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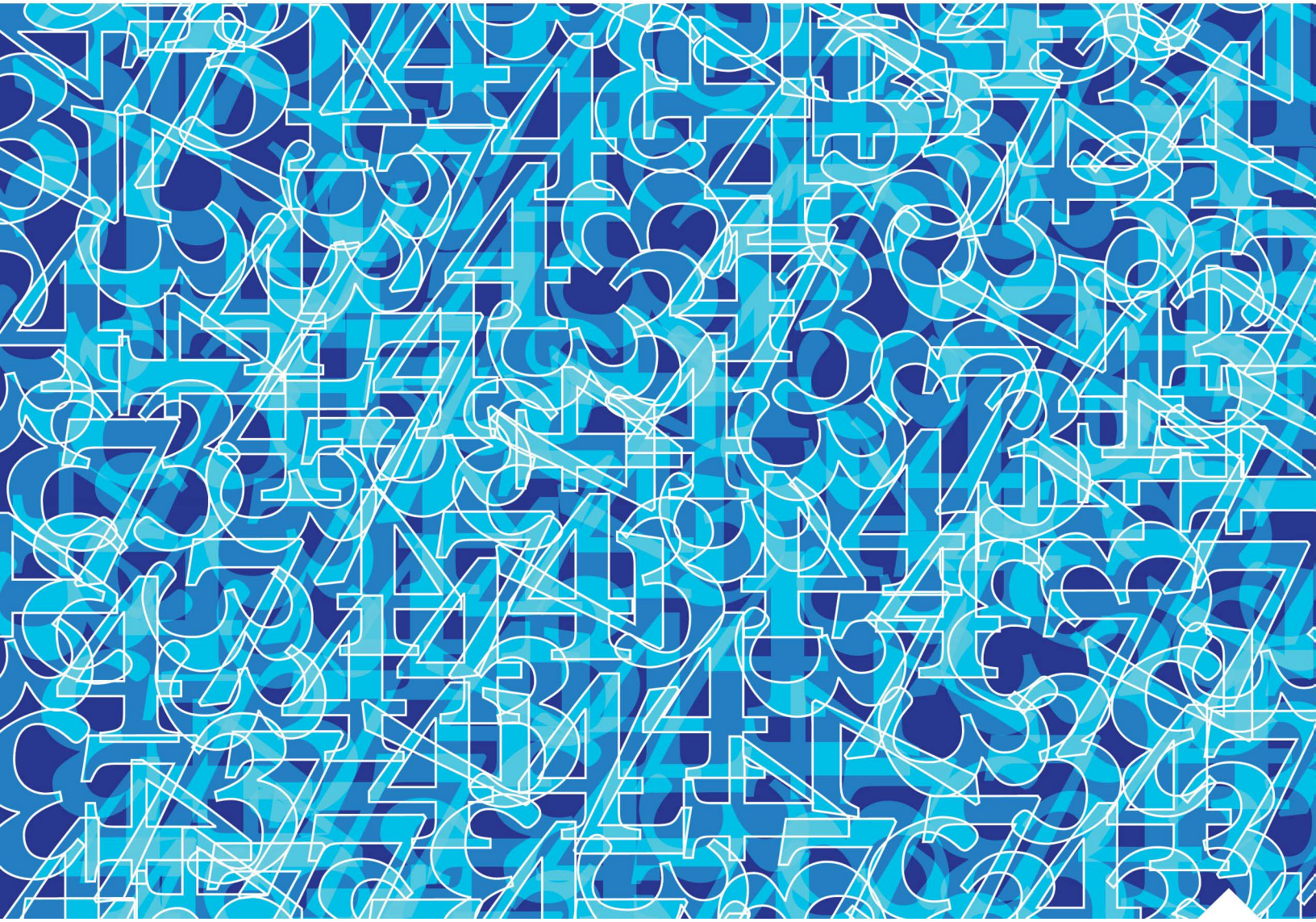

A - Potentially Positive - Welfare Assessment of the Global Minimum Tax

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Abstract

We assess the welfare implications of the Global Minimum Tax (GMT) on corporate income in a multi-country macroeconomic model. The objectives of the GMT are to mitigate harmful tax competition and to curb wasteful profit shifting. The theoretical literature suggests that the welfare effects of the GMT are ambiguous. It contributes positively to welfare by improving tax revenues and limiting profit shifting; however, it may also raise firms' capital costs, exerting a contractionary effect on the economy. Using our applied model, we combine all these effects to produce numerical welfare results, creating what we believe is the first comprehensive and quantitative welfare assessment of the GMT. We simulate the implementation of a GMT of 15 percent by all countries in our model, which are the 27 EU Member States, the US, the UK, Japan, and a tax haven. We measure the welfare change in two scenarios. In the first, additional corporate income tax (CIT) revenues are redistributed as direct transfers to households. This produces mixed welfare results across countries, while the global welfare impact is slightly positive. In the second, additional CIT revenues are redistributed back to firms as lower CIT rates, provided that the rate remains at or above the GMT rate. In most countries, the reduction in the cost of capital from a lower CIT rate more than offsets the increase caused by reduced profit shifting, stimulating economic activity. Positive welfare outcomes are widely, though not universally, experienced, leading to a modest increase in global welfare. We investigate the impact of alternative GMT rates, finding that a 16 percent GMT rate yields the highest level of global welfare.

JEL codes : D58, D60, H21, H25

Keywords: Global minimum tax, Tax coordination, Profit shifting, Model simulation

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1. Introduction

In October 2021, members of the OECD/G20 Inclusive Framework agreed to a comprehensive reform of the international corporate tax system based around two pillars. Pillar One grants taxing rights on the income of highly profitable businesses to market jurisdictions, while Pillar Two establishes a 15% minimum effective tax rate for multinational enterprises (MNEs) with consolidated global revenues exceeding EUR 750 million. While progress on Pillar One has stalled, since 2024, several jurisdictions have begun implementing the rules of Pillar Two[2], which establishes the Global Minimum Tax (GMT). The rules have been adopted by the EU Member States and over thirty other jurisdictions, including the UK and Japan.

Pillar Two requires that the net corporate profits of an in-scope MNE be subject to a minimum effective tax rate of 15% in each jurisdiction where it operates. To ensure this, a system of top-up taxes grants taxing rights to multiple jurisdictions according to a specific rule order.[3] This system gives jurisdictions substantially more taxing power over the undertaxed profits of foreign MNEs operating in their territory.

Previous research has examined the effects of the GMT reform from both empirical and theoretical perspectives. On the empirical side, an early study by the OECD (2020) estimated the impact of the GMT using aggregate country-by-country reporting (CbCR) data from 2016, which was later updated to incorporate CbCR data from 2017-2020 (Hugger et al., 2024). The study finds that the combined effects of the top-up taxes and reduced profit shifting could raise CIT revenues globally by 6.5% to 8.1%. Another empirical study by the EU Tax Observatory (Baraké et al., 2022) estimates a potential CIT revenue increase of up to 16% for EU Member States, considering only a partial implementation of the GMT[4] and without considering changes in profit shifting.

Two key theoretical papers have explored the implications of the GMT. Johannesen (2022) finds that while the welfare effects for non-tax-haven jurisdictions are ambiguous, tax havens benefit unambiguously. His study examines a long-run outcome of the GMT, in which it has been implemented by all countries. The study models a Nash equilibrium where multinational enterprises maximize profits and national governments optimize welfare. Complementary to this analysis is the approach taken by Hebous and Keen (2023), who conclude that the GMT could lead to a potential Pareto improvement, under specific conditions. These analyses are further explored in Section 2.

The studies mentioned above either apply empirical methods to produce revenue estimates or rely on highly stylized theoretical models, sometimes only with two or three jurisdictions. A recent study

[2] These rules are collectively referred to as the Global Anti-Base Erosion (Globe) rules.

[3] In line with the principle of source taxation, the first jurisdiction eligible to impose additional taxation is the one where the profits are reported, through a Qualified Domestic Top-Up Tax (QDMTT). If this jurisdiction does not levy sufficient taxes to meet the 15% minimum, the next taxing right is assigned to the jurisdiction where the MNE is headquartered, which can apply an Income Inclusion Rule (IIR) to capture the undertaxed profits. Finally, if neither the jurisdiction where profits are reported nor the MNE's headquarters jurisdiction impose sufficient taxation, all jurisdictions where the MNE operates can claim a share of the undertaxed profits through the Under-Taxed Profits Rule (UTPR). This final measure serves as a safeguard, ensuring that jurisdictions implementing Pillar Two can protect themselves against harmful tax competition from non-implementing countries.

[4] Only the IIR was implemented, without the QDMTT.

published by the European Commission (Brun et al., 2025) takes a different approach. It employs a calibrated general equilibrium model to produce quantitative long-term revenue estimates. The study combines the theoretical rigor of a general equilibrium model grounded in a solid empirical foundation, as it is calibrated to observed statistics and uses estimated elasticities from the literature. Furthermore, it explicitly models all individual EU Member States, as well as Japan, the UK, and the US, and their cross-border interaction. It also includes a generic tax haven, which provides a major profit shifting channel. Beyond corporate tax revenues, the model captures the broader economic effects of the GMT by considering its impact on the cost of capital, investment, wages, and GDP. The study estimates that implementing the GMT would result in a 7% increase in CIT revenues for EU Member States. Notably, it suggests that whether the USA opts in or out of the GMT is of second-order importance for the rest of the world. Our paper builds on this work, using the same model, CORTAX, and including an enhanced calibration of the GMT and a welfare assessment.

In this paper, we assess the welfare implications of the GMT using CORTAX, which captures the key channels through which the GMT can influence welfare, including shifts in firm and consumer behaviour. In our analysis, welfare is the utility that the representative consumer in each country derives from material consumption and leisure time. The GMT can increase welfare by increasing CIT revenues, which governments can allocate to welfare-enhancing transfers. Additionally, the reduction in profit shifting increases efficiency by decreasing the use of resources involved with tax avoidance. However, the GMT may also have adverse welfare effects, because higher effective taxation raises the cost of capital for firms, discouraging investment. CORTAX allows us to quantitatively evaluate these trade-offs.

Introducing the GMT leads to higher CIT revenues. We present results for two scenarios with alternative specifications for how to redistribute the additional revenue, what is referred to as a "fiscal model closure". In the first scenario, increased CIT revenues are redistributed to households as lump-sum transfers. For this specification, the welfare results are mixed, with some countries winning and other countries losing depending on factors such as the extent to which profit shifting is reduced, the effective change in the cost of capital and the relative importance of a country's tax base. The overall sum of monetary welfare outcomes is slightly positive. In the second scenario, we iterate over domestic CIT rates to find the new equilibrium that leaves CIT revenues constant at their initial absolute levels. That is, we offset the additional CIT revenue that would accrue from reduced profit shifting by lowering CIT rates, provided they are still above GMT. While CORTAX is not a model of endogenous tax competition, this closure allows us to account for the fact that governments' corporate tax policy is not fixed and can respond endogenously to changes in the global tax environment. This second specification yields welfare gains for nearly all countries and a global welfare gain. The outcomes of both scenarios therefore satisfy the Hicks-Kaldor compensation test, indicating a potential Pareto improvement in which the overall gain is positive, such that the winners can compensate the losers and everyone is better off. This is, to our knowledge, the first comprehensive and quantitative welfare assessment of the GMT.

Finally, we examine the optimal rate for the GMT. One of the rationales behind the GMT is that it reduces the incentives of MNEs to shift profits away from where they are produced. Our analysis demonstrates that, through multilateral cooperation, countries can attain a higher level of welfare and collect the same amount of CIT revenues while at the same time minimizing the (inefficient) costs

associated with profit shifting. Following this idea, we loop over different GMT rates to identify the level that maximizes the global welfare gain. Our results indicate that a minimum tax rate of 16% would yield the highest total welfare improvement in the scenario with the CIT rate adjustment. In the other scenario the highest total welfare is found for a minimum rate of 18%.

Our contribution, to the literature and the policy debate, is to move beyond the stylized theoretical models, with sometimes only a few jurisdictions, by using an applied model covering a host of economic channels, including real capital allocation. And at the same time, we add to the empirical work that focusses on tax revenues by including a welfare analysis, for calibrated real-world countries.

We proceed as follows. The next section discusses the ambitions of the reform and the literature with a focus on profit shifting. This is followed by the description of CORTAX and how the rules of the GMT have been implemented. The main results and the underlying mechanisms are presented in Section 5. A robustness analysis is given in Section 6. The final section concludes. In the first Annex we bridge the literature and CORTAX by presenting a small model of simultaneous capital allocation and profit shifting. The second Annex lists detailed country outcomes of the two scenarios.

2. Profit shifting and related GMT literature

Pillar Two is part of a broader G20/OECD initiative to address the challenges of the international tax system, including the large-scale tax avoidance by MNEs, which has been extensively documented (see, for example, Torslov et al., 2023). The stated objectives behind the introduction of the 15% GMT are two-fold: (i) to mitigate (harmful) tax competition among jurisdictions, preventing the race to the bottom in tax rates, and (ii) to curb (wasteful) profit shifting. The 15% minimum rate is evidently intended to establish a floor below which governments cannot lower their CIT rates. It is, in a sense, a way to constrain national governments in their ability to use the tax instrument in their competition for mobile international capital.

Profit shifting is the strategy of MNEs to lower the profits reported in high tax jurisdictions while raising them in jurisdictions with low tax rates. Multiple such strategies have been well-documented and researched (see Beer et al., 2020). One example is that the operations of an entity in a high tax country are financed with loans from an entity of the same group located in a low tax country. The interest payments reduce the taxable profits in the high tax country, while becoming taxable income in the low tax country. The same strategy can be applied to royalty payments, the remuneration for the use of intellectual property (IP), such as trademarks. When the IP-rights are located in a zero-tax haven, the tax advantage can be substantial. Another strategy is transfer pricing, when an entity in a high tax jurisdiction uses inputs from a related party in a lower tax country and the price is set artificially high.

Profit shifting is inefficient in that it distorts the optimal allocation of resources and is directly costly in its use of resources. The resources required to set up an entity in a low tax country may be a fixed cost, and independent of the amount of shifted profits. However, the risks associated with underreporting and concealment costs may increase with the amount of shifted profits. Johannesen (2022) assumes the latter in a model with profit shifting where MNEs optimize net worldwide profits given the tax rates of the countries. In turn, heterogeneous countries, including tax havens, set their tax rates to maximize national welfare given the behaviour of the MNEs. A comparison between the Nash equilibria before

and after the introduction of the GMT suggests that the net welfare effect for the non-haven countries is ambiguous. The GMT raises welfare to the extent that it reduces profit shifting and its wasteful use of resources for concealment. The reduced profit shifting also increases tax revenues, which can be spent on a valued public good. But it lowers welfare of the capital owners of non-haven countries because of the increased tax payments to the governments of tax havens. The tax havens endogenously respond to the GMT by setting their rate to exactly the GMT rate.[5] The net welfare effect depends on the elasticity of profit shifting and the weight of capital owners in the governments' welfare function. In our model we include a similar cost of profit shifting, and we find heterogeneous country results.

In a similar vein, Hebous and Keen (2023) study the effects of a GMT in a model with profit shifting by MNEs and tax competition for paper profits between a low tax and a high tax country. Their starting point is the observation that low tax countries have opposed the international tax reform, in the expectation that they would lose from the implementation of the GMT. The authors derive two different benchmarks for the minimum tax in relation to the welfare outcome for the low tax country. The first one is the Pareto-efficient minimum rate, which maximizes the welfare of the low tax country. The second one is the highest minimum rate that still yields a welfare gain for the low tax country compared to the initial uncoordinated Nash equilibrium, which they refer to as the maximal Pareto dominant rate. In parameterisations of their model, they find a range of values for this dominant rate for the GMT from 17% to 20%, whereas the corresponding efficient minimum rates are 2 to 4 percentage points lower. It is important to emphasise that while the range of optimal GMT rates is similar to that of our study, they are focusing on the welfare of the low-tax country, and no country is worse off, whereas we focus on global welfare.

Under the Hebous and Keen (2023) framework a key condition is that the high-tax country's optimal response to an increase in the low-tax country's rate is to raise its own rate. In other words, the tax rates of the two countries are viewed as strategic complements by the high-tax country. This result concerning strategic complements is also found in OECD (2020), however it is not found universally; Vrijburg and de Mooij (2016) find that countries may view each other's tax rates as strategic substitutes. In our second scenario, we loop over CIT rates to find the new equilibrium that would leave CIT revenues unchanged after the GMT (in high-tax countries not constrained by the GMT). Since profit shifting out of high-tax countries is lower after the GMT, with unchanging CIT rates tax revenues would increase; to keep tax revenues constant, countries reduce statutory CIT rates. This is not an optimal response in the sense that these new rates are not set by a government maximizing a social welfare function. Therefore, our exercise should not be regarded as evidence that the CIT rates are strategic substitutes, nor as evidence that the GMT would induce countries to reduce their domestic CIT rates, but as an exploration of the policy space that affords the increased tax efficiency from reduced profit shifting.

A notable limitation of both the Johannesen (2022) and Hebous and Keen (2023) analyses is that the 'true' profits of the MNEs are taken to be fixed. With the alternative assumption of mobile international capital seeking the highest after-tax return, and the national governments competing over this capital, the welfare analysis would have been further complicated. In contrast to these

[5] Setting a lower rate is suboptimal as, under GMT rules, other jurisdictions would have the taxing rights up to 15 percent, if the tax haven chose to apply a lower rate (see Section 3.4).

studies, Janeba and Schjelderup (2023) explicitly model the tax competition for real capital. Countries strategically set their corporate tax rates to maximise tax revenue given the behaviour of the firms, who have real activity in two non-havens and shift profits to a tax haven. The introduction of the GMT leads to reduced profit shifting and hence a higher tax base and revenues for the non-haven countries. However, a secondary effect is that, due to reduced profit shifting, the value of attracting real capital increases, which may intensify international tax rate competition. They show that the results depend on the initial level of competition.

The ambition of the OECD's global tax reform proposal is to greatly reduce tax competition. However, the analysis of Janeba and Schjelderup (2023) also points to the danger of countries introducing offsetting incentives, by compensating firms for the increased taxation by the GMT. They model competition with lumpsum subsidies and conclude that the revenue gains from reduced profit shifting will be offset by higher subsidies. Additionally, the Pillar Two rules reduce income taxable under the GMT by substance-based exclusions or carve-outs, which are meant to exempt an MNE's "real" presence in a jurisdiction, measured through its employees and tangible assets. Perry (2023) argues that these carve-outs leave the door open for countries to compete and discusses the complexity of the strategic choices for jurisdictions in this context, especially for low-income countries. In this sense, while competition in the tax rates would be limited by the GMT, the use of alternative tax instruments, such as subsidies, tax credits or other incentives could allow countries to resume the race to the bottom by modifying the definition of the tax bases. Whilst noting these results, we do not specifically address these particular issues here.

Finally, an alternative approach is taken in Hines (2024), which takes the current tax rate to be the revealed preference of each jurisdiction, given the (unknown) extent of international competition. Under thia framework, if one assumes a sufficiently large impact from international competition, a GMT of 15 percent rate could be welfare improving. However, even in that case, the framework suggests that this would be inferior to a much larger GMT rate of above 27%.

In this paper, the focus is on the welfare consequences of the GMT in a model with capital mobility and endogenous profit shifting by MNEs. Our macroeconomic model does not directly incorporate endogenous tax rate competition between jurisdictions.[6] In our implementation of the GMT, we are modelling the long-run end state, where GMT has been fully implemented, as in Johannesen (2022) and in Hebous and Keen (2023), and capital allocation has fully adjusted. As such, we assume that countries with a CIT rate below the minimum 15 percent rate will raise it to this level. This is also the strategy taken in Brun et al (2025). We build on this work, but we extend it in three dimensions. First, we differentiate the ETRs that apply to MNEs from the CIT rate that applies to domestic firms, allowing the former to be lower. The GMT shock affects only the former. Second, we produce a welfare assessment, while Brun et al (2025) focus on tax revenue effects. Finally, raising the GMT generally leads to higher revenues from higher rates, reduced profit shifting, or both. In our exercise, this additional revenue can be either transferred to households or used to reduce CIT rates such that national CIT revenues remain unchanged, provided that all CIT rates remain at or above the GMT rate.

[6] In the standard CORTAX model, CIT rates are exogenous, though in some of our simulations, we adjust the rates iteratively.

3. The CORTAX model

The CORporate TAXation model is a computable general equilibrium (CGE) model with a particular focus on corporate taxation, designed for the EU member states, the UK, the USA, and Japan as third countries. It also features a tax haven. CORTAX simulates the effects of corporate tax changes by considering the interactions between all agents in the economy, including firms, households, and national governments. The CORTAX model has been widely used to assess the impacts of corporate tax reform, on topics ranging from the Common Consolidated Corporate Tax Base (Bettendorf et al., 2010; Álvarez-Martínez et al., 2016a; European Commission, 2011, 2016) and the debt bias in corporate taxation (de Mooij and Devereux, 2011; European Commission, 2022a) to the taxation of the digital economy (European Commission, 2018) and the size of base erosion and profit shifting (Álvarez-Martínez et al., 2021). This section outlines the most relevant details of the model with further information available about the current model calibration available in Bratta et al. (2023).

There are three types of firms in each jurisdiction: domestic firms, multinational headquarters, and multinational subsidiaries. Each country has a representative domestic firm, a representative multinational headquarters (which owns a foreign subsidiary in each foreign country), and one subsidiary owned by the MNEs headquartered in each of the other (foreign) countries.

The model captures international trade in intermediate goods and (foreign direct) investment by multinationals. Multinational firms maximize their global equity value, also by engaging in international profit-shifting activities. Profit-shifting can occur between countries, modelled as transfer pricing, and into a tax haven. Profit-shifting incurs an administrative cost, which is modelled as a non-linear function increasing in the ratio of profit shifted abroad over realized profits, and convex.

In the model, governments do not play an active role that would lead to tax competition. The model does not consider governments as strategic players who might use tax rates and bases actively to undercut each other in a competitive manner. Instead, tax instruments, such as corporate tax rates, are treated as given parameters, exogenous to the model. These parameters can be adjusted to simulate different scenarios, but they do not change endogenously within the model's framework[7]. This approach abstracts from the complexities of strategic tax setting by governments, focusing instead on the effects of existing tax policies on profit-shifting behaviours by multinational firms

Households in CORTAX are represented by an overlapping generations model with young households working and old households retired. Households maximize their inter-temporal utility function, which depends on consumption and leisure, subject to their inter-temporal budget constraint. The model assumes that the net savings from young workers (wages, current transfers, and minus consumption) equal the negative value of net savings from old households, who do not work and only receive transfers. Domestic and foreign goods are considered perfect substitutes, so international trade can also satisfy domestic demand, and net exports are endogenously determined. Tax revenues comprise indirect taxes on consumption and direct taxes on corporate and labour income, dividends, capital

[7] With the exception when the tax rate is used to balance the government budget. In our second closure, we do change the corporate tax rates endogenously to leave corporate tax revenues unaffected.

gains, and interest. In this paper we apply two scenarios for closing the government budget. These are discussed separately.[8]

3.1. Profit Shifting in CORTAX

Profit-shifting between non-tax-haven countries is primarily modelled through transfer pricing. Transfer pricing involves multinationals setting a price for intra-firm transactions that deviates from what would be charged if the transactions had occurred between independent entities (the "arm's-length" price). This allows them to shift profits to low-tax jurisdictions and minimize their overall tax burden.

Transfer pricing is carried out by multinationals, which differ from domestic firms by using cross-border intermediate goods and services in their production process. The parent headquarters charges a transfer price for these intra-firm deliveries, which can be artificially adjusted to shift profits to jurisdictions with lower tax rates. This practice incurs organizational costs, modelled as a convex cost function to ensure an interior solution and reflect the increasing marginal cost of profit-shifting. The costs associated with transfer pricing are modelled with an elasticity parameter, which determines the gradient of the cost function. The incentive is to set a higher price[9] when the tax rate in the subsidiary's country is lower than in the headquarters' country, thereby shifting profits to the subsidiary. Conversely, the price is adjusted downward when the subsidiary's tax rate is higher, shifting profits to the headquarters. This manipulation of transfer prices is a key mechanism through which profit-shifting occurs, allowing multinationals to exploit differences in national tax systems to reduce their tax liabilities

In addition to transfer pricing between non-tax-haven countries, firms have the option to shift part of their tax base to a notional tax haven, which has a very low tax rate. The tax haven does not feature utility maximizing households nor real firm activity. This profit-shifting to tax havens is driven by the differential between the firm's home country corporate tax rate and the tax rate in the tax haven. The model uses an elasticity parameter to capture the responsiveness of profit-shifting to this tax differential, whose value is calibrated to match the consensus estimate in Heckemeyer and Overesch (2017)[10]. The more significant the difference between the home country's tax rate and the tax haven's rate, the greater the incentive for firms to shift profits to the tax haven to minimize their tax liabilities.

3.2. Welfare and Compensating Variation

Households' utility function is a constant elasticity of substitution (CES) combination of consumption and leisure. In our simulations, we compare the welfare impact of tax changes by calculating the compensating variation (CV), which is a measure of welfare change that represents the amount of money that would be needed to compensate households for a change in their economic environment, such that they would be indifferent between the original and new situations. For example, a negative welfare change indicates that a specific policy reform under consideration has reduced the well-being of households, and CV represents the amount of money that households would need to receive to be

[8] A more technical treatment of the full model, incl. functional specifications, individual optimization problems, details about market closures, and the empirical calibration, can be found in Álvarez-Martínez et al. (2016b).
[9] The price of the single good is used as a numeraire and is set to one. A higher price therefore exceeds one.
[10] We conduct a robustness analysis by varying the profit-shifting elasticity parameter using the lower and upper bounds of the 95% confidence interval reported in Heckemeyer and Overesch (2017) in Section 6.

exactly compensated for the loss. In the same vein, a positive welfare change indicates that the policy reform has improved the well-being of households, and the CV represents the amount of money that if subtracted from household income would exactly offset the welfare change.[11] The welfare change for the tax haven is measured as the change in its tax revenue. This is a money measure, as are the CV's of the households of the other countries, and thus can be added.

3.3. Parametrization of CORTAX and FDI Stock Data

The data for the CORTAX model calibration is sourced from various sources, including Eurostat, OECD, UN, ZEW-Mannheim, and the Bureau van Dijk Orbis database, and is processed into model inputs. Labor supply is based on employment data from AMECO and UN population statistics, with wage levels ensuring alignment with labour value added. Tax rates on labour and consumption are sourced from Eurostat for EU countries and calculated for non-EU countries. Tax compliance costs are based on European Commission (2022b), and government collection costs are estimated with OECD data. To ensure accurate CIT revenue-to-GDP ratios, a balancing factor is included. The model also covers other major taxes, using Eurostat and OECD data to calibrate tax rates for each country.[12]

Corporate income tax details, including country-specific statutory rates and tax allowances, are taken from Spengel et al. (2020), while capital shares are sourced from Eurostat and Orbis. ETRs on the corporate income of both MNE headquarters and subsidiaries are obtained from Garcia-Bernardo et al. (2023)[13] and are matched by adjusting statutory rates to reflect effective taxation after accounting for allowances and profit shifting. We deviate from this approach when the ETR reported in Garcia-Bernardo et al. (2023) exceeds the statutory rate. In such cases, we apply the statutory rate instead. For the United States, where the ETR in Garcia-Bernardo et al. (2023) is based on a single observation, we rely on Clausing, Saez, and Zucman (2021), who report an average effective corporate tax rate of 17% in 2018. We apply statutory tax rates to domestic firms.

There are two reasons to pay particular attention to the data on bilateral FDI positions. First, these data are commonly reported on an immediate origin and immediate destination basis. Therefore, redirected FDI through conduit countries leads to double counting of FDI (Van 't Riet & Lejour, 2018). Some countries may have unrealistically high incoming and outgoing FDI compared to the size of their economies. This would distort our calibration of the return to investment. Second, we need the real bilateral FDI investment to calibrate the size of the foreign subsidiaries of the MNEs.[14]

Our analysis of bilateral foreign direct investment (FDI) stocks in 2019 draws upon the IMF's Coordinated Direct Investment Survey (CDIS) data, which details the investment positions of each country pair, both as investors and recipients. For instances where the CDIS dataset lacks certain FDI values, we manually complement the data using available information on Inward FDI stocks.

[11] Since a negative CV implies a positive welfare change and viceversa, we change the sign in our tables to ease interpretation.

[12] For more information on the calibration see Bratta et al. (2023).

[13] We employ the country-specific mean of ETR2, as reported in Garcia-Bernardo et al. (2023). The definition of the effective tax rate divides the sum of paid corporate income taxes by the sum of operating profits, excluding both financial revenue and financial expenses from the denominator, in line with the definition of the corporate tax base in CORTAX.

[14] This, in turn, is relevant for the UTPR, one of the rules of the GMT, which allows top-up taxation of a share of undertaxed profits, where the share depends on participation of one MNE in the shifted profits of another MNE.

Additionally, we normalize all values to the average USD-EUR exchange rate for the year 2019 to maintain consistency.

We also implement a specific refinement to the country-by-country FDI data matrix. Concretely, we adopt the approach advocated by Damgaard et al. (2019) to separate genuine FDI from 'conduit' FDI, which is often routed through particular countries for tax or regulatory benefits rather than substantive business operations. By leveraging FDI-to-GDP ratios and a regression-based predictive model proposed by the authors, we estimate the proportion of authentic FDI within the total FDI for each recipient country. Although the majority of countries exhibit real FDI proportions near 100%, some, including Luxembourg, Malta, Cyprus, and Ireland, present notably lower real FDI shares as per our estimations. This refined perspective offers an enhancement over conventional bilateral FDI statistics, which may otherwise present a skewed view of investment flows.

3.4. Implementation of Pillar Two in CORTAX

The introduction of the global minimum tax within CORTAX is modelled based on the assumption that all countries with current MNE ETRs below the 15% threshold, including tax havens, will adjust their CIT rates to meet the new 15% minimum standard. In practice, in the Pillar Two agreement, the 15% ETR in each jurisdiction can be attained by a combination of top-up taxes, and the additional revenue generated would accrue to different jurisdictions depending on who implements the top-up tax. In our analysis we assume that the 15% minimum is attained through Qualified Domestic Minimum Top-Up Taxes (QDMTTs), such that all extra revenue accrues to the country where the profits are made. This effectively renders the Income Inclusion Rule (IIR) and the Undertaxed Profits Rule (UTPR) unnecessary, as all corporate profits globally would be subjected to at least a 15% tax rate for affected companies. Consequently, this modelling approach focuses on the changes in national tax revenues resulting from the effects on the countries' conventional CIT tax bases, including from reduced profit shifting.

In a sense, our implementing strategy is akin to modelling and "end state" or long run equilibrium of the state of the international taxation after Pillar Two. We assume that a successful implementation of the IIR and UTPR would incentivize countries, including the tax haven, with rates below 15% to either implement QDMTTs on their own or bring their domestic effective CIT rates to 15% under the OECD's Model Rules. This is because if a country does not collect the tax for itself, MNEs will still pay up to the minimum tax to other jurisdictions through either the IIR or UTPR. Hence, there is no benefit to the country in choosing not to collect the tax for itself.

In our analysis, we split EU Member States into two groups: low-tax and high-tax countries. Low-tax countries are those whose average MNE ETR lies below 15% before the introduction of the GMT. Those are Croatia, Ireland, Luxembourg, Cyprus, Estonia, Hungary, Latvia, Lithuania, Slovenia and Bulgaria. The rest of the EU Member States have MNE ETRs above 15% on average before the GMT according to our calibration, so we consider them high-tax countries. Non-EU countries (e.g. the US, the UK and Japan) are high-tax countries as well.

Low-tax countries are affected by the GMT through two mechanisms: first, the GMT constrains their MNE ETR and places it at exactly 15%. Second, the tax haven rate also increases to 15%. Consequently, profit shifting out of the EU low-tax countries stops with the introduction of the GMT. For high-tax

countries, the GMT has two indirect effects: first, on the transfer pricing incentives with low-tax trading partners, and second, on the incentives to shift part of the tax base to the tax haven. Both profit shifting incentives will be reduced, increasing the effective taxation of MNEs in high tax countries as well. This will be the case for the United States, since its MNE ETR is above 15% in our calibration. Since we model Pillar Two through an increase in the QMDTTs, the participation or lack thereof of the US in Pillar Two is not critical for our results.

Finally, as explained above, MNE ETRs are calibrated averages that apply to the "representative MNEs" in our model (one representative headquarter, and 30 representative subsidiaries per country). In reality, even if the average ETR is above 15% in a given jurisdiction, there may still be some undertaxed profits in that jurisdiction (OECD, 2024). These undertaxed MNE entities are not affected in our exercise, while they will be constrained by the GMT in reality. Accounting for this would increase the quantitative impact of the GMT shock in our model. At the same time, not all MNEs are in scope of the GMT, but only those with global net revenues above 750 million euro. We assume that our representative MNE is impacted as though it was fully in-scope. Finally, the GMT contemplates carve-outs from the GMT tax base based on firms' physical presence in a jurisdiction, which we do not model. Accounting for the 750-million-euro threshold and for carve-outs would decrease the quantitative impact of the GMT shock in our model. Since we abstract from elements that would both amplify and cushion the size of the shock, we believe our exercise is overall a good approximation.

4. Main Results and Discussion of Mechanisms

This section provides an overview of the results from our analysis. It is crucial to differentiate between two competing effects that ultimately influence total welfare. On one hand, increasing the GMT directly reduces the extent of profit shifting, reducing the associated cost and leading to higher corporate tax bases, and corresponding revenues. These increased revenues can be used for government transfers, thus stimulating consumption and enhancing welfare. On the other hand, a higher GMT rate increases the tax bill for firms, lowering after-tax income for the capital owners, which decreases welfare. Moreover, the GMT raises the cost of capital for firms diminishing the incentive for investment, leading to lower capital stocks, labour demand, and equilibrium wages, which ultimately negatively impacts household welfare.

Table 1 below provides a summary of the results by country group when governments adjust their expenditures on direct transfers to the older generation to balance the budget. The introduction of the GMT results in increased cost of capital for firms, as shown in Table 1. This increase is most pronounced for firms headquartered in EU low-tax countries such as Ireland, Cyprus, Hungary, Latvia and Bulgaria, which experience, on average, a 0.097 percentage point rise compared to the status quo. To a lesser extent, the cost of capital also rises in EU high-tax countries and those outside the EU.

The GMT leads to higher corporate income tax (CIT) revenues. For countries whose ETRs were previously below the GMT, CIT revenues increase as domestic statutory tax rates rise. Consequently, CIT revenue growth is especially notable among low-tax EU countries: this group's CIT revenue increase

by 20.58%.[15] High-tax EU countries and non-EU countries experience a CIT revenue rise of 5.64% which is exclusively driven by reduced profit outflows to tax havens as the tax differential, ergo the incentive to shift profits, shrinks.

The additional tax revenues are used to boost direct transfers to older individuals[16], thereby directly enhancing their private consumption. However, the increased cost of capital affects firms' investment decisions, ultimately affecting equilibrium wages, employment, and capital stocks. The simulation results indicate a slight economic contraction. This effect is more pronounced in low-tax EU countries, where the cost of capital has increased significantly, leading to an average reduction in GDP by about one percentage point.[17]

Importantly, for most countries, the increase in CIT revenues more than compensates disincentive effect on the cost of capital, and welfare increases with the GMT. This positive welfare result is obtained in tax havens, which experience substantial welfare gains due to increased CIT revenues, and EU low-tax countries, while welfare changes are negative, on average, for EU-high tax countries. The simulation results indicate a small, positive change in global welfare, as measured by the sum of compensating variations; however, this overall gain arises only when the welfare effect in the tax haven is included.

However, there is significant heterogeneity within the group of EU high-tax countries, as can be seen from Figure 1. In particular, a few large economies, notably France, Germany and Spain, whose effective CIT rates were substantially above 15% prior to the implementation of the GMT, experience relatively larger increases in the cost of capital. This is because, under the pre-GMT regime, these countries saw considerable profit shifting to tax havens due to large tax differentials. With the introduction of the GMT, those differentials narrow, profit shifting is curtailed, and the tax burden on MNEs in those countries increases, thereby raising the cost of capital. While CIT revenues in these countries increase due to the reduced outflow of profits, the contractionary effects of reduced investment, lower productivity, and declining wages dominate. The associated welfare losses are only partially mitigated by increased transfer payments to the older generation.

By contrast, most other EU high-tax countries, those with effective tax rates above 15% but not as high as in France or Germany, experience welfare gains. In these cases, the increase in the cost of capital is modest, and the rise in CIT revenues is sufficient to fund transfers that more than offset the negative macroeconomic effects. These outcomes align with the theoretical predictions outlined in the previous section.

[15] We omitted Luxembourg from Figure 1 to improve readability. According to our simulations, the introduction of a global minimum tax increases the effective tax rate for MNEs headquartered in Luxembourg by approximately 7.7 percentage points and would lead to a welfare gain of about 4.5% of GDP with an adjustment of the transfer payments to offset tax revenue changes.

[16] We allocate additional revenues exclusively to transfer payments for the older generation. This minimizes the behavioral responses on labor supply and savings decisions, which are made by the younger generation.

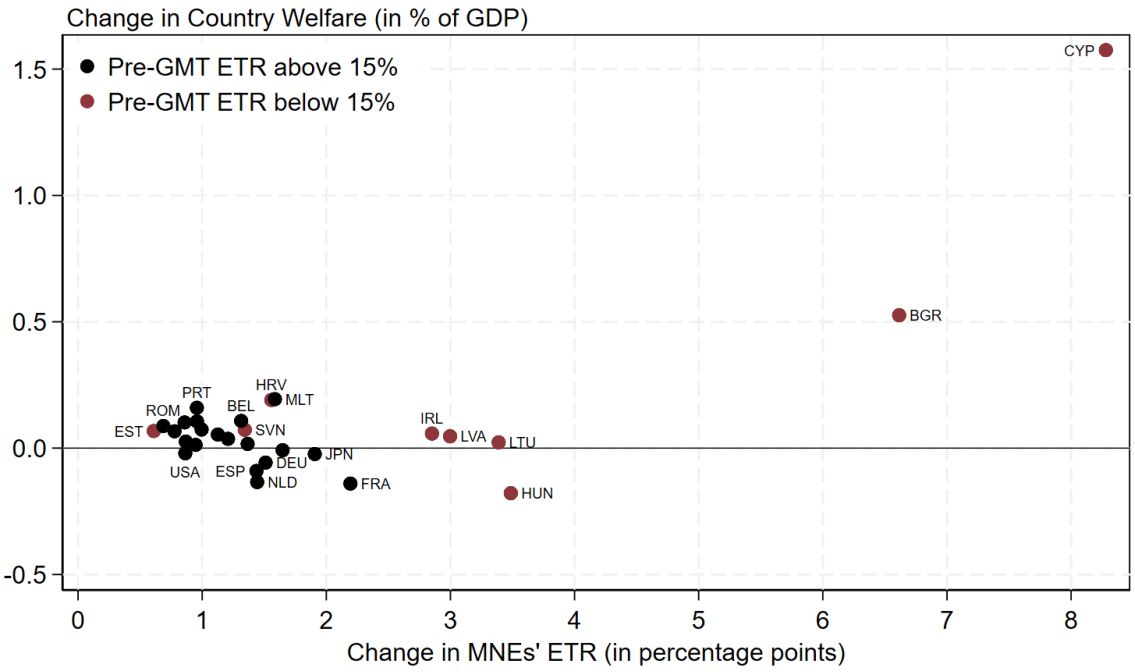
[17] It is important to note that changes in GDP and welfare do not necessarily move in the same direction. For instance, a decline in labor supply may lead, all else being equal, to lower overall production and thus a reduction in GDP. However, this can coincide with an increase in welfare, as households benefit from more leisure time.

Table 1: Results of CORTAX run, % change, and EUR for CV, GMT = 15%, transfer closure

	Cost of capital (in pp)	CIT rev	GDP	CV (in bn EUR)	CV (in % of GDP)
EU-high tax	+ 0.052	+ 5.64	- 0.22	- 4.80	- 0.04
EU-low tax	+ 0.097	+ 20.58	- 1.13	+ 2.96	+ 0.30
EU-total	+ 0.055	+ 6.68	- 0.28	- 1.84	- 0.01
Non-EU	+ 0.041	+ 5.76	- 0.15	- 1.69	- 0.01
Tax haven	NA	NA	NA	+ 7.21	NA
Total	+ 0.046	+ 6.12	- 0.20	+ 3.68	+ 0.01

Notes: The group of EU low-tax countries is formed by those countries that have effective CIT rates below 15%, i.e., Croatia, Ireland, Luxembourg, Cyprus, Estonia, Hungary, Latvia, Lithuania, Slovenia and Bulgaria. EU high-tax countries are the remaining 17 Member States of the EU. The group of non-EU countries is composed of the U.S., the U.K., and Japan. Country-group totals are weighted by GDP in the case of the cost-of-capital, the changes in CIT revenues, as well as the changes in equilibrium GDP growth. Changes in welfare relative to GDP are expressed in 2019 GDP values, reflecting the calibration of the CORTAX model.

Figure 1: Heterogeneity Analysis (Transfer adjustment closure)



Notes: The figure plots, for each country in our sample, the change in the effective tax rate (ETR) on corporate profits faced by multinational enterprises (MNEs) on the horizontal axis, and the simulated welfare change (as a percentage of GDP) on the vertical axis. The simulations adjust government budgets by adjusting the lumpsum transfer to the old generation of households.

The GDP-weighted average for the group turns out negative, because France, Germany, and Spain carry substantial weight in the group due to the size of their economies, thereby overshadowing the positive welfare effects observed in many smaller high-tax EU countries. Detailed country-level fiscal and macroeconomic outcomes can be found in Table B.1 in the Appendix.

Alternatively, if governments respond to the GMT by lowering statutory CIT rates for MNEs, while maintaining overall tax revenues at their pre-reform levels, the aggregate welfare across the 30 countries and the tax haven increases noticeably. Specifically, we model a scenario in which statutory CIT rates are adjusted downward to offset the additional revenues generated by the GMT. In countries where such adjustments are not possible under the GMT rules, the excess revenues are redistributed to households in the form of lump-sum transfers.[18] This result suggests that if countries were welfare maximizing in our model, their likely response to the GMT would be to lower CIT rates. This is a departure from some of the literature, suggesting that CIT rates may be strategic substitutes, rather than strategic complements.

Table 2 summarizes the macroeconomic impacts of adjusting the MNE ETR to maintain total CIT revenues at baseline levels, rather than increasing transfers to the older generation. Interestingly, the results reveal varying effects across different country groups. For EU high-tax countries, the CIT rate is lowered by about one percentage point on average, which more than compensates for the reduced opportunities of profits shifting, and the cost of capital ultimately decreases by 0.03 percentage points. This stimulates investment, and these countries experience a modest GDP growth of 0.05% and a welfare improvement, with an increase of €14.85 billion. In contrast, EU low-tax countries face a 0.10 percentage point increase in the cost of capital, accompanied by an 20% rise in CIT revenues, resulting from the adoption of a higher CIT rate. While these changes result in a GDP contraction of 1.4%, welfare increases by €3.04 billion, equivalent to about 0.31% of GDP, in line with the findings in Hebous and Keen (2023), who suggest that low tax countries could also gain. For the EU as a whole, there is a welfare gain of €17.89 billion.

Non-EU countries see a reduction in the cost of capital by 0.03 percentage points, stable CIT revenues, and approximately stable GDP. These countries experience an increase in wages and a small reduction in employment, leading to small net increases in both consumption and leisure. These changes lead to a welfare increase of €19.22 billion. Tax havens experience a gain of €1.94 billion, leading to a global welfare improvement of €39.04 billion.

At the country level, the welfare effects of introducing the 15% GMT vary significantly across the 30 countries in our sample, as shown in Figure 2. [19]

[18] The reduction in statutory CIT rates is applied only to MNEs, excluding domestic firms. Moreover, it is applied uniformly to all MNEs, rather than being limited to those that fall within the scope of the Global Anti-Base Erosion (GloBE) rules, i.e. MNEs with consolidated revenues exceeding EUR 750 million. As a result, our simulation does not distinguish between in-scope and out-of-scope MNEs.

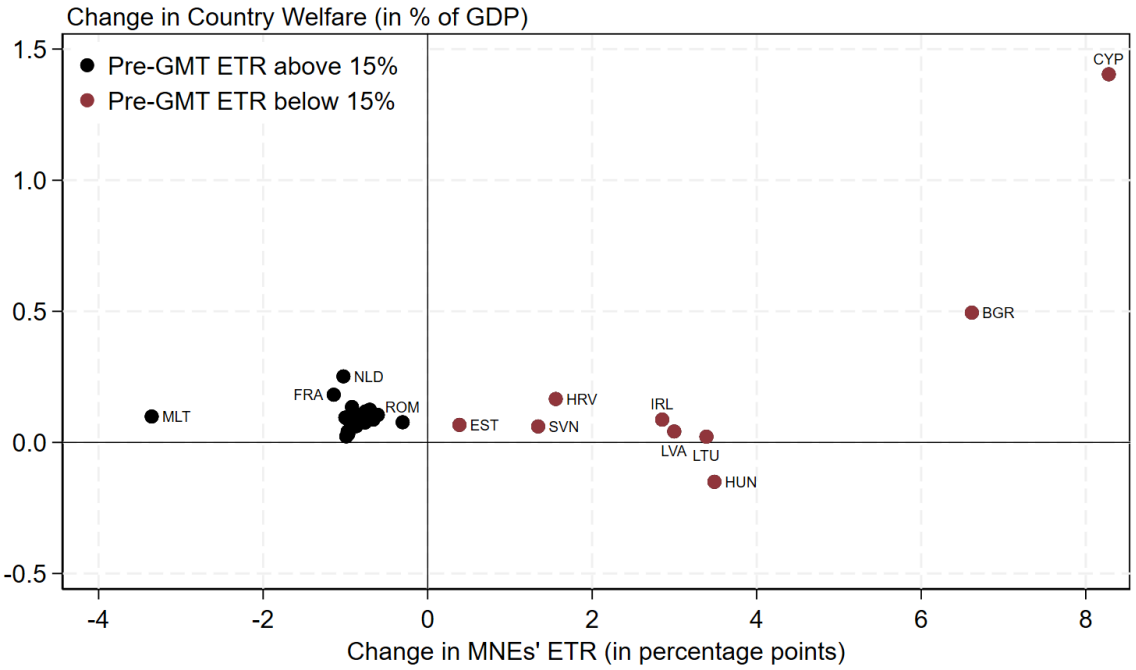
[19] As before, we omitted Luxembourg from Figure 2 to improve readability. According to our simulations, the introduction of a global minimum tax increases the effective tax rate for MNEs headquartered in Luxembourg by approximately 7.7 percentage points and would lead to a welfare gain of about 4.5% of GDP with an adjustment of the CIT rate to offset tax revenue changes.

Table 2: Results of CORTAX run, % change, and EUR for CV, GMT = 15%, CIT rate adjustment closure

	Cost of capital (in pp)	CIT rev	GDP	CV (in bn EUR)	CV (in % of GDP)
EU-high tax	- 0.03	+/- 0.00	+ 0.05	+ 14.85	+ 0.11
EU-low tax	+ 0.10	+ 19.67	- 1.40	+3.04	+ 0.31
EU-total	- 0.02	+ 1.37	- 0.14	+ 17.89	+ 0.13
Non-EU	- 0.03	+/- 0.00	- 0.03	+ 19.22	+ 0.09
Tax haven	NA	NA	NA	+ 1.94	NA
Total	- 0.02	+ 0.55	- 0.07	+ 39.04	+ 0.11

Notes: See the note with Table 1.

Figure 2: Heterogeneity Analysis (CIT rate adjustment closure)



Notes: The figure plots, for each country in our sample, the change in the effective tax rate (ETR) on corporate profits faced by multinational enterprises (MNEs) on the horizontal axis, and the simulated welfare change (as a percentage of GDP) on the vertical axis. The simulations adjust government budgets by varying the CIT rate applied to MNEs. In countries where the initial ETR exceeded the 15% global minimum, the resulting increase in CIT revenues allows governments to reduce CIT rates for in-scope firms, leading to a decline in their effective tax rates.

While most countries experience modest welfare gains relative to GDP, those with initially low effective corporate tax rates see particularly large improvements. These gains are primarily driven by substantial increases in CIT revenues, which enable higher direct transfer payments to households. For instance, Bulgaria and Cyprus record welfare gains equivalent to 0.5% and 1.4% of GDP, respectively. A notable exception is Hungary, where the increase in CIT revenues and associated transfers is insufficient to offset the contractionary effects of a higher cost of capital, resulting in a small welfare loss of approximately 0.1% of GDP.

Countries with baseline ETRs above 15% generally see small positive welfare effects due to reduced distortions in global profit allocation without facing upward tax pressure themselves. Detailed country-level fiscal and macroeconomic outcomes can be found in Table B.2 in the Appendix.

In the remaining part of the section, we explore the consequences of adopting alternative GMT rates, ranging from 10% to 25%. At the aggregate level, Figure 3 illustrates the change in total welfare (compensating variation), expressed in billion euros, summed over the 27 EU Member States, the United States, Japan, the UK, and a tax haven. The results are presented for the two closure scenarios, with different assumptions on the use of the additional revenues generated by the GMT.

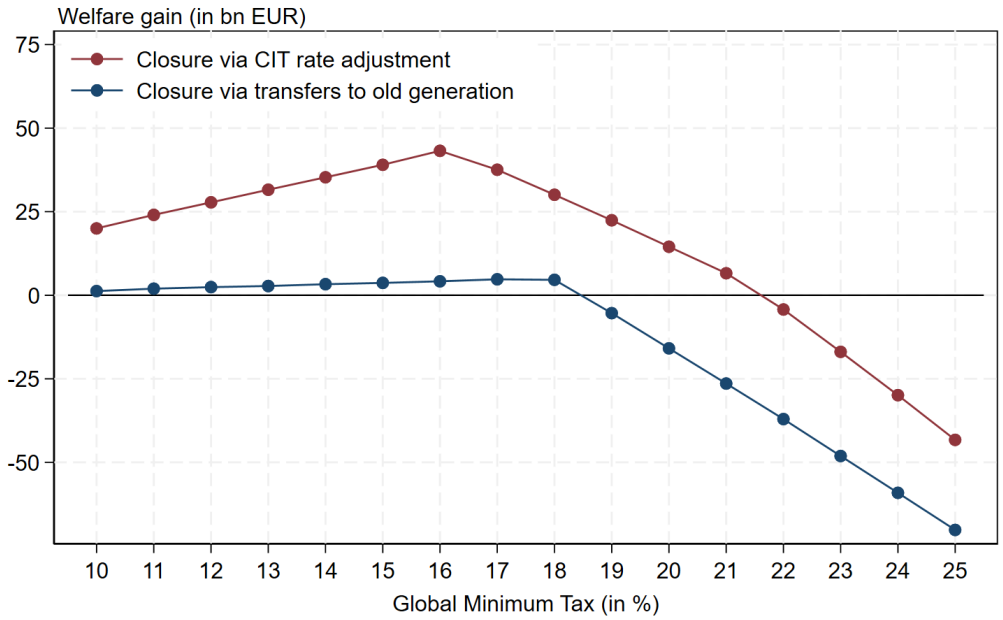
Two key findings emerge: first, both fiscal closure rules, balancing the government budget either by increasing transfers to the older generation or by adjusting corporate income tax (CIT) rates, lead to overall welfare gains. However, the magnitude of these gains differs substantially. When CIT revenues are recycled through supply-side measures such as CIT rate reductions, the resulting welfare improvements are significantly larger than when revenues are allocated to demand-side transfers.

The second significant finding relates to the welfare-optimal level of the GMT rate. When budgets are balanced by adjusting the CIT rate for MNEs, our results show initially rising welfare gains, peaking at 16%. Beyond 16%, welfare gains decline as the contractionary economic effects become more pronounced and ultimately overshadow the overall impact on welfare. As the GMT rises, the pool of countries constrained by the GMT increases. Specifically, as the GMT increases from 17% to 18%, there is a significant jump in the number of constrained countries. A GMT of 15% would replace the current ETR in five major countries within our sample of 30 countries, see Figure 4 below, namely the United States, the United Kingdom, Poland, Portugal and Austria, driving the global welfare results into negative territory.

5. Robustness test

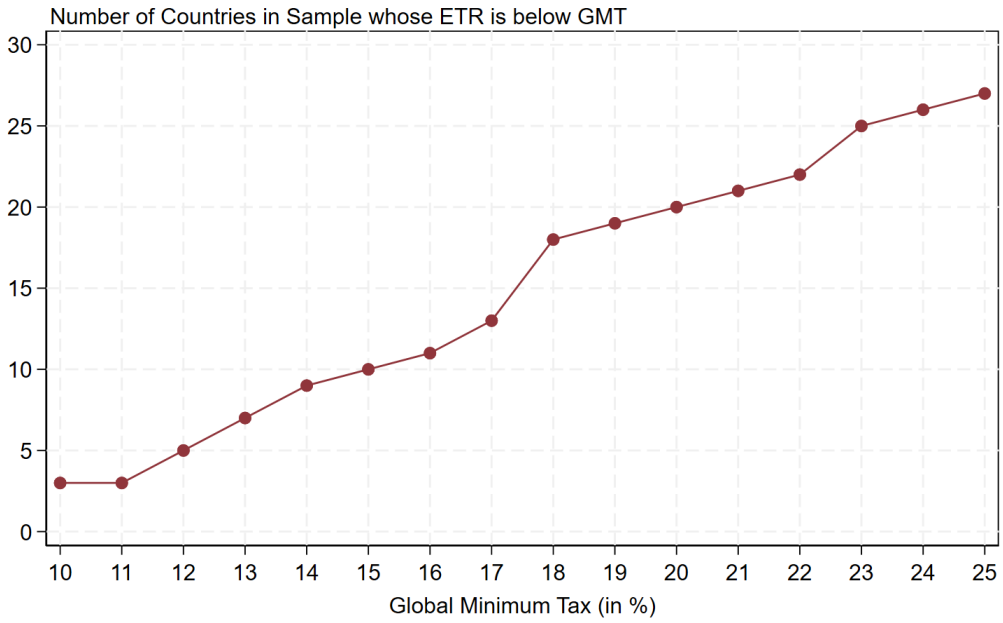
The model incorporates the ability of firms to shift a portion of their tax base to tax havens, representing a distinct channel for profit shifting. This mechanism is parameterised in accordance with existing literature, specifically drawing on the semi-elasticity estimates from the meta-regression study by Heckemeyer and Overesch (2017). To assess the sensitivity of our baseline results to changes in the profit-shifting semi-elasticity with respect to tax differentials, denoted as γ, we conduct two sensitivity checks with alternative parameter values of the semi-elasticity.

Figure 3: The effect on total welfare from GMT adoption



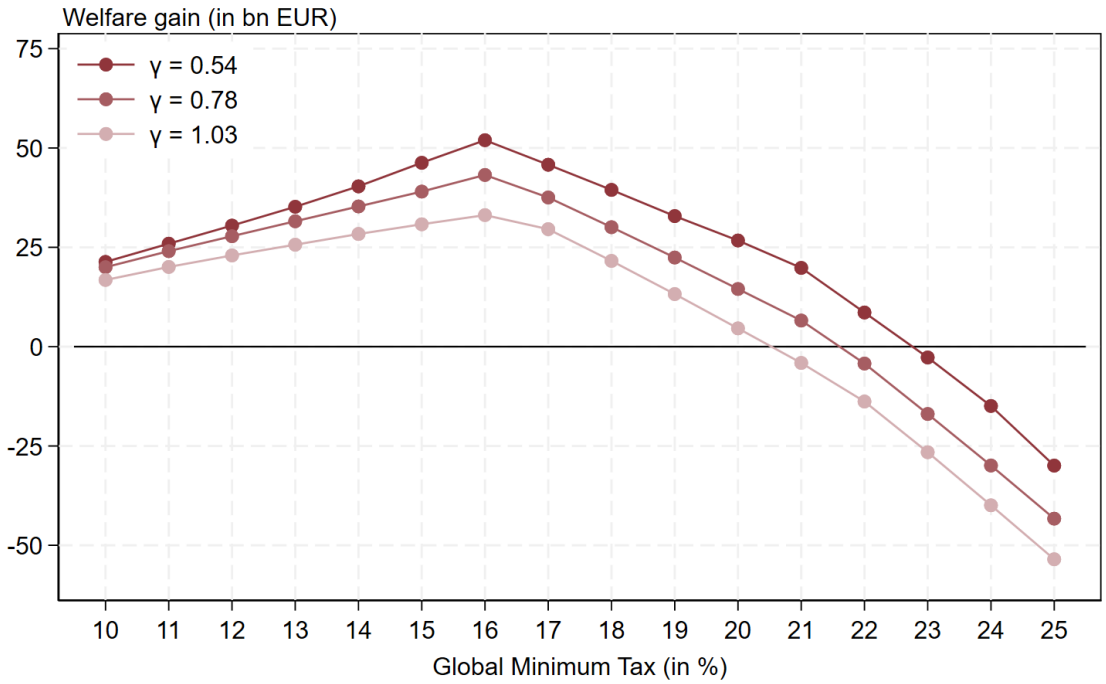
Notes: The figure shows the total welfare change across 27 EU Member States, the United States, Japan, the UK, and a tax haven resulting from the adoption of the global minimum tax (GMT), based on CORTAX model simulations. We consider two scenarios: (1) closure of the government budget constraint via adjusting transfer to the old generation, and (2) closure of the government budget constraint via adjusting effective CIT rates. The horizontal axis displays the hypothetical GMT rate.

Figure 4: Number of Countries in Sample whose ETR is below GMT



Notes: The figure shows the number of countries whose current effective tax rate (ETR), calibrated primarily using Garcia-Bernardo et al. (2023; see Section 3.3 for details), is strictly below a hypothetical value of the global minimum tax (GMT). For example, ten out of the 30 countries in our sample have an ETR below 15%.

Figure 5: Total welfare gains curve under varying profit shifting semi-elasticities



Notes: The figure shows the total welfare change across 27 EU Member States, the United States, Japan, the UK, and a tax haven resulting from the adoption of the global minimum tax (GMT), based on CORTAX model simulations. We consider the scenario with a closure of the government budget constraint via adjusting effective CIT rates for MNEs. The horizontal axis displays the hypothetical GMT rate. The parameter γ describes the elasticity of pre-tax profits with respect to tax rate differentials between the tax haven and the respective country.

Figure 5 illustrates the welfare gains curve previously discussed (with the semi-elasticity set to 0.78), compared to scenarios where the elasticity is set at 0.54 and 1.03, representing the lower and upper bounds of the 95% confidence interval reported in Heckemeyer and Overesch (2017). These values represent situations where firms either respond less or more strongly to cross-country tax differentials by shifting either a smaller or a larger share of their pre-tax profits to tax havens.

The figure reveals that as the semi-elasticity increases, the total welfare gains curve becomes flatter. This implies that achieving a specific welfare gain through curtailing the extent of profit shifting requires a higher global minimum tax rate when the semi-elasticity is larger. However, it is crucial to note that despite the flattening of the welfare gains curves at higher semi-elasticity levels, their peak remains at 16%. This finding underscores the robustness of the optimal tax rate, even under varying profit-shifting sensitivities.[20]

[20] We obtain very similar results when using the transfer adjustment method to offset tax revenue changes resulting from the adoption of the GMT. In this case, the welfare-maximizing tax rate shifts slightly downward as the profit-shifting semi-elasticity increases. Specifically, the optimal GMT rate is 18% under the baseline semi-elasticity of 0.78 (see Figure 3 above), and 17% under the lower-bound elasticity of 0.54. These results remain within a narrow range around our baseline estimate, confirming the robustness of the welfare-

6. Discussion and conclusion

The analysis of the Global Minimum Tax (GMT) presented here provides a quantitative evaluation of its welfare implications across major economies using the CORTAX model. The introduction of the 15 percent minimum rate raises CIT revenue for all countries. The study focuses on two primary strategies for balancing government budgets: direct consumer transfers and adjustments to domestic corporate tax rates.

When governments opt to redistribute increased CIT revenue through lumpsum transfers, the GMT shows mixed welfare outcomes, which aligns with the theoretical predictions of Johannesen (2022). The negative results arise when welfare benefits from increased revenue do not outweigh the economic contraction from higher corporate tax burdens.

Conversely, the approach of adjusting domestic corporate tax rates to maintain pre-GMT revenue levels proves beneficial to all "high-tax" countries (meaning countries with a rate above the GMT rate[21]). The contractionary pressure on firms who reduce their profit shifting is mitigated by reducing the statutory CIT rate, which enhances investment incentives, boosting GDP and overall welfare. The CORTAX model's results suggest that the same level of CIT revenues worldwide can be obtained in a welfare-increasing way if countries cooperate and profit shifting is reduced.

The model is employed to investigate a range of GMT rates. The first scenario, where increases in CIT revenue are redistributed to households, shows increasing modest total gains as the rate increases, peaking at 18%. The second scenario, where CIT rates are reduced, shows larger gains, which peak at a GMT rate of 16%. Our robustness analysis confirms that the welfare-maximizing GMT rate remains stable across a range of parameter values, supporting the baseline findings and aligning closely with the Pillar Two rate.

The analysis reveals that low tax countries in the EU, meaning those with effective CIT rates below the GMT threshold, display ambiguous welfare outcomes. On aggregate, this group experiences a welfare gain in the first, and a welfare loss in the second scenario analysed. We also note that the overall welfare gains in both scenarios would be sufficient to compensate the countries with negative welfare outcomes. Conversely, the tax haven benefits from increased government revenues in both scenarios. This outcome aligns with the theoretical results of Johannesen (2022).

While the CORTAX model provides valuable quantitative insights, some limitations must be noted. First, the model cannot capture the dynamic aspects of international tax competition, as it provides long-run equilibrium outcomes rather than a transition path. Furthermore, our analysis does not examine the political dynamics that may influence the implementation of the GMT. Future research could explore these dimensions. The participation, or not, of the United States in Pillar Two may influence the political dynamics. We note however that the way we have implemented the GMT, with all low tax countries, including the tax haven, setting their rates at 15%, and the US itself having a tax rate for MNEs above 15%, its participation, or lack thereof, is not crucial for our results.

maximizing GMT rate to plausible variations in the responsiveness of profit shifting. All results are available upon request.

[21] This discussion applies to both the EU-high tax countries and the non-EU countries.

Additionally, while the CORTAX model concentrates on EU countries and their primary trading partners, it excludes key economies such as China, as well as other developing countries, some of which have also begun implementing the GMT. The impact of the GMT is likely to vary across countries, depending on their exposure to mobile capital, the relative significance of corporate tax revenues within their economies, and the degree of tax competition faced, issues explored by Haufler et al. (2025). Moreover, our analysis abstracts from the distributional effects of the GMT, including its potentially uneven impact on MNE shareholders compared to transfer recipients, as discussed in Johanessen (2002). Overall, we believe this study contributes to an enhanced quantitative understanding of the GMT's implications.

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Appendix A: Simultaneous capital allocation and profit shifting of a single MNE

As noted, much of the literature discussed in Section 2 takes the real profits of MNEs as given. In this section, we illustrate the impact of variable profits using a small theoretical optimisation model for a single MNE. First, we derive the simple capital allocation decision, and then, in a second step, we introduce profit shifting to show how this affects the MNE's optimisation process. This simple framework reflects some key mechanisms operating in our macroeconomic model. In this way, the section seeks to bridge the models with fixed real profits and our calibrated general equilibrium model, building intuition for the empirical results in Section 4.

Consider the net profit maximization of a single multinational firm allocating its given total capacity ($\bar{K}$) over all jurisdictions (k_j). Concave profit functions F_j, with $F_j(0)=0$, convert investment (capacity) into real profits $\tilde{\pi}_j$. The CIT rates are t_j.

(1) $\max_{k_j \geq 0, \tilde{\pi}_j \geq 0} \sum_j (1-t_j)\tilde{\pi}_j$ subject to $\tilde{\pi}_j = F_j(k_j)$ and $\sum_j k_j \leq \bar{K}$

The Kuhn-Tucker conditions, with parameters λ_j and μ, the latter non-negative, read as follows. These conditions mean that if one of the inequalities is strict, the other is an equality.

(2a) $1-t_j \leq \lambda_j \quad \perp \quad \tilde{\pi}_j \geq 0$

(2b) $\lambda_j F_j^{'}(.) \leq \mu \quad \perp \quad k_j \geq 0$ with $F_j^{'}(.) = \partial F_j(.)/\partial k_j$

Optimal allocation of capital requires that the product of the net return of profit, $1-t_j$, and the marginal profit of capital, $F_j^{'}(k_j)$, must be equal for all jurisdictions to invest in. The lower levels of allocated capital are paired with the lower after-tax returns (as the profit function is concave).

(3) $(1-t_j)F_j^{'}(.) = \mu$ for all j .

Now, as a thought experiment, suppose that all jurisdictions raise their tax rates such that the net after-tax returns are reduced in the same proportion. This means that the objective function is scaled by the same factor, but nothing else changes in the optimization, and hence the allocation remains as it was. Yet, if all jurisdictions simultaneously join the GMT, this would raise their effective tax rates (ETRs), but differently because the initial tax rates differ between the jurisdictions. Thus the ETRs are affected differently, and hence the optimal allocation of capital will change. This is an important difference with the models with fixed profits. We examine the consequences for the ETRs further below.

We add profit shifting in the vein of Johannesen (2022), where we distinguish between the real profits $\tilde{\pi}_j$ and reported profits π_j. Profit shifting is costly, with a convex cost function C depending on the size of underreporting $C(\tilde{\pi}_j - \pi_j)$, with $C(0)=0$. The 'paper' profit shifting is to a tax

haven jurisdiction, with a (very) low tax rate t^L. This low rate is raised when the GMT is implemented. The tax haven has no real activities and no resident MNE.

The MNE maximizes the total net after-tax profits minus the cost of profit shifting.

(4) $\max_{k_j \geq 0, \tilde{\pi}_j \geq 0, \pi_j \geq 0} \quad \sum_j \tilde{\pi}_j - \sum_j t_j \pi_j - \sum_j t^L(\tilde{\pi}_j - \pi_j) - \sum_j C(\tilde{\pi}_j - \pi_j)$

subject to $\tilde{\pi}_j = F_j(k_j)$ and $\sum_j k_j \leq \bar{K}$ and $\pi_j \leq \tilde{\pi}_j$

The last constraint reflects that reported profits must not exceed real profits.

The Kuhn-Tucker conditions are now as follows, with η_j as additional parameter.

(5a) $1 - t^L - C'(.) + \eta_j \leq \lambda_j \quad \perp \quad \tilde{\pi}_j \geq 0$

(5b) $\lambda_j F_j'(.) \leq \mu \quad \perp \quad k_j \geq 0$

(5c) $t^L + C'(.) - \eta_j \leq t_j \quad \perp \quad \pi_j \geq 0$

For an interior solution with (positive) reported profits we have that the tax haven rate plus the marginal cost of shifting equals the jurisdictional tax rate: $t^L + C'(.) = t_j$. If the combined costs would be higher, then shifting would incur a loss, if they were lower, then more could be shifted. This implies that the marginal effective tax rate equals the initial jurisdictional tax rate. If such an interior solution would hold for all jurisdictions, then all ETRs (including marginal shifting costs) remain unchanged and hence the investment allocation will be as before and independent of the profit shifting. Equations (5) lead to equation (3). This is a somewhat unexprected result. It is a consequence of the cost function used above, which has the absolute value of shifting as argument. CORTAX, however, features a cost function based on the share of shifting, which always impacts the investment allocation.

Define the share of profit shifting from jurisdiction *j* by $\theta_j = (\tilde{\pi}_j - \pi_j)/\tilde{\pi}_j$. The cost of profit shifting takes the following form.

(6) $C(\theta) = A^{-1/\gamma} \frac{\theta^{1+1/\gamma}}{1+1/\gamma} \tilde{\pi}$

We can redefine the optimization with these shares as choice variables instead of the reported profits. The share should not exceed 1, disallowing reporting losses.

(7) $\max_{k_j \geq 0, \tilde{\pi}_j \geq 0, \theta_j \geq 0} \quad \sum_j \tilde{\pi}_j - \sum_j ((1-\theta_j)t_j + \theta_j t^L)\tilde{\pi}_j - \sum_j C(\theta_j)\tilde{\pi}_j$

subject to $\tilde{\pi}_j = F_j(k_j)$ and $\sum_j k_j \leq \bar{K}$ and $\theta_j \leq 1$

And the first-order conditions.

(8a) $$1-((1-\theta_j)t_j+\theta_j t^L)-C(\theta_j)\leq \lambda_j \quad \perp \quad \tilde{\pi}_j \geq 0$$

(8b) $$\lambda_j F_j^{'}(.)\leq \mu \quad \perp \quad k_j \geq 0$$

(8c) $$(t_j - t^L - C^{'}(.))\tilde{\pi}_j \leq \eta_j \quad \perp \quad \theta_j \geq 0$$

Assuming there is some underreporting, i.e. $\theta_j < 1$ which implies $\eta_j = 0$, then we find an expression for the optimal share of shifting θ^* by differentiating equation (6). The larger the tax rate differential, the larger the share of profit shifting from jurisdiction *j*.

(9) $$\theta_j^* = A(t_j - t^L)^\gamma$$

Implementation of the GMT means $t^L = t^M$. Observe the implication for low tax jurisdictions. For these jurisdictions holds that $t^L < t_j < t^M$, their initial tax rate is less than the global minimum tax rate, t^M. For them to implement the GMT we pose that they must raise their statutory CIT rates to the level of the global minimum tax. Thus, it has been implemented in the CORTAX scenarios, $t_j = t^M = t^L$. This then immediately has the implication of a raised effective tax rate so that they will attract less capital as they did before, possibly with negative welfare effects. Also, there is no profit shifting from the low tax jurisdictions as, by equation (9), $\theta_j^* = 0$. When we discuss the results, we pay special attention to the group of low tax jurisdictions.

A notable limitation of the small MNE model in this section is the fixed supply of capital. We can already observe here that the GMT will reduce the net return to capital, as in the objective function of (3), when the tax haven rate t^L is replaced by GMT rate t^M. The increase of these tax costs can only partially be recovered by the reduced profit shifting by the MNE.

In an open economy, a reduction in the net return to capital results in less investment and a lower equilibrium level of capital stock. In Section 3 an open-economy macroeconomic model is introduced that allows us to estimate the extent to which capital stock might be affected by changes in relative prices, in particular, the net returns to capital.

Appendix B

Table B.1: Country-specific Results of CORTAX run, GMT = 15%, Transfer closure

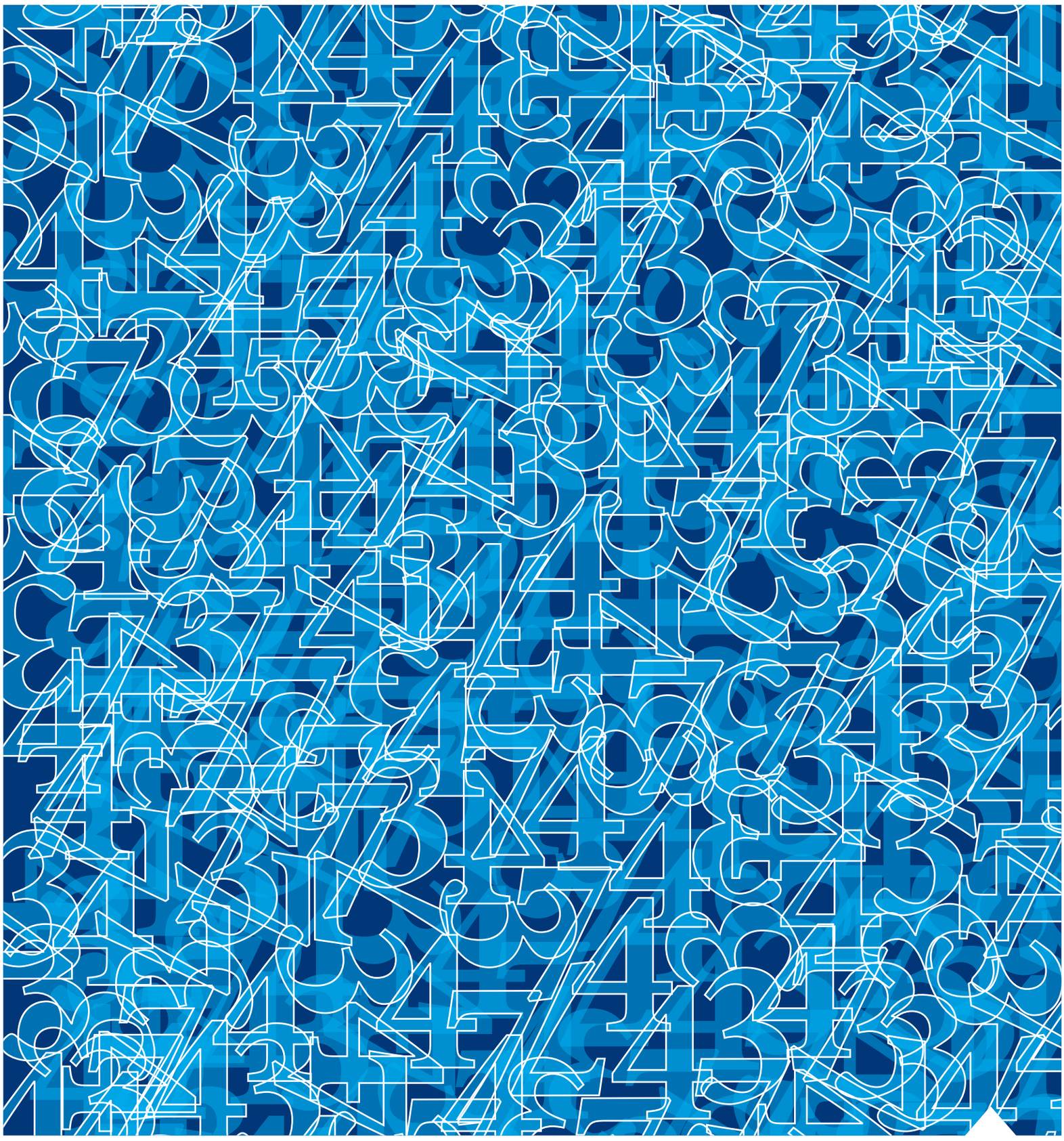
		ETR (in %)	ETR (in pp)	Cost of capital (in pp)	Capital stock (in %)	Wages (in %)	Employment (in %)	GDP (in %)	CIT rev. (in %)	Tax rev. (in %)	Welfare (in bn EUR)
High-tax EU	AUT	17.1	0.87	0.03	-0.41	-0.14	-0.10	-0.19	5.74	0.20	0.09
	BEL	21.6	1.31	0.03	-0.46	-0.13	-0.20	-0.27	6.20	0.40	0.44
	CZE	17.0	0.86	0.02	-0.27	-0.09	-0.12	-0.18	4.19	0.27	0.33
	DEU	23.7	1.51	0.06	-0.72	-0.27	-0.12	-0.28	6.96	0.18	-1.85
	DNK	20.5	1.21	0.02	-0.25	-0.10	-0.10	-0.17	4.09	0.16	0.08
	ESP	22.9	1.44	0.06	-0.76	-0.28	-0.09	-0.27	6.77	0.14	-1.15
	FIN	16.2	0.78	0.02	-0.25	-0.07	-0.10	-0.14	4.90	0.19	0.13
	FRA	31.1	2.19	0.09	-0.89	-0.34	-0.10	-0.32	7.20	0.10	-3.11
	GRC	22.2	1.37	0.02	-0.15	-0.06	-0.04	-0.08	3.30	0.09	0.04
	ITA	25.2	1.65	0.05	-0.09	-0.05	-0.03	-0.05	1.64	0.02	-0.14
	MLT	24.5	1.59	0.00	-0.06	-0.02	-0.09	-0.06	3.96	0.80	0.03
	NLD	23.0	1.44	0.07	-0.71	-0.32	-0.05	-0.24	6.83	0.42	-0.92
	POL	17.9	0.95	0.03	-0.27	-0.10	-0.07	-0.14	4.26	0.13	0.12
	PRT	18.0	0.96	0.01	-0.20	-0.05	-0.12	-0.13	5.09	0.37	0.39
	ROM	16.0	0.69	0.01	-0.19	-0.04	-0.10	-0.13	5.30	0.26	0.39
	SVK	21.0	1.13	0.02	-0.15	-0.05	-0.09	-0.12	2.44	0.12	0.06
	SWE	18.3	1.00	0.02	-0.39	-0.14	-0.13	-0.22	6.13	0.27	0.27
Low-tax EU	BGR	8.4	6.62	0.14	-1.91	-0.62	-0.72	-1.15	38.16	1.97	0.66
	CYP	6.7	8.28	0.31	-5.34	-1.59	-2.80	-3.85	44.55	4.78	0.38
	EST	14.6	0.61	0.01	-0.16	-0.05	-0.07	-0.09	5.53	0.22	0.02
	HRV	13.5	1.56	0.02	-0.33	-0.07	-0.20	-0.25	9.44	0.48	0.16
	HUN	11.6	3.49	0.13	-0.88	-0.48	-0.10	-0.49	13.32	0.05	-0.41
	IRL	12.1	2.85	0.06	-1.44	-0.87	-0.59	-1.37	12.85	0.73	0.15
	LTU	11.7	3.39	0.09	-0.97	-0.38	-0.18	-0.44	21.29	0.59	0.02
	LUX	7.3	7.69	0.27	-10.01	-4.62	-4.92	-7.46	95.92	12.72	1.92
	LVA	12.1	3.00	0.02	-0.28	-0.10	-0.08	-0.16	13.86	0.27	0.02
	SVN	13.7	1.34	0.04	-0.35	-0.10	-0.11	-0.18	7.76	0.24	0.04
non-EU	GBR	17.9	0.96	0.03	-0.36	-0.10	-0.14	-0.19	6.47	0.38	2.23
	JPN	28.0	1.91	0.07	-0.62	-0.26	-0.10	-0.25	4.51	0.34	-0.87
	USA	17.0	0.86	0.04	-0.40	-0.12	-0.05	-0.12	5.97	0.23	-3.06
	TH										7.21

Notes: The table shows the country-specific effects of the adoption of a GMT of 15% in all countries and the tax haven. Changes in tax revenues are balanced by adjusting direct transfer payments to the old generation. The following column definitions apply: "ETR (in %)" – baseline ETR faced by MNEs after profit shifting, "ETR (in pp)" – change in ETR faced by MNEs after profit shifting, "Cost of capital" – change in the cost of capital faced by MNEs, "Capital stock" – change in the size of the country's capital stock, "Wages" – change in equilibrium labour wages, "Empl." – change in equilibrium employment levels, "GDP" – change in total production, "CIT rev." – change in CIT revenues, "Tax rev." – change in total tax revenues, including CIT, consumption and labour income tax revenues, "Welfare" – change in total welfare.

Table B.2: Country-specific Results of CORTAX run, GMT = 15%, CIT rate closure

		ETR (in %)	ETR (in pp)	Cost of capital (in pp)	Capital stock (in %)	Wages (in %)	Employment (in %)	GDP (in %)	CIT rev. (in %)	Tax rev. (in %)	Welfare (in bn EUR)
High-tax EU	AUT	17.1	-0.76	-0.03	0.16	0.13	-0.12	-0.06	0.00	0.08	0.40
	BEL	21.6	-0.76	-0.02	0.05	0.09	-0.10	-0.08	0.00	0.03	0.31
	CZE	17.0	-0.93	-0.03	0.10	0.11	-0.08	-0.02	0.00	0.08	0.26
	DEU	23.7	-0.70	-0.03	0.16	0.13	-0.13	-0.05	0.00	0.07	4.05
	DNK	20.5	-0.96	-0.02	0.02	0.09	-0.11	-0.05	0.00	0.05	0.19
	ESP	22.9	-0.61	-0.03	0.18	0.13	-0.12	-0.04	0.00	0.06	1.35
	FIN	16.2	-0.99	-0.03	0.10	0.10	-0.10	-0.04	0.00	0.06	0.17
	FRA	31.1	-1.14	-0.05	0.22	0.19	-0.21	-0.05	0.00	0.09	4.04
	GRC	22.2	-0.97	-0.02	0.05	0.05	-0.03	0.00	0.00	0.03	0.09
	ITA	25.2	-0.99	-0.03	0.02	0.03	-0.02	0.00	0.01	0.02	0.41
	MLT	24.5	-3.36	0.01	-0.13	0.04	-0.08	0.02	0.00	0.06	0.02
	NLD	23.0	-1.02	-0.05	0.17	0.24	-0.32	-0.13	0.00	0.11	1.73
	POL	17.9	-0.86	-0.03	0.11	0.10	-0.09	-0.02	0.00	0.07	0.82
	PRT	18.0	-0.87	-0.01	0.03	0.05	-0.05	-0.04	0.00	0.04	0.15
	ROM	16.0	-0.30	-0.01	-0.08	0.03	-0.12	-0.12	2.57	0.14	0.34
	SVK	21.0	-0.97	-0.02	0.03	0.05	-0.03	0.01	0.00	0.03	0.04
	SWE	18.3	-0.92	-0.02	0.09	0.14	-0.15	-0.06	0.00	0.08	0.49
Low-tax EU	BGR	8.4	6.62	0.14	-2.23	-0.61	-1.06	-1.49	37.58	1.91	0.62
	CYP	6.7	8.28	0.31	-6.47	-1.55	-3.99	-5.01	42.25	4.19	0.34
	EST	14.6	0.39	0.01	-0.17	-0.03	-0.12	-0.16	4.59	0.18	0.02
	HRV	13.5	1.56	0.02	-0.44	-0.07	-0.32	-0.40	9.08	0.44	0.14
	HUN	11.6	3.49	0.13	-0.78	-0.49	0.01	-0.41	12.99	0.06	-0.35
	IRL	12.1	2.85	0.06	-1.59	-0.87	-0.75	-1.57	11.82	0.56	0.22
	LTU	11.7	3.39	0.09	-0.99	-0.38	-0.19	-0.47	21.09	0.58	0.02
	LUX	7.3	7.69	0.27	-12.86	-4.48	-8.03	-10.45	88.83	12.36	1.97
	LVA	12.1	3.00	0.02	-0.30	-0.10	-0.10	-0.21	13.48	0.25	0.02
	SVN	13.7	1.34	0.04	-0.39	-0.10	-0.15	-0.25	7.48	0.22	0.03
non-EU	GBR	17.9	-1.00	-0.03	0.16	0.11	-0.09	-0.01	0.00	0.07	2.00
	JPN	28.0	-0.82	-0.03	0.15	0.12	-0.09	-0.01	0.00	0.06	3.91
	USA	17.0	-0.66	-0.03	0.20	0.10	-0.08	-0.03	0.00	0.04	13.30
	TH		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.94

Notes: The table shows the country-specific effects of the adoption of a GMT of 15% in all countries and the tax haven. Changes in tax revenues are balanced by adjusting the statutory corporate income tax rate. For the definition of the columns see the note with Table **B**.1.



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