$

This corresponds to equation (17).

Appendix A4.1.1 The general form of the comparative static for the developing country

To derive the comparative statics, we first calculate the FOCs for both the developed and developing country. Second, we totally differentiate the entire FOC with respect to t_a, t_b and t_h. Here, t_a and t_b are endogenous and t_h exogenous. In the optimum, the total derivation will be equal to zero. By using the Cramer's Rule, we obtain two effects $\frac{dt_a}{dt_h}$ and $\frac{dt_b}{dt_h}$. In Appendix A4.1, we calculate the tax-setting effect of the developing country $\frac{dt_a}{dt_h}$. In Appendix A4.2, the tax-setting effect of the developed country ($\frac{dt_b}{dt_h}$) will be calculated.

Now that I have given an overview of the steps, the FOCs can be calculated. The FOC for country a is denoted by H_a. In the optimum H_a should be equal to zero. This gives the following equation

$$H_a = \frac{\partial R_a}{\partial t_a}(t_a, t_b, t_h) = 0.$$

FOC country b is denoted by H_b

$$H_b = \frac{\partial R_b}{\partial t_b}(t_a, t_b, t_h) = 0.$$

Totally differentiating both FOCs gives

$$dH_a = \frac{\partial H_a}{\partial t_a}dt_a + \frac{\partial H_a}{\partial t_b}dt_b + \frac{\partial H_a}{\partial t_h}dt_h = 0,$$

$$dH_b = \frac{\partial H_b}{\partial t_a}dt_a + \frac{\partial H_b}{\partial t_b}dt_b + \frac{\partial H_b}{\partial t_h}dt_h = 0.$$

We can turn this equation into a two-by-two matrix of the second derivatives

$$\begin{pmatrix} \frac{\partial H_a}{\partial t_a} & \frac{\partial H_a}{\partial t_b} \\ \frac{\partial H_b}{\partial t_a} & \frac{\partial H_b}{\partial t_b} \end{pmatrix} \begin{pmatrix} dt_a \\ dt_b \end{pmatrix} = \begin{pmatrix} -\frac{\partial H_a}{\partial t_h} \\ -\frac{\partial H_b}{\partial t_h} \end{pmatrix} dt_h.$$

On the left side of the equation the endogenous effects are given. On the right side of the

equation one can observe the exogenous effects.

Afterwards, the effect of the GMT on the developing country's tax rate can be written as

$$\frac{dt_a}{dt_h} = \frac{\begin{vmatrix} -\frac{\partial H_a}{\partial t_h} & \frac{\partial H_a}{\partial t_b} \\ -\frac{\partial H_b}{\partial t_h} & \frac{\partial H_b}{\partial t_b} \end{vmatrix}}{\Big|H\Big|}.$$

We know that the denominator (H[9]) is positive when the tax rates are set optimally (2 FOCS). From this results, it follows that the sign of the total effect can be determined solely by the numerator

$$\frac{dt_a}{dt_h} = \begin{vmatrix} -\frac{\partial H_a}{\partial t_h} & \frac{\partial H_a}{\partial t_b} \\ -\frac{\partial H_b}{\partial t_h} & \frac{\partial H_b}{\partial t_b} \end{vmatrix}.$$

Rewriting the matrix gives the following four individual terms

$$\frac{dt_a}{dt_h} = -\frac{\partial H_a}{\partial t_h} \cdot \frac{\partial H_b}{\partial t_b} + \frac{\partial H_b}{\partial t_h} \cdot \frac{\partial H_a}{\partial t_b}.$$

This equation is given in section 5. The individual terms are explained extensively in the following paragraphs. In Appendix A4.1.6, the individual terms will be substituted into the total equation mentioned above.

Appendix A4.1.2 The first term of the comparative static for the developing country

In equation (21), the FOC of country a was calculated. This FOC will be used as the starting point

$$H_a = -t_a\left(\frac{(s - \frac{(t_a - t_h)\eta_a}{2\beta})^2}{F}\right) + \bar{\alpha}(B_a - \frac{t_a\eta_a}{2\beta})$$

Second, one can take the derivative with respect to t_h. Taking the derivative of $-t_a(\frac{(s-\frac{(t_a-t_h)\eta_a}{2\beta})^2}{F})$ with respect to t_h gives $-t_a(\frac{(\frac{s\eta_a}{\beta}+\frac{(t_h-t_a)\eta_a^2}{2\beta^2})}{F})$. Factoring out $\frac{\eta_a}{\beta}$ and rearranging this equation shows the following term $-t_a \cdot \frac{((s-g_a)\frac{\eta_a}{\beta})}{F}$. From equation (12), we obtain $\frac{d\bar{\alpha}}{dt_h} = \frac{g_b^* - g_a^*}{F}$. Taking the derivative of $\bar{\alpha}(B_a - \frac{t_a\eta_a}{2\beta})$ with respect to t_h gives $\frac{g_b - g_a}{F}(B_a - \frac{t_a\eta_a}{2\beta}) + \bar{\alpha}\frac{\eta_a}{2\beta}$. Note that we apply the chain rule here. The last term comes from the derivative of B_a.

[9] According to the general form of the Cramer Rule, H can be calculated by $a_1 \cdot b_2 - a_2 \cdot b_1$

Thus, the first term of the equation in A4.1.1 can be written as follows

$$\frac{\partial H_a}{\partial t_h} = -t_a \cdot \frac{((s-g_a)\frac{\eta_a}{\beta})}{F} + \frac{g_b - g_a}{F}(B_a - \frac{t_a \eta_a}{2\beta}) + \bar{\alpha}\frac{\eta_a}{2\beta},$$

or equivalently

$$\frac{\partial H_a}{\partial t_h} = -t_a \cdot \frac{(B_a\frac{\eta_a}{\beta})}{F} + \frac{g_b - g_a}{F}(B_a - \frac{t_a \eta_a}{2\beta}) + \bar{\alpha}\frac{\eta_a}{2\beta}.$$

To simplify the calculations, the first and third term are taken together. These terms have a common $\frac{\eta_a}{\beta}$ fraction. This fraction is therefore factored out. Restructuring the equation gives the following terms

$$\frac{\partial H_a}{\partial t_h} = \frac{\eta_a}{\beta}(\frac{-t_a B_a}{F} + \frac{\bar{\alpha}}{2}) + \frac{(g_b - g_a)}{F}(B_a - \frac{t_a \eta_a}{2\beta}).$$

Next, we want to obtain the same denominators. In this case, the most appropriate denominator is 2F. Note that the definition of $\bar{\alpha}$ is already divided by F, see equation (10). This leads to the following equation

$$\frac{\partial H_a}{\partial t_h} = \frac{\eta_a}{\beta}(\frac{-2t_a B_a}{2F} + \frac{\bar{\alpha}}{2}) + \frac{2(g_b - g_a)}{2F}(B_a - \frac{t_a \eta_a}{2\beta}).$$

From this equation, we cannot immediately tell whether the total sign is positive or negative. We know that the fraction $\frac{(-2t_a B_a)}{2F}$ has a negative sign, because we assume that the tax base is positive. Governments do not pay rebates on losses. To obtain a positive tax base, the amount of earning profits s must be larger than the transfer price g. Note that a relatively high η_a reduces the tax base due to its profit shifting effect (higher g). In reality, η_a is limited to a certain extent to make the condition $s > g_a$ hold. Besides, the $\frac{\bar{\alpha}}{2}$ term has a positive sign. According to equation (10), a relatively high η_a leads to an increase in $\bar{\alpha}$. The total number of MNEs in country a increases with an increase in η_a. Finally, $\frac{2(g_b - g_a)}{2F}(B_a - \frac{t_a \eta_a}{2\beta})$ has a negative sign when η_a is sufficiently large. In this case, g_a is most likely larger than g_b. This corresponds to the empirical literature (Bernardo and Janský, 2022; Janeba and Schjelderup, 2022). In total, there is no clear positive or negative effect. Therefore, the formula must be rewritten. First, we simplify the term $\frac{\eta_a}{\beta}(\frac{-2t_a B_a}{2F} + \frac{\bar{\alpha}}{2})$. Second, the term $\frac{2(g_b - g_a)}{2F}(B_a - \frac{t_a \eta_a}{2\beta})$ will be simplified. When both terms are simplified, we put the terms together and derive the results. Note that the institutional quality parameter for the developed country (η_b) equals 1.

Substituting the definitions of $\bar{\alpha}$, g, η_b and B_a into the following combination $\frac{\eta_a}{\beta}(\frac{-2t_a B_a}{2F} + \frac{\bar{\alpha}}{2})$ shows the following result

$$\frac{\eta_a}{\beta}(\frac{-2t_as + 2t_a\frac{t_a-t_h}{2\beta}\eta_a - t_as + t_bs + \eta_a(\frac{-t_at_h}{2\beta} + \frac{t_a^2+t_h^2}{4\beta}) + (\frac{t_bt_h}{2\beta} - \frac{t_b^2+t_h^2}{4\beta})}{2F}).$$

Take the t_as terms together and separate the variables in the first bracket (numerator)

$$\frac{\eta_a}{\beta}(\frac{-3t_as + \frac{2t_a^2}{2\beta}\eta_a - \frac{2t_at_h}{2\beta}\eta_a + t_bs - \frac{t_at_h}{2\beta}\eta_a + \frac{t_a^2}{4\beta}\eta_a + \frac{t_h^2}{4\beta}\eta_a + (\frac{t_bt_h}{2\beta} - \frac{t_b^2+t_h^2}{4\beta})}{2F}).$$

The term $\frac{2t_a^2}{2\beta}\eta_a$ can be rewritten as $\frac{4t_a^2}{4\beta}\eta_a$. This allows us to combine this term with $\frac{t_a^2}{4\beta}\eta_a$ and $\frac{t_h^2}{4\beta}\eta_a$. This shows the following result

$$\frac{\eta_a}{\beta}(\frac{-3t_as + t_bs + \frac{5t_a^2+t_h^2}{4\beta}\eta_a - \frac{3t_at_h}{2\beta}\eta_a + \frac{t_bt_h}{2\beta} - \frac{t_b^2+t_h^2}{4\beta}}{2F}).$$

Finally, the term $\frac{5t_a^2+t_h^2}{4\beta}\eta_a - \frac{3t_at_h}{2\beta}\eta_a$ can be written as $[\frac{t_a^2-t_at_h}{\beta} + \frac{1}{4\beta}(t_a - t_h)^2]\eta_a$.

$$\frac{\eta_a}{\beta}(\frac{-3t_as + t_bs + [\frac{t_a^2-t_at_h}{\beta} + \frac{1}{4\beta}(t_a - t_h)^2]\eta_a + \frac{t_bt_h}{2\beta} - \frac{t_b^2+t_h^2}{4\beta}}{2F}).$$

This is the final result of step 1 and will be used later to calculate the total (first) effect (outcome A4.1.2).

We continue with step 2, simplifying the term $\frac{2(g_b-g_a)}{2F}(B_a - \frac{t_a\eta_a}{2\beta})$. This term can be written as

$$\frac{2(g_b - g_a)}{2F}(s - \frac{t_a - t_h}{2\beta} - \frac{t_a\eta_a}{2\beta}),$$

or equivalently

$$(\frac{2(g_b - g_a)}{2F})(s - \frac{t_a\eta_a}{\beta} + \frac{t_h\eta_a}{2\beta}).$$

Substituting the definition of g_a, g_b and multiplying the two terms gives

$$s(\frac{\frac{t_b-t_h}{\beta}\eta_b - \frac{t_a-t_h}{\beta}\eta_a}{2F}) + \frac{\eta_a}{\beta}(\frac{-t_a(\frac{t_b-t_h}{\beta}\eta_b - \frac{t_a-t_h}{\beta}\eta_a)}{2F} + \frac{\eta_a}{\beta}(\frac{\frac{t_h}{2}(\frac{t_b-t_h}{\beta}\eta_b - \frac{t_a-t_h}{\beta}\eta_a)}{2F}.$$

The first term comes from the multiplication $(\frac{2(g_b-g_a)}{2F})s$. The last two terms come from the multiplication $(\frac{2(g_b-g_a)}{2F})(-\frac{t_a\eta_a}{\beta} + \frac{t_h\eta_a}{2\beta})$. We observe that only the first term depends on s, the second and third term are not affected by s. On the other hand, the second and

third term depend on $\frac{\eta_a}{\beta}$. This fraction was also used in step 1. This allows us to combine the result of step 1 and step 2. This gives an extensive formula. So keep in mind that every term is multiplied by $\frac{\eta_a}{\beta}$ except the term $s(\frac{\frac{t_b-t_h}{\beta}\eta_b-\frac{t_a-t_h}{\beta}\eta_a}{2F})$.

Combining the two steps gives

$$\frac{\partial H_a}{\partial t_h} = \frac{\eta_a}{\beta}[\frac{(-3t_a s + t_b s + [\frac{t_a^2-t_a t_h}{\beta} + \frac{1}{4\beta}(t_a-t_h)^2]\eta_a + \frac{t_b t_h}{2\beta} - (\frac{t_b^2+t_h^2}{4\beta})}{2F}$$
$$\frac{-t_a(\frac{t_b-t_h}{\beta} - \frac{t_a-t_h}{\beta}\eta_a) + \frac{t_h}{2}(\frac{t_b-t_h}{\beta} - \frac{t_a-t_h}{\beta}\eta_a)}{2F}] + s(\frac{\frac{t_b-t_h}{\beta} - \frac{t_a-t_h}{\beta}\eta_a}{2F}).$$

Note that the first line corresponds to the result of step 1. The second term corresponds to the part of step 2 that is multiplied by $\frac{\eta_a}{\beta}$. Finally, the third term corresponds to the part of step 2 that is multiplied by s and is independent of $\frac{\eta_a}{\beta}$.

Then, η_a is factored out

$$\frac{\partial H_a}{\partial t_h} = \frac{\eta_a}{\beta}[\frac{(\eta_a)(\frac{-3t_a s+t_b s}{\eta_a} + [\frac{t_a^2-t_a t_h}{\beta} + \frac{1}{4\beta}(t_a-t_h)^2] + \frac{t_b t_h}{2\beta\eta_a} - (\frac{t_b^2+t_h^2}{4\beta\eta_a}))}{2F}$$
$$\frac{(\eta_a)(-t_a(\frac{t_b-t_h}{\beta\eta_a} - \frac{t_a-t_h}{\beta})) + \frac{t_h}{2}(\frac{t_b-t_h}{\beta\eta_a} - \frac{t_a-t_h}{\beta})}{2F}] + s\eta_a(\frac{\frac{t_b-t_h}{\beta\eta_a} - \frac{t_a-t_h}{\beta}}{2F}).$$

To clarify the sign we take η_a to infinity. Keep in mind that η_a is limited because $s > g$. When η_a is in the denominator, that specific fraction will cancel out. The following terms are not cancelled out

$$\frac{\partial H_a}{\partial t_h} = \frac{\eta_a}{\beta}[\frac{(\eta_a)([\frac{t_a^2-t_a t_h}{\beta} + \frac{1}{4\beta}(t_a-t_h)^2]}{2F} + \frac{(\eta_a)(-t_a(-\frac{t_a-t_h}{\beta})) + \frac{t_h}{2}(-\frac{t_a-t_h}{\beta})}{2F}] + s\eta_a(\frac{-\frac{t_a-t_h}{\beta}}{2F}).$$

From this equation, it follows that $[\frac{t_a^2-t_a t_h}{\beta} + \frac{1}{4\beta}(t_a-t_h)^2]$ and $-t_a(-\frac{t_a-t_h}{\beta})$ are positive when η_a goes to infinity. The term $[\frac{t_a^2-t_a t_h}{\beta} + \frac{1}{4\beta}(t_a-t_h)^2]\eta_a$ has a positive sign because t_a is by definition larger than t_h. On the other hand, $\frac{t_h}{2}(-\frac{t_a-t_h}{\beta})$ and $s\eta_a(-\frac{t_a-t_h}{\beta})$ are negative when η_a goes to infinity. Furthermore, the term $t_a(\frac{t_a-t_h}{\beta})$ must be larger than $\frac{t_h}{2}(-\frac{t_a-t_h}{\beta})$. Again, this can be derived from the condition $t_a > t_h$. However, it remains uncertain whether the total positive effects are bigger than the total negative effects. When s also goes to infinity, the negative effects will outweigh the positive effects. Note that only the last fraction depends on s. In short, these insights are still not sufficient to determine the sign.

To get better insights, I take s to infinity. Again, the standard equation has been used as the starting point

$$\frac{\partial H_a}{\partial t_h} = \frac{\eta_a}{\beta}[\frac{(-3t_a s + t_b s + [\frac{t_a^2 - t_a t_h}{\beta} + \frac{1}{4\beta}(t_a - t_h)^2]\eta_a + \frac{t_b t_h}{2\beta} - (\frac{t_b^2 + t_h^2}{4\beta})}{2F}$$
$$\frac{-t_a(\frac{t_b - t_h}{\beta} - \frac{t_a - t_h}{\beta}\eta_a) + \frac{t_h}{2}(\frac{t_b - t_h}{\beta} - \frac{t_a - t_h}{\beta}\eta_a)}{2F}] + s(\frac{\frac{t_b - t_h}{\beta} - \frac{t_a - t_h}{\beta}\eta_a}{2F}).$$

Factoring out s gives

$$\frac{\partial H_a}{\partial t_h} = \frac{\eta_a}{\beta}[\frac{s(-3t_a + t_b + [\frac{t_a^2 - t_a t_h}{s\beta} + \frac{1}{s4\beta}(t_a - t_h)^2]\eta_a + \frac{t_b t_h}{s2\beta} - (\frac{t_b^2 + t_h^2}{s4\beta}))}{2F}$$
$$\frac{s(-t_a(\frac{t_b - t_h}{s\beta} - \frac{t_a - t_h}{s\beta}\eta_a) + \frac{t_h}{2}(\frac{t_b - t_h}{s\beta} - \frac{t_a - t_h}{s\beta}\eta_a))}{2F}] + s(\frac{\frac{t_b - t_h}{\beta} - \frac{t_a - t_h}{\beta}\eta_a}{2F}).$$

To clarify the sign we take s to infinity. When s is in the denominator, that specific fraction will cancel out. The following terms remain

$$\frac{\partial H_a}{\partial t_h} = \frac{\eta_a}{\beta}[\frac{s(-3t_a + t_b)}{2F} + s(\frac{\frac{t_b - t_h}{\beta} - \frac{t_a - t_h}{\beta}\eta_a}{2F})$$

From this equation, it follows that $-3t_a + t_b$ and $s(\frac{\frac{t_b - t_h}{\beta} - \frac{t_a - t_h}{\beta}\eta_a}{2F})$ are negative when s goes to infinity. I assume that t_a is not 3 times smaller than t_b. In section 5, we explained that the developing country (a) provides a lower tax rate due to the difference in the tax base and profit shifting effect. In reality, these low tax-setting policies are taking place (Goodspeed, 2006; Dietsch and Rixen, 2014). However, we do not observe extremely large differences in tax rates. This assumption is therefore plausible. Furthermore, I assume that $g_b < g_a$. This also means that η_a should compensate for the lower tax rate in the developing country, otherwise this condition ($g_b < g_a$) would not hold. This is also a very plausible assumption because we experience more profit shifting in developing countries compared to developed countries (Bernardo and Janský, 2022).

This simplified version of the equation gives important insights. It turns out that when sales revenues (s) are sufficiently large, the outcome tends to be negative. The negative terms become more dominant than the positive terms because the negative terms are dependent on the level of sales revenues. These terms push the outcome towards strategic substituting tax rates. This result only holds when $g_b < g_a$. When η_a is relatively low

(still higher than η_b) and s is still relatively high, we find ambiguous effects. The term $s(\frac{\frac{t_b-t_h}{\beta}-\frac{t_a-t_h}{\beta}\eta_a}{2F})$ might become positive, because g_b might become larger than g_a. Keeping in mind that the developing country (a) has a lower tax rate compared to the developed country (b), a lower η_a would mean that the developed country becomes more attractive for profit shifting. This means that the terms, that are dependent on g (mentioned above), switch in sign (becomes positive or negative). In this scenario, there is no clear direction toward a positive or negative sign. This means that the outcome of the first term is ambiguous when $g_b > g_a$.

In short, the first term tends to be negative when s is sufficiently large and η_a is relatively high ($g_a > g_b$). When this condition fails, I find ambiguous effects. The profit shifting effect and location effect changes. The outcome of the comparative static depends strongly on these conditions and effects.

Appendix A4.1.3 The second term of the comparative static for the developing country

The FOC of country b can be written as

$$H_b = -t_b(\frac{(s-\frac{(t_b-t_h)\eta_b}{2\beta})^2}{F}) + (1-\bar{\alpha})(B_b - \frac{t_b\eta_b}{2\beta}).$$

By taking the derivative of $-t_b(\frac{(s-\frac{(t_b-t_h)\eta_b}{2\beta})^2}{F})$ with respect to t_b and applying the chain rule, we obtain $-\frac{B_b^2}{F} - t_b(\frac{-B_b\cdot\frac{\eta_b}{\beta}}{F})$. From equation (14), we obtain $\frac{d\bar{\alpha}}{dt_b} = \frac{B_b}{F}$. The derivative of $(1-\bar{\alpha})(B_b - \frac{t_b\eta_b}{2\beta})$ with respect to t_b gives $-\frac{B_b}{F}(B_b - \frac{t_b\eta_b}{2\beta}) + (1-\bar{\alpha})\frac{-\eta_b}{2\beta}$.

Thus, the second term can be written as follows

$$\frac{\partial H_b}{\partial t_b} = -\frac{B_b^2}{F} - t_b(\frac{-B_b\cdot\frac{\eta_b}{\beta}}{F}) - \frac{B_b}{F}(B_b - \frac{t_b\eta_b}{2\beta}) + (1-\bar{\alpha})\frac{-\eta_b}{2\beta}.$$

Note that the tax base is by assumption positive, the sales revenues s are therefore larger than g. The first, third and fourth term of this specific equation are therefore negative. Only the second term has a positive sign. In this case, the magnitude of the second term is lower than the magnitude of the remaining terms because the main diagonal of the matrix is negative. This also means that the total effect must be negative. Note that η_a is only influencing the $\bar{\alpha}$ in the last term. A higher η_a leads to a higher $\bar{\alpha}$, and thus reducing the negative effect for country b. Moreover, an increase in s influences all the tax base and $\bar{\alpha}$ terms. In short, this term shows a negative effect.

Appendix A4.1.4 The third term of the comparative static for the developing country

The FOC of country b is used as the starting point

$$H_b = -t_b(\frac{(s - \frac{(t_b - t_h)\eta_b}{2\beta})^2}{F}) + (1 - \bar{\alpha})(B_b - \frac{t_b\eta_b}{2\beta}).$$

Second, one can take the derivative with respect to t_h. Taking the derivative of $-t_b(\frac{(s-\frac{(t_b-t_h)\eta_b}{2\beta})^2}{F})$ with respect to t_h gives $-t_b(\frac{(\frac{s\eta_b}{\beta}+\frac{(t_h-t_b)\eta_b^2}{2\beta^2})}{F})$. Rearranging this equation gives $-t_b \cdot \frac{((s-g_b)\frac{\eta_b}{\beta})}{F}$. From equation (12), we know that $\frac{d\bar{\alpha}}{dt_h} = \frac{g_b^* - g_a^*}{F}$. Taking the derivative of $\bar{\alpha}(B_b - \frac{t_b\eta_b}{2\beta})$ with respect to t_h gives $\frac{g_b - g_a}{F}(B_b - \frac{t_b\eta_b}{2\beta}) + (1 - \bar{\alpha})\frac{\eta_b}{2\beta}$. Note that we apply the chain rule here. The last term comes from the derivative of B_b.

Combining all these terms gives the third term of the main equation

$$\frac{\partial H_b}{\partial t_h} = -t_b \cdot \frac{(B_b\frac{\eta_b}{\beta})}{F} + \frac{g_a - g_b}{F}(B_b - \frac{t_b\eta_b}{2\beta}) + (1 - \bar{\alpha})\frac{\eta_b}{2\beta}.$$

This term is very similar to the first term of the main equation, however, now we determine the effect of t_h on H_b. Also in this case we substitute the relevant definitions of $\bar{\alpha}$, g, η_b and B_b to determine the total sign. The formula can be written as follows

$$\frac{\partial H_b}{\partial t_h} = \frac{1}{\beta}[\frac{(-3t_b s + t_a s + [\frac{t_b^2 - t_b t_h}{\beta} + \frac{1}{4\beta}(t_b - t_h)^2] + 1 + \frac{t_a t_h}{2\beta}\eta_a - (\frac{t_a^2 + t_h^2}{4\beta}\eta_a)}{2F}$$
$$\frac{-t_b(\frac{t_b - t_h}{\beta} - \frac{t_a - t_h}{\beta}\eta_a) + \frac{t_h}{2}(\frac{t_b - t_h}{\beta} - \frac{t_a - t_h}{\beta}\eta_a)}{2F}] + s(\frac{\frac{t_b - t_h}{\beta} - \frac{t_a - t_h}{\beta}\eta_a)}{2F})$$

Then, η_a is factored out

$$\frac{\partial H_a}{\partial t_h} = \frac{1}{\beta}[\frac{(\eta_a)(\frac{-3t_b s + t_a s}{\eta_a} + [\frac{t_b^2 - t_b t_h}{\eta_a\beta} + \frac{1}{4\eta_a\beta}(t_b - t_h)^2] + \frac{1}{\eta_a} + \frac{t_a t_h}{2\beta} - (\frac{t_a^2 + t_h^2}{4\beta}))}{2F}$$
$$\frac{(\eta_a)(-t_b(\frac{t_b - t_h}{\beta\eta_a} - \frac{t_a - t_h}{\beta})) + \frac{t_h}{2}(\frac{t_b - t_h}{\beta\eta_a} - \frac{t_a - t_h}{\beta})}{2F}] + s\eta_a(\frac{\frac{t_b - t_h}{\beta\eta_a} - \frac{t_a - t_h}{\beta}}{2F}).$$

To clarify the sign we take η_a to infinity. When η_a is in the denominator, that specific fraction will cancel out.

$$\frac{\partial H_a}{\partial t_h} = \frac{1}{\beta}[\frac{(\eta_a)(\frac{t_a t_h}{2\beta} - (\frac{t_a^2 + t_h^2}{4\beta}) - t_b(-\frac{t_a - t_h}{\beta}) + \frac{t_h}{2}(-\frac{t_a - t_h}{\beta}))}{2F}] + s\eta_a(\frac{-\frac{t_a - t_h}{\beta}}{2F}).$$

From this equation, it follows that $-t_b(-\frac{t_a-t_h}{\beta})$ is positive when η_a goes to infinity. The term $\frac{t_a t_h}{2\beta} - (\frac{t_a^2+t_h^2}{4\beta})$ might be positive or negative depending on the values for t_a and t_h. On the other hand, $\frac{t_h}{2}(-\frac{t_a-t_h}{\beta})$ and $s\eta_a(-\frac{t_a-t_h}{\beta})$ are negative when η_a goes to infinity. It is uncertain whether the total positive effects are bigger than the total negative effects. When s also goes to infinity, the negative effects will outweigh the positive effects. Note that only the last fraction depends on s. These insights are still not sufficient to determine the sign.

To get better insights, I take s to infinity

$$\frac{\partial H_b}{\partial t_h} = \frac{1}{\beta}[\frac{(-3t_b s + t_a s + [\frac{t_b^2 - t_b t_h}{\beta} + \frac{1}{4\beta}(t_b - t_h)^2] + 1 + \frac{t_a t_h}{2\beta}\eta_a - (\frac{t_a^2+t_h^2}{4\beta}\eta_a)}{2F}$$
$$\frac{-t_b(\frac{t_b-t_h}{\beta} - \frac{t_a-t_h}{\beta}\eta_a) + \frac{t_h}{2}(\frac{t_b-t_h}{\beta} - \frac{t_a-t_h}{\beta}\eta_a)}{2F}] + s(\frac{\frac{t_b-t_h}{\beta} - \frac{t_a-t_h}{\beta}\eta_a)}{2F})$$

Factoring out s gives

$$\frac{\partial H_b}{\partial t_h} = \frac{1}{\beta}[\frac{s(-3t_b + t_a + [\frac{t_b^2 - t_b t_h}{s\beta} + \frac{1}{s4\beta}(t_b - t_h)^2] + \frac{1}{s} + \frac{t_a t_h}{s2\beta} - (\frac{t_a^2+t_h^2}{s4\beta}\eta_a)}{2F}$$
$$\frac{s(-t_b(\frac{t_b-t_h}{s\beta} - \frac{t_a-t_h}{s\beta}\eta_a) + \frac{t_h}{2}(\frac{t_b-t_h}{s\beta} - \frac{t_a-t_h}{s\beta}\eta_a))}{2F}] + s(\frac{\frac{t_b-t_h}{\beta} - \frac{t_a-t_h}{\beta}\eta_a}{2F}).$$

To clarify the sign we take s to infinity. When s is in the denominator, that specific fraction will cancel out.

$$\frac{\partial H_b}{\partial t_h} = \frac{1}{\beta}[\frac{s(-3t_b + t_a)}{2F} + s(\frac{\frac{t_b-t_h}{\beta} - \frac{t_a-t_h}{\beta}\eta_a}{2F}).$$

From this equation, it follows that $-3t_b + t_a$ and $s(\frac{\frac{t_b-t_h}{\beta} - \frac{t_a-t_h}{\beta}\eta_a}{2F})$ are negative when s goes to infinity. I assume that t_b is not 3 times smaller than t_a. In section 5, we explained that the developing country (a) provides a lower tax rate due to the difference in tax base and profit shifting effect. This means that this condition holds. Furthermore, I assume that $g_b < g_a$ meaning that η_a should compensate for the lower tax rate in the developing country. Again, this is also a very plausible assumption because we experience more profit shifting in developing countries compared to developed countries.

The explanations and conditions of the terms are similar to Appendix A4.1.2. It turns out that when the sales revenues (s) are sufficiently large, the outcome tends to be negative. If η_a is relatively low (still higher than η_b) and s is still relatively high, we find ambiguous effects. The term $s(\frac{\frac{t_b-t_h}{\beta}-\frac{t_a-t_h}{\beta}\eta_a}{2F})$ might become positive. Keeping in mind that the developing country (a) has a lower tax rate compared to the developed country (b), a lower η_a would mean that the developed country becomes more attractive for profit shifting. This means that the terms, that are dependent on g (mentioned above), switch in sign (becomes positive). In this scenario, there is no clear direction toward a positive or negative sign. This means that the outcome of the first term is ambiguous when $g_b > g_a$.

Appendix A4.1.5 The fourth term of the comparative static for the developing country

The FOC of country a can be written as

$$H_a = -t_a(\frac{(s-\frac{(t_a-t_h)\eta_a}{2\beta})^2}{F}) + \bar{\alpha}(B_a - \frac{t_a\eta_a}{2\beta})$$

t_b only pops up in the $\bar{\alpha}$ term. From equation (14), we obtain $\frac{d\bar{\alpha}}{dt_b} = \frac{B_b}{F}$. This will be used in the following derivative.

Given these insights, the last term can be denoted by the following equation

$$\frac{\partial H_a}{\partial t_b} = \frac{B_b}{F}(B_a - \frac{t_a\eta_a}{2\beta}).$$

The profit shifting effect $\frac{t_a\eta_a}{2\beta}$ is reducing the tax base of country a, however, the tax base will not become negative. There is a constraint in the tax base. I argue that the maximum reduction in tax base is maximised by the tax base itself because effectively governments do not pay rebates on losses. This means that the tax base remains positive after profit shifting. This leads to a positive effect between the brackets. When s is sufficiently large, it shows a positive total effect.

Appendix A4.1.6 The results of the comparative static for the developing country

Within the individual equations, we still observe contradicting effects. The results show that, when s is sufficiently large and $g_a > g_b$, the terms $\frac{\partial H_a}{\partial t_h}$ and $\frac{\partial H_b}{\partial t_h}$ tends to be negative. Given that these conditions hold, the total strategic effect should therefore become negative. The first (Appendix A4.1.2), second (Appendix A4.1.3) and third term (Appendix A4.1.4) are negative and the last term (Appendix A4.1.5) is positive. According to the equation mentioned in Appendix A4.1.1, this means that the tax rate of the developing

country is a strategic substitute. When the profit shifting conditions fail, we find ambiguous effects. In short, the outcome of the comparative static depends strongly on these conditions. The results of Appendix A4.1.6 will be used in the calculations of the indirect effect.

Franzese and Hayes (2009) and many other researchers argue that the developing and developed tax rates are most likely strategic complements. These researchers do not always rely on heterogeneity and therefore differ in the strategic tax-setting effect. Note that these researchers have made several assumptions that are not applicable in this setting. The results of these papers would mean that $\frac{dt_a}{dt_h} > 0$ and $\frac{dt_b}{dt_h} > 0$. Most of the tax competition literature imposes that tax rates are strategic complements (de Mooij and Vrijburg, 2016). However, Hebous and Keen (2022) also argue that strategic complementing tax rates are in the literature not theoretically assured. Leibrecht and Hochgatterer (2012) find that effective tax rates on capital income are strategic substitutes. Furthermore, Chirinko and Wilson (2011) show strategic substituting tax rates between US States. So there remains a possibility of strategic substituting tax rates. My model only finds clear (strategic substituting) results when s is sufficiently large and η_a compensates for the lower t_a. This result is in line with the result of Janeba and Schjelderup (2022). Thus, the institutional quality in developing countries should be relatively low (high η_a) compared to the institutional quality of the developed country. This is a realistic scenario. In reality, we observe that the institutional quality affects both the amount of profit shifting and the location decision effect. So there remains a possibility of strategic substituting tax rates.

Appendix A4.2.1 The general form of the comparative static for the developed country

Now that I have determined the sign for the developing country. I will determine the tax-setting effect for the developed country. This effect is calculated by using the following equation

$$\frac{dt_b}{dt_h} = \frac{\begin{vmatrix} \frac{\partial H_a}{\partial t_a} & -\frac{\partial H_a}{\partial t_h} \\ \frac{\partial H_b}{\partial t_a} & -\frac{\partial H_b}{\partial t_h} \end{vmatrix}}{\Big|H\Big|}.$$

We know that the denominator (H) is positive when the tax rates are set optimally. The sign of the total effect can be determined solely by the numerator.

$$\frac{dt_b}{dt_h} = \begin{vmatrix} \frac{\partial H_a}{\partial t_a} & -\frac{\partial H_a}{\partial t_h} \\ \frac{\partial H_b}{\partial t_a} & -\frac{\partial H_b}{\partial t_h} \end{vmatrix}.$$

Rewriting the matrix gives the following four individual terms

$$\frac{dt_b}{dt_h} = \frac{\partial H_a}{\partial t_a} \cdot -\frac{\partial H_b}{\partial t_h} + \frac{\partial H_b}{\partial t_a} \cdot \frac{\partial H_a}{\partial t_h}.$$

The second and fourth term are similar to the previous calculations. The second term corresponds to Appendix A4.1.4 and the fourth term corresponds to Appendix A4.1.2. These calculations tend to be negative when s and η_a are sufficiently large ($g_a > g_b$). As I have discussed previously, this assumption corresponds to the empirical literature. The institutional quality is relatively low in developing countries and the sales revenues of MNEs are relatively high. This means that we only have to calculate the first and third term of this equation to derive the strategic tax-setting effect. Again, note that the institutional quality parameter $\eta_b = 1$.

Appendix A4.2.2 The first term of the comparative static for the developed country

The FOC of country a can be written as

$$H_a = -t_a(\frac{(s - \frac{(t_a - t_h)\eta_a}{2\beta})^2}{F}) + \bar{\alpha}(B_a - \frac{t_a\eta_a}{2\beta})$$

Now we can take the derivative with respect to t_a. Taking the derivative of $-t_a(\frac{(s-\frac{(t_a-t_h)\eta_a}{2\beta})^2}{F})$ with respect to t_a and using the chain rule gives us $-\frac{B_a^2}{F} - t_a(\frac{-B_a \cdot \frac{\eta_a}{\beta}}{F})$. From equation (13), we obtain $\frac{d\bar{\alpha}}{dt_b} = \frac{-B_a}{F}$. Taking the derivative of $\bar{\alpha}(B_a - \frac{t_a\eta_a}{2\beta})$ with respect to t_a gives $-\frac{B_a}{F}(B_a - \frac{t_a\eta_a}{2\beta}) + \bar{\alpha}(\frac{-\eta_a}{2\beta})$.

This shows the following term

$$\frac{\partial H_a}{\partial t_a} = -\frac{B_a^2}{F} - t_a(\frac{-B_a \cdot \frac{\eta_a}{\beta}}{F}) - \frac{B_a}{F}(B_a - \frac{t_a\eta_a}{2\beta}) + \bar{\alpha}(\frac{-\eta_a}{2\beta}).$$

The first, third and fourth term of this specific equation are negative. Only the second term has a positive sign. The magnitude of the second term is lower than the magnitude of the remaining terms, because the main diagonal of the matrix should be negative. This follows the same explanation as Appendix A4.1.3. Note that both the tax base of country a and $\bar{\alpha}$ are determined by η_a. In short, the first term of the main equation remains negative. s has a positive effect on all the tax base terms.

Appendix A4.2.3 The third term of the comparative static for the developed country

The FOC of country b

$$H_b = -t_b\left(\frac{(s - \frac{(t_b - t_h)\eta_b}{2\beta})^2}{F}\right) + (1 - \bar{\alpha})(B_b - \frac{t_b\eta_b}{2\beta}).$$

t_a only pops up in the $\bar{\alpha}$ term. From equation (13), we obtain $\frac{d\bar{\alpha}}{dt_a} = \frac{-B_a}{F}$. This will be used in the following derivative.

The third term can be written as follows

$$\frac{\partial H_b}{\partial t_a} = -\frac{-B_a}{F}(B_b - \frac{t_b}{2\beta}).$$

Again, the profit shifting effect $\frac{t_b}{2\beta}$ is reducing the tax base, however, the tax base will not become negative in this model. The maximum reduction in tax base is limited by the tax base itself because effectively governments do not pay subsidies on losses. The total sign of this term is therefore positive. When s is sufficiently large, it results in a positive effect within the brackets. An increase in s also positively affects the tax base. In short, the total sign of this term remains positive.

Appendix A4.2.4 The results of the comparative static for the developed country

Concluding, the first, second and fourth term tend to be negative when s is sufficiently large and $g_b < g_a$. The third term is strictly positive. By using the main equation in Appendix A4.2.1, it turns out that the tax rates tend to be strategic substitutes.

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